3-2017

# Determinants of urban land supply in China: How do political factors matter?

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March 2017

Paper No. 07-2017

# Determinants of Urban Land Supply in China: How Do Political Factors Matter?

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**Abstract**

This paper explores two political factors for their potential effects on urban land supply in China: corruption, and competition for promotion. We find that standard urban-economic predictions hold in the sense that both population and income increases are strongly significant determinants for the increase in urban land supply. Conditional on these demand-side factors, we find that the usage of two-stage auctions (as a proxy for corruption) is highly correlated with the increase in land supply. The corruption effects are strongest for commercial land, followed by residential land and then industrial land. To shed light on the competition motives among prefectural leaders, we examine how the number of years in office affects land supply, and distinguish among different hypotheses. Our empirical results show robust rising trends in land sales (both in quantity and revenue). These results are consistent with the hypothesis that the impatience and anxiety in later years from not being promoted may contribute to the increase in land sales revenue in later years; they are inconsistent with the hypothesis that prefectural leaders may give up and become more corrupt in later years. We also find that prefectural leaders may aim for larger land sales revenue overall in the first few (around 5) years in office instead of larger revenue in the first couple years.

*Keywords* : land supply, China, political factors, institution, monocentric-city model

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†For their extremely helpful suggestions, we thank the two reviewers, as well as Tomoki Fujii and Jing Li. We also thank all participants at the Asian Development Review Conference in Seoul held in 2016 for their helpful comments. We would like to thank Xin Yi for his outstanding research assistance.

# 1 Introduction

According to communist theory and hence by law, all urban land in China is owned by the state. However, as China has opened up and begun economic reform toward a more market-oriented economy, land in China is also being gradually marketized. The current system is based on leaseholding; the state is still the ultimate owner of all land, but private parties can purchase land use rights for a certain period (usually 70 years for residential usage and 40 years for commercial usage). Before 2004, the way in which these leaseholds were sold or transferred was not transparent. The 2004 reform required that all land transactions by the governments be published on the Internet. Such reform allowed researchers to collect land transaction data from 2004 onwards; this made the current study possible.

Cities in China have grown rapidly in the past few decades. The urbanization rate has grown from around 20% in 1979 to about 55% now. As city populations grow, urban land demand increases. In other economies where free markets are the norm, economic forces (e.g., those illustrated in Alonzo-Muth-Mills monocentric city models) may explain most of the urban land supply expansion. Local governments around the globe have influence over land supply, say, via zoning, land use regulations, and housing permits. But such political influence is presumably dwarfed by the large power that local governments in China enjoy when determining their land supply. In the Asian context, two notable exceptions are Hong Kong and Singapore.

We obtained data for all transactions of land parcels by the various levels of local government in China since 2007. For our purposes, we aggregated variables at the prefectural level. The most common form of this level is the so-called "prefectural-level city" (*di-ji-shi*). Note that there are prefectures that are not prefectural-level cities; they are typically rural areas. The terminology "prefectural-level city" is the official name for such jurisdictions, but this can be somewhat confusing, because its geographic scope is usually much larger than a metropolitan area, typically covering large area of rural land. For this reason, we prefer to simply call them prefectures. We use the total floor space sold by governments in each prefecture to measure the *change in land supply*; this information is available for each year from 2007 to 2013. Corresponding measures for each of the three major types of usage (i.e., residential, commercial, and industrial) are also available. Our land and population data together cover the *urban parts* of the 286 prefectures.[1]

The purpose of this paper is to empirically probe the political determinants of land

[1] Note that only urban land is owned by the state; the rural land in each prefecture is owned collectively by the rural residents. Thus, land sales by local governments are urban by their nature. We also have the urban population of each prefecture. See Section 2.1 for more details.

supply, and in this context we will investigate two distinct issues. The first is corruption, which is believed to be one of the motives in local governments' selling of land (see, for example, Cai, Henderson, and Zhang 2013). Second, to shed light on the influence of competition among prefectural officials, we study the effect of years in office (the number of years that a particular leader has been in office in that prefecture and in that year) on land sales.[2] The literature has documented that competition for promotion within the hierarchy in government posts and the communist party has various effects.[3] The institutional background is that there are no specific term periods or limits for prefectural leaders,[4] and their appointments are reviewed and decided by provincial leaders within the communist party. The key criteria is local economic performance (GDP growth), and hence competition among prefectural leaders encourages these leaders to sell land or to pursue higher land sales revenue in order to fund infrastructure or other mega projects that may help boost the local economy. The fact that local governments were not allowed to borrow by issuing debt until very recently reinforces this incentive.

Based on these competition motives, we propose three hypotheses regarding how years-in-office may affect land supply. **Hypothesis 1** is that a local leader tends to sell many land parcels or earn large land sales revenue in the beginning of his or her term in order to promote local economic growth. First, larger land sales revenue may provide more funds for infrastructure or mega projects that enhance economic performance. Second, even if land sales revenue is not used to fund infrastructure, the increase in land supply per se is conducive to economic growth because it lowers the land cost for both business and manufacturing operations and also lowers housing costs that attract larger inflows of population. If Hypothesis 1 is true, land sales quantity and/or revenue tend to be larger in the initial years in office for prefectural leaders. **Hypothesis 2** is that when a prefectural leader stays too long (compared with the distribution of the years in office among prefectural leaders), he or she might feel pressure to perform and hence increase land sales (in quantity and/or revenue) in order to increase the chance of getting promoted. **Hypothesis 3** is also related to the later years. Hypothesis 2 assumes that when one is not promoted after staying in a prefecture for too long, he or she gets anxious for promotion, but another possible explanation is that he or she may simply "give up", and thus engage in less land sales for the purpose of getting promoted. Note that a prefectural leader might still increase

[2] See Hsu and Yang (2016) for a theory of political economy that incorporates these two factors.

[3] See, for examples, Li and Zhou (2005) for GDP-growth competition among provincial leaders, and Zheng, Kahn, Sun, and Luo (2014) for how political competition among prefectural leaders on local environmental quality.

[4] On paper, a regular term is five years, but this is hardly binding, as the actual lengths of terms vary substantially and could be either shorter or longer than five years. See Section 3.3.2 for details.

land supply for corruption. A priori, there are various possibilities regarding whether each hypothesis is supported by data. But logically, if there is any pattern in later years due to the competition-for-promotion motive, it cannot be that both Hypotheses 2 and 3 hold simultaneously.

It is important to note that governments may supply more land simply because people need it; this response to the demand pressure should be considered also. Thus, before probing the effects of political factors, we first determine whether standard urban-economic determinants have expected influence on the urban land supply in China. As in the Alonzo-Muth-Mills monocentric city models and their variants, increases in population and income are two key sources of increases in land demand. Our first set of results confirms that increments in both population and income significantly influence the change in land supply in positive ways.

Our next step is to study whether the two above-mentioned political factors possess additional significant influence on the change of land supply, conditional on the above-mentioned urban-economic determinants. In terms of corruption, direct evidence is hard to come by. Hence, we resort to the powerful finding by Cai, Henderson, and Zhang (2013) that the usage of two-stage auctions among the three methods of land sales by governments is an indication of corruption.[5] We find a very strong positive association between corruption and the change in land supply. This association is strongest for commercial land, followed by residential land and then industrial land. We also run a set of regressions with land sales revenue as the dependent variable. We find that the effects of corruption on the land sales revenue for residential and commercial land are much smaller than the effects on the change in land supply, whereas the reduction of the effect for industrial land is relatively moderate. The contrast between these two sets of results suggests that as corruption leads to the governments selling more land, but at smaller prices (compared with other sales methods), the land sales revenue increases less than proportionally than the quantity of land sales. Residential and commercial land seem to be the main sources of corruption.

The above results suggest that land sales revenue and quantity may entail different information, and so in terms of the years-in-office effect, we also run two sets of regressions, one using the change in land supply and one using land sales revenue. Note that the leadership in China is two-track: At the prefectural level, the mayor is the official leader of the government, but the "real boss" is the highest party official, the party (chief) secretary, in that prefecture. Thus, we run these regressions for both party secretaries and mayors to examine whether there is any difference between the two. To identify the years-in-office

[5]For more details, see Section 3.3 and Cai et al. (2013).

effect, we use a quadratic specification and tease out the specificity of prefectures and individuals leaders by estimating prefecture-leader fixed effects. As the story is based on the political competition for promotion, we also control for corruption.

We find that there is a very robust rising trend. That is, the longer a prefectural leader is in office, the more he or she sells (both in terms of quantity and revenue). The effect for party secretaries is much stronger than that for mayors. Here we briefly sketch the reasons behind this rising pattern, as details will be given in Section 3.3.2. First, the result is consistent with Hypothesis 2: impatience or anxiety at not getting promoted in later years may contribute to the rising trend. As 77% of party secretaries' lengths of terms were no more than 4 years, those who stay longer than 4 years may feel anxiety or impatience.

Second, note that based on the results on corruption, a prefectural leader may increase land supply for more pocket money. Thus, if Hypothesis 3 is true (when a prefectural leader gives up in later years), the rising pattern implies that these prefectural leaders become more corrupt in later years. However, we find that the effect of corruption on the increase of land supply decreases with the number of years in office. In addition, we also see that conditioned on other factors that may potentially affect corruption, the correlation between years in office and corruption are negative and insignificant. Thus, our results do not support Hypothesis 3.

Third, our results seem to contradict Hypothesis 1 because we do not see large initial land sales, but whether this is inconsistent with the competition-for-promotion motive or not needs to be carefully examined. As most Chinese cities are growing in both population and income during this period, by restricting the land sales quantity early, the government may raise more revenue later on because land prices are further pushed up. Thus, an ambitious prefectural leader might trade the early large revenue with the larger overall land sales revenue over a longer time span, which may still increase the chance of getting promoted (even a little later than the average number of years in office). If this conjecture is true, then there should be a rising trend of land prices. We find that this is indeed the case. We also find that the increases in land sales revenue are larger from year 2 to year 5, whereas the increases become smaller after 5 years. Thus, the rising pattern in the first few years may still be consistent with a competition-for-promotion motive because prefectural leaders may aim for larger land sales revenue overall in the first few (say, five) years in office.

We briefly review the related literature on China's land market as follows. Although the surge of land and housing prices in Chinese cities has attracted global interest (Wu, Gyourko and Deng, 2016; Fang et al., 2015), few attempts have been made to understand the urban land market from the supply perspective until very recently. While some research highlights the role of the central government's land use quota allocation system (Liang,

Lu and Zhang, 2016), most existing literature focuses on local governments' land supply behavior. Based on empirical analyses of 35 major cities, Deng, Gyourko and Wu (2012) point out that besides a strong common trend on the national level, local governments' land supply behavior is substantially affected by the degree of local financial deficits; local chief officers' desires for promotions also play an important role. Du and Peiser (2014) find that local governments intentionally control the land supply in order to maximize their revenue from the land market. Empirical research by Wu, Feng and Li (2015) concludes that budgetary deficits of local governments can affect their land supply behavior; increases in land prices, however, are mainly driven by demand-side factors. Their finding supports our assertion that urban-economic determinants such as income and population increases must be controlled before political factors can be investigated.

In comparison to the above-mentioned studies, we are the first the study the effect of years-in-office on land sale behavior. In addition, we also provide analysis covering all three major types of land usage, instead of limiting the analysis to residential land parcels. In terms of corruption, whereas Cai, Henderson, and Zhang (2013) focus on the differential effects between two-stage and English auctions at the individual-parcel level, we focus on how this distinction affects prefectural aggregate variables.

The rest of the paper is organized as follows. In Section 2 we detail the basic sources of data and examine the standard urban-economic predictions, mainly a demand-side explanation. Section 3 explores whether and how various political factors matter, conditional on the demand factors. Section 4 concludes.

# 2 Data and Demand Factors

## 2.1 Data

In our analysis it is important to first clarify the level of geography. Most of the data we collect are at the prefecture level. The most common form of this level is the so-called "prefectural-level city" (*di-ji-shi*). Although *direct-control cities* (*di-ji-shi*; that is, Beijing, Chongqing, Shanghai, and Tianjin) are politically at the same level of provinces, they are geographically similar to prefectural-level cities and hence included in this level. However, prefectural-level "cities" are usually too big, often much bigger than a metropolitan area in natural international standards based on commuting flows (Fujita, Mori, Henderson, and Yoshitsugu Kanemoto 2004). One can easily tell this by inspecting the map, say, of Chongqing, Beijing, or Xuzhou. To remedy this problem, we use "urban population", which

is defined as residents of the "urban areas" in the prefecture,[6] rather than the population of the entire prefecture. Note that doing so means we look at *all urban areas within a prefecture collectively*; some of these urban areas may be outside the metropolitan area in which the prefectural government is located. Also note that our prefectural population data is from census data in 2000 and 2010. For the years in between, we either interpolate or extrapolate. We do not use the population data from the China City Statistical Yearbook because the population figures therein are only for *hukou*; as such they do not include "migrant workers" and do not reflect the true size of a city.

From the official website of the Ministry of Land and Resources, we collect information on all transactions of land parcels by various levels of local (urban) governments in China. During the period of 2007 to 2013, there were about 1.8 million land parcel transactions by local governments in total. For our purpose of research, we aggregate variables to the prefectural level. The *change in land supply* measure that we use is the total floor space sold by governments in each prefecture and in each year from 2007 to 2013. For some of our questions of study, government officials may care more about land revenue than increasing land supply per se. Thus, we also obtain data on land sales revenue.[7] We also know the type of land use per land transaction, i.e., residential, commercial, and industrial. From the revenue and quantity information on land sales, we also calculate the average price per unit of land area or per unit of floor space. We also know the method by which land is sold. As mentioned in the introduction, the fraction of two-stage auctions is used to capture the degree of corruption. Note that all land that has been sold in our data is urban land. This is because rural land is owned collectively by villagers, and any rural land must be converted to urban land (via acquisition by the urban government) before it can be sold. Hence, our land sales data is consistent with the level of geography in our study.

From the China City Statistical Yearbook we also obtain other prefectural-level characteristics such as GDP and its breakdown.[8] In particular, we make the analysis consistent with our level of geography (all urban areas within a prefecture), we exclude the GDP of the primary industry, and aggregate the secondary and tertiary GDP to represent the

[6]There is a very fine and specific definition of an urban area in China, which is a small jurisdiction called *ju-wei-hui* (neighborhood committee), which is close to the concept of neighborhood. Rural areas correspond to *cun-wei-hui*.

[7]Both land sales revenue and the change in land supply are used as dependent variables in our regression specifications. Du and Peiser (2014) make the point that local governments may want to "hoard land" to seek higher land sales revenue later on. Hence, land sales revenues and changes in land supply might show different trends. Nevertheless, as we will see, these two do show different patterns in terms of corruption, but in terms of the years-in-office effect, they often go the same way. See Section 3 for more details.

[8]The prefectural GDP per capita used here is nominal. In the regressions that we run in the next section, we control for year fixed effects. Since monetary policy is the same economy-wide, if we deflate GDP per capita, then we we cannot control for year fixed effects.

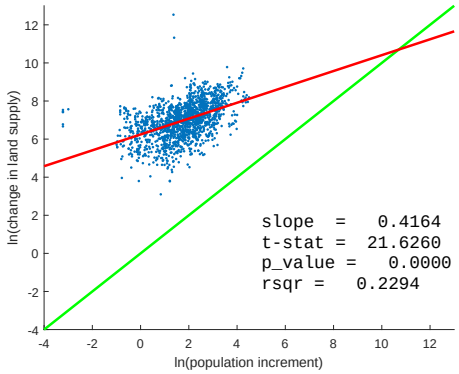


Figure 1: Population increment and change in land supply

*urban GDP*, or the GDP produced in urban areas. Our population, land, and GDP data together cover 286 prefectural-level cities. The sources of other data sets are detailed in their respective sections or subsections.

## 2.2 Standard Predictions of Urban Economics

To start thinking about the determinants of urban land supply, imagine a strict version of the monocentric-city model: land and housing demand is inelastic. Suppose the city government's supply of land meets demand. Then one would expect a 45-degree line representing the relation between population increment and the change in land supply in the log scale. Figure 1 shows a scatter plot of population increment and change in land supply by prefecture in the log scale. Although there is a strong correlation between the two variables, the slope is less than 45 degrees. This indicates that the increase in land supply is less than the increase in population. However, this is consistent with the predictions from a standard monocentric city model when land and housing demand is elastic. That is, land demand grows less than proportionally with respect to population growth because new city residents are willing to reduce their consumption of land and housing in order to save on commuting costs. Also, as is well known, standard models also predict that an increase in income increases demand for land and housing (as well as land and housing for business and industrial activities).

Columns (1) to (4) of Table 1 show the regression results of the logarithms of the change in land supply (total and by type: residential, commercial, and industrial) on the two above-mentioned standard urban economic explanations of land-demand increases. In all the regressions in this paper, we control for year fixed effects and cluster standard errors

at the province level. In this regression in Table 1, we do not include prefecture fixed effects because we want to investigate the effect of population growth, but since our population data is interpolated or extrapolated, the logarithms of population increments become constant over time. As industrial structures may affect the breakdown of land supply and potentially affect the total land supply as well, we use the ratio of tertiary industries to secondary industries (in terms of GDP) to proxy industrial structure. Columns (5)–(8) show results when we control for this ratio.

As expected, the effect of population increments and the increase in GDP per capita are strongly significant. The elasticities of the change in land supply to population increase are around 0.42 to 0.48. The elasticities of the change in land supply to the increase in GDP per capita are around 0.040 to 0.071. The service to manufacturing ratio has a strongly significant negative impact on the change in industrial land supply. We also observe that this ratio has a positive effect on the change in commercial land supply; however, this effect is insignificant. As the two main sectors produce opposite effects, it is conceivable that the effect on the change in residential land supply would be insignificant. Finally, this ratio also has a significant negative effect on the change in total land supply, which indicates that the effects on the change in industrial and residential land supply dominate that for commercial land supply.

# 3 How Do Political Factors Matter?

As mentioned and verified in the previous section, increases in land supply may be due to government responses to demand factors, such as increases in population or income. In this section, we study the effect of corruption and the years-in-office of prefectural leaders, conditional on the above-mentioned demand factors. Before we proceed, we first examine the relationship between land sales revenue and budget deficit.

## 3.1 Budget Deficits

There are institutional reasons that closely link land sales by local governments with budget deficits. Since the tax sharing system reform in 1994, the central government has kept a major part of tax revenues, while the local governments are still burdened with increasing local expenditures. However, unlike local governments in western countries, local Chinese governments were until very recently prevented from directly issuing debt to fund such budgetary deficits or other investments on mega projects. Accordingly, the Chinese local

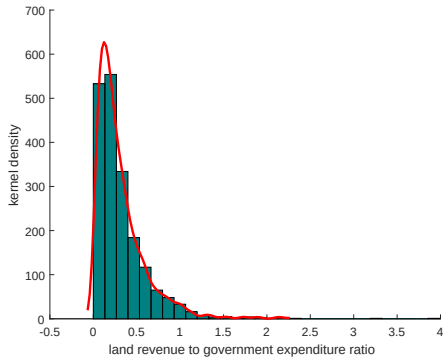


Figure 2: Ratio of land-sales revenue to government expenditure

governments have relied heavily on land sale revenues as an important source of financial funding. Nominally, what we mean by "deficit" here is the so-called "in-budget revenue" minus expenditure. Here, in-budget revenue includes tax and miscellaneous revenue, but not land sales. In 2007, aggregating over all prefectures, land sales revenue was 58% of total government expenditure. The corresponding percentages for years 2008 to 2013 are $22\%, 37\%, 50\%, 44\%, 34\%$, and $49\%$ respectively. These percentages indicate that land sales are indeed important parts of local government finances, although they vary substantially from year to year. The ratio of land-sales revenue to government expenditure also varies substantially by prefecture. Figure 2 shows the distribution of this ratio; the unweighted mean and standard deviation thereof is 0.35 and 0.15, respectively.

Not surprisingly, we also observe in Figure 3 a strong positive linkage between budget deficit and land sales. However, despite the positive and clear association between deficits and land sales, there is a great deal of variation in land sales for any given budget deficit. Needless to say, budget deficit is highly endogenous to various political factors, and it is difficult to identify and disentangle all the relevant factors. For example, budget deficits may be higher because governments want to spend more on infrastructure to promote economic growth, and this is related to the above-mentioned political competition motives. There may also be reasons other than political competition and corruption that influence budget deficits. To address this issue, for all of the regressions below, we compare the results when including budget deficits as a regressor to the results without including budget deficits as a regressor. The two sets of results are quite similar. In our benchmark regressions, we do not include budget deficits as a regressor; we also show results with this regressor in the robustness checks.

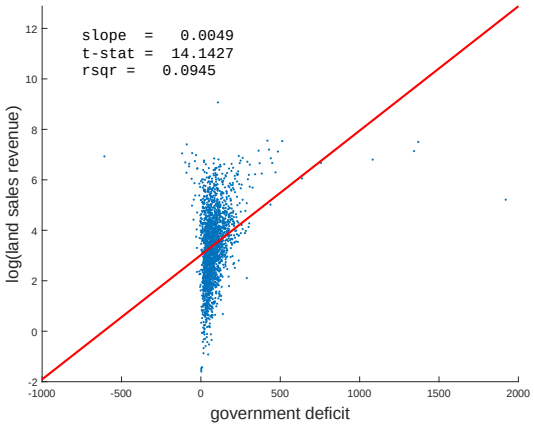


Figure 3: Budget deficit and land-sales revenue

## 3.2 Corruption

Corruption is widely believed to be prevalent in China. Land sales are often considered one of the main sources of corruption in China. However, direct evidence on corruption is hard to come by. Court, media, and party records reflect only part of the corruption, and these records often reflect political rivalries and the (in)efficiency of the court system (or similarly, the inner control of the communist party).

Nevertheless, Cai, Henderson, and Zhang (2013) provide indirect but powerful proof that corruption in land sales does exist, via a comparison between different auction systems. In particular, they show strong evidence that among the three available methods of land sales (sealed bidding, English auction, two-stage auction), corruption is highly associated with the two-stage auction. The second stage of a two-stage auction is an English auction that occurs if more than one bidder is still competing for the land parcel at the end of the first stage. The key difference in a two-stage auction from an English auction is that the entry occurs sequentially in the first stage and is public information, whereas the entry to the English auction is simultaneous. The sequential nature of this auction form allows both government officials and developers room to signal, hence preventing further competitors from entering.[9] They show empirically that land sales prices and competition are significantly less for two-stage auctions, and officials divert hotter properties to two-stage auctions. These results are consistent with the theory of corruption and bidding they

[9]Cai et al. (2013) explain how the signaling is done: "Although the auction is announced about 20 working days in advance, the exact date of the start of the first stage of the auction may not be specified. Second, although bidders can apply during the announcement period before the first stage starts, approvals to participate, or qualification, can be delayed until after the first stage is under way. Thus, the insider bidder alone may know the exact time the first stage starts and he alone may be qualified to submit a bid at that time. As a result, if there is a bid at reserve price as soon as the auction opens, other bidders can infer from that signal that it is likely that the auction has been corrupted."

develop. Given their results, we take the fraction of two-stage auctions among all land sales as a proxy for corruption.

Columns 1 to 4 in Table 2 show the results. Here, we regress the change in each type of land supply (in logarithm) on the fraction of two-stage auctions in that type, with the same set of controls in Table 1. Overall speaking, two-stage auction has a positive and significant effect on the increase of total land supply, as well as of each type of land. In Columns 5 to 8, we show the results when the dependent variable becomes the logarithm of land sales revenue. In comparison to the results based on quantity of land sales (Columns 1-4), the coefficients on corruption are dramatically reduced for residential and commercial land, whereas the reductions for total and industrial land are smaller. The effect on industrial land sales revenue becomes insignificant. Whereas corruption leads to a greater quantity of land sold, the increase in land revenue is less than proportional, suggesting that there is a price cut when there is a two-stage auction compared with other methods. The price cut is also evidenced in Cai, Henderson, and Zhang (2013), and this is consistent with the bribers' benefits.[10] These results suggest that residential and commercial land is a major source of corruption. This is likely because residential and commercial land has much higher land prices than industrial land.[11]

Is it possible that these regressions suffer from endogeneity issues? Generally speaking, we can not totally rule out the possibility, but we argue that this concern is likely to be minor. First, there could be a channel where the increase in land supply leads to more corruption because of some sorts of positive externality that spurs the development of the city and hence increases land demand, which gives room to more corruption via land sales. However this channel is unlikely to be simultaneous with the channel from corruption to changes in land supply, as infrastructure takes time to build and mega projects such as special economic zones take time to realize.[12] Even when this time lag is short, the controls of current population and income alleviate this concern. However, can income and population themselves be endogenous via the same channel? Again, this is unlikely because of the time needed for the effect of land sales on GDP and population increase to take

[10] As is clear from Figure 1 in Cai et al., the distribution of the ratio of sales price to reserve price is much more condensed around the lower bound, 1, for two-stage auctions than English auctions. In particular, the sales prices of more than 70% of two-stage auctions are at the reserve price, whereas this fraction is slightly more than 30% for English auctions. They also show that the price cut in two-stage auction is robust when conditional on other factors. This is in line with bribers' benefit as they pay less to acquire land parcels using this method.

[11] The mean, median, and 95th percentile of the prices of industrial land in our pooled sample are 200.2, 182.0, and 384.6 RMB per square meter, respectively. The corresponding numbers for residential land are 574.2, 339.8, and 1774.6, and those for commercial land are 605.9, 368.5, and 1665.3.

[12] Note that a more complete modeling of this argument would require a dynamic model.

effect (think of the migration restrictions in China). Second, in terms of potential omitted variables, we do a robustness check by controlling for prefecture fixed effects. Here, we do not control for prefecture fixed effects because corruption may be highly related to local culture and tradition. We investigate prefectural fixed effects in Section 3.4.

## 3.3 The Effect of Years in Office

Here, we study how land sales revenue and the changes in land supply are affected by the number of years that a prefectural leader has been in office. This information about the trajectories of land sales quantity and revenue within a prefectural leader's tenure, other things being equal, helps us test the three hypotheses described in the introduction.

### 3.3.1 Methodology and Results

In China, promotions of local government officials are determined by provincial-level party committees. Considering that for provincial-level party (chief) secretaries, the GDP growth rate serves as a key performance indicator in evaluating the performance of their subordinates, the prefectural-level leaders, it has been widely believed that these prefectural-level leaders have a strong incentive to boost local GDP growth, especially by investing in infrastructure and mega projects. Then, since a substantial amount of funding for such investments comes from land sales, and since land sales are more flexible than other revenue sources, it is likely for local leaders to try to increase land sales revenue to support such development in infrastructure and mega projects. If land prices are very elastic, then selling more land entails more revenue, but if land prices are inelastic, restricting land supply may lead to higher revenue. In addition, local governments also have incentives to supply more land so as to accommodate growing city populations, which of course is another important source of growing GDP. So, as land sales quantity and revenue renders different information, we include both as dependent variables.

To test the three hypotheses regarding the effect of years-in-office, we adopt a quadratic specification and run regressions for both prefectural party secretaries and mayors. As the conjecture is based on prefectural leaders' incentive to promote GDP, we control for both demand factors and corruption. Instead of simply controlling prefecture fixed effects to account for prefectural-level invariant factors, we take one step further by controlling for prefecture-specific party-secretary/mayor fixed effects. That is, for each prefecture, there is a coefficient for each prefectural leader to account for its specificity. In such a specification,

the sum of such prefecture-leader fixed effects can be viewed as prefectural fixed effects.[13] Note that for the demand factors, we can no longer use the population growth variable because the logarithm of population increase is time-invariant, as we explained earlier in Section 2. But to avoid completely losing any information on population increase, we change the income variable (logarithm of the increase in urban GDP per capita) to GDP itself (logarithm of the increase in urban GDP).[14] From this point on, we do not repeat the word "urban" in the regression tables, as we focus on the urban areas throughout the entire paper.

Before discussing the results, we note that the endogeneity concerns are minor in this case as well. First, there is unlikely to be a reverse causality from land sales (in either quantity or revenue) on the years-in-office variable. The concern here is that land sales may come back to affect the increase in GDP. Again, this effect is unlikely to be simultaneous with the effect from years-in-office to land sales, as it takes some time for infrastructure and/or housing development to realize. Even when the time lag is short, in our robustness checks we show that the presence of the GDP-increase variable does not change the results. Last, the inclusion of prefecture-leader fixed effects should alleviate any concern on potential omitted variables.

Table 3 shows the results for party secretaries. The first four columns show the results for the increase in land supply, and the last four columns show those for land sales revenue, all in logarithms. For all eight columns, we find strongly significant upward trends during the party secretaries tenures. All quadratic-term coefficients are negative but insignificant, which suggests a very slight concavity in the rising trend. Table 4 shows the results for mayors. The increases in land supply also show significant rising trends except for industrial land. The results on land revenue is much weaker, except that the coefficient for residential land remains significant. Note that all linear-term coefficients for party secretaries are all much larger than those for mayors. Also note that the coefficients of the controls are mostly insignificant; this is likely because the prefecture-leader fixed effects soak up much of the variations.

In sum, we find a rising trend both in quantity and revenue of land sales, and note that this pattern is much stronger for party secretaries than mayors.

[13] An alternative way is to control for both prefecture fixed effects and prefecture-leader fixed effects. We find in this case the prefecture-leader fixed effects are less precisely estimated (i.e., with larger p-values).

[14] Note that because we are looking at the increase, population information does not automatically drop out.

### 3.3.2 Behind the Rising Pattern

Recall briefly the three hypotheses laid out in the introduction. **Hypothesis 1:** a local leader tends to sell many land parcels or earn large land sales revenue in the beginning of his or her term in order to promote local economic growth. Hence, for prefectural leaders land sales quantity and/or revenue tend to be greater in the initial years in office. **Hypothesis 2:** when a prefectural leader stays too long, he or she might feel pressure to perform and hence increase land sales (in quantity and/or revenue) in order to increase the chances of promotion. **Hypothesis 3:** when a prefectural leader is not promoted after staying in a prefecture for too long, he or she may simply "give up", and thus engage in less land sales.

First, the rising pattern is consistent with Hypothesis 2; namely, impatience or anxiety at not being promoted in later years may contribute to the rising trend. To support this result, we collected data on the length of terms for prefectural party secretaries and mayors for all 1773 party secretaries and 1970 mayors who were in position in the 287 prefectural cities between 1983 and 2013. The average length of term was 3.64 years with a standard deviation of 1.87 years for party secretaries and 3.29 years with a standard deviation of 1.76 years for mayors. Moreover, 77% of party secretaries' lengths of terms were no more than 4 years, whereas the corresponding number for mayors was 70%. Our land and population data cover seven years, but the largest length of term is 9 years for both party secretaries and mayors (some leaders were already in office in 2007 and stayed in that position throughout our data period). As large fractions of leaders stay no more than 4 years, those who stay more than 4 years may feel anxiety or impatience.

The main difference between Hypotheses 2 and 3 is the different psychological reactions to not being promoted yet at later years. Based on the results on corruption, it is safe to say that a prefectural leader may increase land sales for more pocket money. Thus, if Hypothesis 3 is true (a prefectural leader gives up in later years), the rising pattern in the effect of years in office on land sales implies that these prefectural leaders become more corrupt over time. To check this, we examine the effect of interacting corruption with years in office in the regressions in Tables 3 and 4. As seen in Table 2, corruption exerts more influence on land sales quantity than land sales revenue for the reasons explained in Section 3.2; we examine the regressions with the change in land supply as the dependent variable. The results are shown in Panel 1 of Table 5. Here we focus on the effect of party secretaries, as the rising trend is most pronounced for them. For total, residential, and commercial land, the coefficients on the interaction terms imply that the effect of corruption on the increase of land supply is less the longer the years in office.[15] If a prefectural leader "gives up"

[15]The coefficients on the interaction terms for industrial land are insignificant. The positive and significant

in later years and becomes more corrupt, he or she should sell more land instead of less. Hence, the results here suggest that Hypothesis 3 is not supported. An alternative way to examine this is to run a regression of corruption on years in office and the same set of other regressors in Table 3. Here again we focus on party secretaries. The results are shown in Panel 2 of Table 5. Here, we see that conditioned on other factors that may potentially affect corruption, the correlation between years in office and corruption is negative for residential land, positive for commercial land, and insignificant for industrial land. Overall, there is a negative but insignificant correlation. We can conclude that the empirical results do not support Hypothesis 3.

The rising pattern throughout the years in office implies that Hypothesis 1 is not supported, but whether this is inconsistent with promotion-for-competition motives or not should be carefully examined. There are potentially two distinct arguments that may reconcile the competition-for-promotion motive with the fact that Hypothesis 1 does not hold. The first argument is that when urban areas expand, cities need convert rural land into urban land, but rural land is owned collectively by rural residents. So, even if a prefectural leader is ambitious, he or she may need to convert more rural land to urban land first before realizing his or her ambition. In China, various uses of urban land are collectively called *construction land,* in contrast with land not slated for "development". The increase in construction land can be used as a proxy for how much rural land is converted to urban land in a year. Focusing on party secretaries, Panel 1 of Table 6 shows the results when regressing the increase in construction land (also in logarithm) on the same set of regressors as in Table 3.[16] Here, we do not find any significant effects for years in office; this suggests that the proportion of increase in construction land is roughly constant within a prefectural leader's tenure. Hence, if a prefectural leader is ambitious in land sales, we should probably see a larger increase in construction land initially, but we do not see this here.

The second argument is that as most Chinese cities are growing in both population and income during this period, by restricting the land sales quantity early, the government may raise more revenue later on because land prices are further pushed up. Thus, an ambitious prefectural leader might trade an early large revenue with the larger overall land sales revenue over a somewhat longer time span, which may still increase the chance of getting promoted (even if a little later than the average number of years in office). If this conjecture is true, then we should expect to see a rising trend of land prices as well.

coefficients of the quadratic interaction terms of the other types of land indicate a slight convexity, but as these coefficients are much smaller than those of the linear interaction terms, the overall pattern is still that the effect of corruption on the increase of land supply is less the longer the years in office.

[16]Here, different columns show the variation when budget deficits are included and when the GDP-increase variable is excluded. See Section 3.4 for the reasons behind these variations.

Focusing on party secretaries, Panel 2 Table 6 shows the results when regressing land prices (in logarithm) on the same set of regressors as in Table 3, except that we replace GDP increase with GDP itself.[17] Here we find that land prices indeed rose over the years in office for the party secretaries (Columns 1), and that the effect is mainly driven by residential land prices (Column 2). Further evidence for this argument is from regressing land sales revenue on each $n$-th year in office as a dummy (instead of the quadratic specification) with $n = 1, 2, ..., 9$ and with the same set of other controls. Again, there is a clear rising trend in the effect of years in office, and the *increments* from one year to the next are $1.13, 1.15, 1.15, 1.23, 1.09, 1.05, 0.96$, and $0.84$, respectively. (The maximum number of years in office is nine years for party secretaries; hence there are eight increments). Thus, the increase in revenue is larger from year 2 to year 5, and the increases become smaller after 5 years. This is also consistent with the above-mentioned distribution of the term lengths. Thus we can conclude that the rising pattern in the first few years may still be consistent with competition-for-promotion motive because prefectural leaders may aim for larger land sales revenue overall in the first few (around five) years in office.[18]

## 3.4 Robustness Checks

We conducted various robustness checks for our results in the previous two subsections. First, we conducted two sets of robustness checks for the results on corruption. For the reasons explained in Section 3.1, we ran a the same set of regressions in Table 2 but now controlling for budget deficits (in logarithm). Table 7 shows the results; it can be seen that the results remain quite similar to those in Table 2.

In the benchmark regressions in Table 2, we do not control for prefecture fixed effects, as corruption may be related to local culture. Table 8 shows the results with these prefecture fixed effects. Here, we see that the coefficients on corruption are reduced sharply, except that the coefficients on industrial land increases. Comparison with Table 2 suggests that corruption may indeed be quite related to local time-invariant factors, but even so, the increases in residential and commercial land supply still exhibit very strong correlations with corruption. Also intriguing is the fact that the effect of corruption on industrial land increases (as even becomes significant for industrial land revenue) compared with Table 2. This suggests that industrial activity is less correlated with local time-invariant factors; this is comprehensible because industrial activities are quite mobile across locations.

[17] In the previous regressions, both the dependent and independent variables are flows. But as prices should depend on the overall supply and demand, we use GDP, instead of its increase, as the demand factor.

[18] With different data coverage, Du and Peiser (2014) show evidence for this hypothesis at the provincial level.

For the robustness checks for the years-in-office effect, we also examine the case where budget deficits are controlled. Also, recall that to address endogeneity issues, we rely on the assumption that the channel from land sales (in quantity or revenue) to boost GDP is not simultaneous; hence we simply treat the current-year increase in GDP as a demand factor variable. We thus also do a robustness check when GDP-increase is not included, in case the time lag of the above-mentioned channel is short. For these robustness checks, we focus on the total quantity and revenue of land sales. Table 9 shows the results for party secretaries. Columns 1 and 5 repeat the benchmark results from Table 3 for quantity and revenue of land sales, respectively. Columns 2-4 show the results for quantity of land sales with budget deficits controlled (Column 2); when GDP-increase is not controlled (Column 3); and a combination of the previous two cases (Column 4). Columns 6-8 repeat the same cases for land sales revenue. The results are all very similar to the ones in the benchmark. Table 10 repeat the same exercises for mayors. The rising trend for the increase in land supply remains quite robust. Again, we do not see much influence from controlling for budget deficits, but we start to see a rising trend for land revenue when GDP-increase is not controlled. Note that in Table 9, we do not see such large changes in coefficients. This is likely because the explanatory power of mayors' years in office is weaker, as seen when comparing Tables 3 and 4; the GDP-increase accounts for some variation in land sales. Thus, when GDP-increase is taken out, mayors' years in office start to capture the variations in land sales.

The last robustness check is to include prefecture-specific time trends. This is based on a concern that given land sales quantity, price, and revenue all rise over time, could our result of the rising trends in years in office simply result from the various controls not being able to *fully* explain these rising trend in quantity, price, and sales? In particular, this concern is not fully addressed by controlling for year fixed effects, which capture *overall* rising trends in land sales quantity, price, and revenue, but not those specific to prefectures. Thus, we add prefecture-specific linear time trends to the regressions in Tables 3 and 4 and show the results in Table 11 (but for total land supply only). Note that linear time trends translate to exponential time trends in levels as our dependent variables are all in logarithm. Here we see that even with the linear time trend, the rising trend in years in office remains quite robust.[19]

[19] In particular, whereas the years-in-office effect on total land revenue is not significant in Table 4, it has now become significant with the prefecture-specific time trend (Columns 6 and 8).

# 4 Conclusions

In this paper, we hypothesize that the two key features in China's political economy of land supply are corruption and competition for promotion. We thus explore the effects of corruption on the increase in urban land supply, as well as the effect of years in office within prefectural leaders' term to shed light on the competition motives. Conditional on standard urban-economic (or demand-side) determinants and industrial structure, the usage of two-stage auctions (the indicator of corruption) is strongly associated with the quantity of land sales, but less so for the revenue. This suggests that larger corruption leads to larger increases in land supply, but reduces prices compared with other methods of land sales. The effects of corruption are strongest for commercial land, followed by residential land, whereas the effect on industrial land is insignificant. This indicates that industrial land sales are not a major source of corruption, perhaps because of its lower land value.

For the years-in-office effect, we formulate three hypotheses regarding how the competition-for-promotion motive may matter. Our empirical results show very robust rising trends in land sales (both in quantity and revenue). These results are consistent with the hypothesis that the impatience and anxiety of not getting promoted yet at later years may contribute the increase in land sales revenue in later years, and it is inconsistent with the hypothesis that prefectural leaders may give up in later years. By investigating how land prices and the increment of land sales revenue change with years in office, we find that the rising pattern in the first few years may still be consistent with competition-for-promotion motive because prefectural leaders may aim for larger land sales revenue overall in the first few (around five) years in office. Altogether, these results suggest that the competition-for-promotion motive is likely to affect land sales through a combination of maximizing overall revenues in the first few years by restraining early sales and the impatience/anxiety of not getting promoted at later years.

The questions that we ask and study in this paper seem quite specific to China because this occurs in an environment where local governments have dominant land ownership and strong control over land use and where the selection of government officials is a top-down rather than a bottom-up process (democracy). There are a few other communist countries that bear similar features, but none of them is going through or has gone through the kind of economic reform and growth that has spurred the urbanization in China, except perhaps Vietnam. Hong Kong and Singapore also bear some similar features in terms of the control of land that these two governments have, but obviously there is a lack of political competition with other cities within a hierarchy.

Nevertheless, these lessons from China are precious and interesting precisely because of

their specificity, as we get to see the effects of "institutions". Although this paper provides no ground for making normative statements about China's urban land supply, this first-cut evidence provides us with clues to think about normative issues. In particular, as the institutional environment seems to resemble one where Henry George's idea of single tax from land might be put into effect, one can ask *to what extent* the Henry George Theorem (Arnott and Stiglitz, 1979) holds in China. As mentioned by Cai, Henderson, and Zhang (2013), the prevalence of corruption has squandered the opportunity for China to realize the ideals of Henry George. Our results indicate that corruption is relevant. But still, the quantitative question remains unanswered. Also, the qualitative question of how political competition matters in terms of welfare must be clarified. We tackle these questions in Hsu and Tang (2016).

# References


[1] Arnott, R. J., and J. E. Stiglitz (1979). "Aggregate land rents, expenditure on public goods, and optimal city size" Quarterly Journal of Economics, 471-500.

[2] Cai, H., Henderson, J. V., and Q. Zhang (2013). "China's land market auctions: evidence of corruption?," The Rand Journal of Economics, 44(3), 488-521.

[3] Deng, Yongheng, Joseph Gyourko, and Jing Wu (2012). "Land and House Price Measurement in China," Property Markets and Financial Stability, Heath A., Packer F. and Windsor C. eds., Bank of International Settlement and Reserve Bank of Australia.

[4] Du, Jinfeng and Richard Peiser (2014). "Land supply, pricing and local governments' land hoarding in China," Regional Science and Urban Economics, 48: 180-189.

[5] Fang, Hangming, Gu, Quanlin, Xiong, Wei, and Li-an Zhou (2015). "Demystifying the Chinese Housing Boom", NBER Working Paper 21112, April 2015.

[6] Fujita, Masahisa, Tomoya Mori, J. Vernon Henderson, and Yoshitsugu Kanemoto (2004). "Spatial distribution of economic activities in Japan and China," in: J. V. Henderson & J. F. Thisse (ed.), Handbook of Regional and Urban Economics, edition 1, volume 4, chapter 65: 2911-2977. Elsevier.

[7] Hsu, Wen-Tai, and Yang Tang (2016). "The Political Economy of Land Supply in China," working paper, Singapore Management University.

[8] Li, Hongbin and Li-an Zhou (2005). "Political Turnover and Economic Performance: The Incentive Role of Personnel Control in China," Journal of Public Economics, 89(9/10): 1743-172.

[9] Liang, Wenquan, Ming Lu and Hang Zhang (2016). "Housing Prices Threaten Competitiveness: How Do China's Inland-Favoring Land Policies Raise Wages," Journal of Housing Economics, forthcoming.

[10] Wu, Guiying, Feng, Qu, and Pei Li (2015). "Does local governments' budget deficit push up housing prices in China?", China Economic Review, 35: 183-196.

[11] Wu, Jing, Joseph Gyourko, and Yongheng Deng (2016). "Evaluating the Risk of Chinese Housing Markets: What We Know and What We Need to Know," China Economic Review, 39: 91-114.

[12] Zheng, S., M. E. Kahn, W. Sun, and D. Luo (2014). "Incentives for China's urban mayors to mitigate pollution externalities: The role of the central government and public environmentalism," Regional Science and Urban Economics, 47, 61-71.

## Table 1: Standard Urban-Economic Predictions: First Look

| | ln(increase in land supply) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| VARIABLES | total | residential | commercial | industrial | total | residential | commercial | industrial |
| ln(population increase) | 0.437*** | 0.423*** | 0.478*** | 0.444*** | 0.449*** | 0.429*** | 0.470*** | 0.479*** |
| | (0.0543) | (0.0674) | (0.0591) | (0.0578) | (0.0567) | (0.0688) | (0.0593) | (0.0625) |
| ln(increase in GDP per capita) | 0.0578*** | 0.0402*** | 0.0706*** | 0.0557*** | 0.0576*** | 0.0401*** | 0.0708*** | 0.0556*** |
| | (0.0108) | (0.0136) | (0.0127) | (0.0137) | (0.0110) | (0.0137) | (0.0125) | (0.0142) |
| ratio of GDPs (tertiary to secondary) | | | | | -0.217** | -0.105 | 0.138 | -0.590*** |
| | | | | | (0.104) | (0.123) | (0.133) | (0.187) |
| Constant | 5.734*** | 4.317*** | -1.196*** | 3.384*** | 5.893*** | 4.395*** | -1.298*** | 3.815*** |
| | (0.167) | (0.211) | (0.187) | (0.206) | (0.182) | (0.230) | (0.212) | (0.262) |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,438 | 1,437 | 1,441 | 1,429 | 1,438 | 1,437 | 1,441 | 1,429 |
| R-squared | 0.499 | 0.389 | 0.329 | 0.431 | 0.504 | 0.390 | 0.331 | 0.458 |

Notes: (1) Standard errors are clustered at the province level and shown in parentheses. (2) ***: significant at 1% level; **: significant at 5% level; * significant at 10% level. (3) The difference between Columns (1)-(4) and Columns (5)-(8) is whether the ratio of tertiary to secondary GDP is included as a control.

## Table 2: Corruption and Land Supply

| | ln(increase in land supply) | | | | ln(land sales revenue) | | | |
|---|---|---|---|---|---|---|---|---|
| VARIABLES | (1) total | (2) residential | (3) commercial | (4) industrial | (5) total | (6) residential | (7) commercial | (8) industrial |
| ln(population increase) | 0.442*** | 0.427*** | 0.460*** | 0.477*** | 0.658*** | 0.702*** | 0.700*** | 0.601*** |
| | (0.0554) | (0.0664) | (0.0562) | (0.0623) | (0.0823) | (0.0853) | (0.0823) | (0.0872) |
| ln(increase in GDP per capita) | 0.0585*** | 0.0411*** | 0.0701*** | 0.0548*** | 0.0664*** | 0.0736*** | 0.102*** | 0.0725*** |
| | (0.0108) | (0.0131) | (0.0121) | (0.0141) | (0.0141) | (0.0152) | (0.0149) | (0.0174) |
| ratio of GDPs (tertiary to secondary) | -0.239** | -0.161 | 0.124 | -0.593*** | 0.00858 | 0.127 | 0.475** | -0.546*** |
| | (0.103) | (0.122) | (0.134) | (0.185) | (0.174) | (0.174) | (0.222) | (0.191) |
| fraction of 2-stage (total) | 0.838*** | | | | 0.586** | | | |
| | (0.215) | | | | (0.273) | | | |
| fraction of 2-stage (residential) | | 0.765*** | | | | 0.268* | | |
| | | (0.138) | | | | (0.157) | | |
| fraction of 2-stage (commercial) | | | 1.210*** | | | | 0.494** | |
| | | | (0.210) | | | | (0.205) | |
| fraction of 2-stage (industrial) | | | | 0.791* | | | | 0.583 |
| | | | | (0.456) | | | | (0.423) |
| Constant | 5.211*** | 3.870*** | -2.296*** | 3.089*** | 9.696*** | 9.516*** | 3.614*** | 8.044*** |
| | (0.226) | (0.228) | (0.269) | (0.487) | (0.312) | (0.272) | (0.316) | (0.464) |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,438 | 1,437 | 1,437 | 1,429 | 1,409 | 1,437 | 1,425 | 1,429 |
| R-squared | 0.519 | 0.421 | 0.381 | 0.462 | 0.545 | 0.515 | 0.459 | 0.491 |

Notes: (1) Standard errors are clustered at the province level and shown in parentheses. (2) ***: significant at 1% level; **: significant at 5% level; * significant at 10% level. (3) The "fraction of 2-stage (type)" is the fraction of all transactions within that prefecture for that type of land (or total) that use 2-stage auction. It is used to proxy corruption.

## Table 3: Years in Office (Party Secretaries) and Land Supply

| | ln(increase in land supply) | | | | ln(land sales revenue) | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| VARIABLES | total | residential | commercial | industrial | total | residential | commercial | industrial |
| years in office | 0.541*** | 0.698*** | 0.860*** | 0.807*** | 1.175*** | 1.340*** | 1.141*** | 0.900*** |
| | (0.134) | (0.193) | (0.174) | (0.280) | (0.133) | (0.179) | (0.180) | (0.234) |
| (years in office)^2 | -0.00146 | 0.000407 | -0.0135 | -0.00562 | -0.00687 | -0.00718 | -0.0166 | -0.00960 |
| | (0.00689) | (0.00959) | (0.0101) | (0.0114) | (0.00753) | (0.00937) | (0.0107) | (0.00976) |
| ln(GDP increase) | 0.00243 | -0.0569 | 0.00255 | -0.0261 | -0.0373 | -0.0237 | -0.00363 | -0.0131 |
| | (0.0380) | (0.0616) | (0.0744) | (0.0783) | (0.0569) | (0.0811) | (0.0764) | (0.0632) |
| ratio of GDPs (tertiary to secondary) | -0.229 | -0.0338 | -0.773** | -0.700 | -0.349 | -0.264 | -0.451 | -0.614 |
| | (0.282) | (0.420) | (0.384) | (0.614) | (0.283) | (0.390) | (0.402) | (0.515) |
| fraction of 2-stage (total) | 0.260 | | | | 0.287 | | | |
| | (0.225) | | | | (0.310) | | | |
| fraction of 2-stage (residential) | | 0.384* | | | | 0.0354 | | |
| | | (0.227) | | | | (0.239) | | |
| fraction of 2-stage (commercial) | | | 0.675*** | | | | 0.296 | |
| | | | (0.215) | | | | (0.188) | |
| fraction of 2-stage (industrial) | | | | 0.568 | | | | 0.359 |
| | | | | (0.354) | | | | (0.373) |
| Constant | 5.411*** | 3.067*** | -0.694 | 3.691*** | 10.05*** | 9.002*** | 5.506*** | 8.615*** |
| | (0.488) | (0.684) | (0.623) | (1.100) | (0.582) | (0.758) | (0.738) | (0.806) |
| Prefecture-(Party-Secretary) FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,343 | 1,344 | 1,341 | 1,340 | 1,325 | 1,344 | 1,331 | 1,340 |
| R-squared | 0.893 | 0.867 | 0.813 | 0.839 | 0.933 | 0.907 | 0.875 | 0.895 |

Notes: (1) Standard errors are clustered at the province level and shown in parentheses. (2) ***: significant at 1% level; **: significant at 5% level; * significant at 10% level. (3) A prefecture-(party secretary) fixed effect is actually prefecture-specific party-secretary fixed effects. That is, for each prefecture, there is a coefficient for each prefectural party secretary to account for its specificity.

## Table 4: Years in Office (Mayors) and Land Supply

| | ln(increase in land supply) | | | | ln(land sales revenue) | | | |
|---|---|---|---|---|---|---|---|---|
| VARIABLES | (1) total | (2) residential | (3) commercial | (4) industrial | (5) total | (6) residential | (7) commercial | (8) industrial |
| years in office | 0.163*** | 0.117* | 0.124** | -0.0479 | 0.0122 | 0.119* | -0.00214 | -0.0776 |
| | (0.0512) | (0.0667) | (0.0598) | (0.0711) | (0.0502) | (0.0615) | (0.0775) | (0.0687) |
| (years in office)^2 | -0.00187 | -0.00659 | -0.0276*** | 0.00210 | -0.00379 | -0.00930 | -0.0164 | 0.00516 |
| | (0.00806) | (0.00984) | (0.00906) | (0.0106) | (0.00753) | (0.00878) | (0.0120) | (0.0104) |
| ln(GDP increase) | 0.0112 | -0.0553 | 0.0178 | -0.0207 | -0.0261 | -0.0247 | 0.0179 | -0.0171 |
| | (0.0414) | (0.0716) | (0.0765) | (0.0835) | (0.0620) | (0.0900) | (0.0791) | (0.0747) |
| ratio of GDPs (tertiary to secondary) | -0.0968 | 0.292 | -0.480 | -1.051 | -0.415 | -0.226 | -0.411 | -0.933 |
| | (0.341) | (0.468) | (0.559) | (0.740) | (0.399) | (0.513) | (0.634) | (0.672) |
| fraction of 2-stage (total) | 0.0800 | | | | 0.0893 | | | |
| | (0.244) | | | | (0.290) | | | |
| fraction of 2-stage (residential) | | 0.299 | | | | -0.0297 | | |
| | | (0.245) | | | | (0.238) | | |
| fraction of 2-stage (commercial) | | | 0.649*** | | | | 0.269 | |
| | | | (0.206) | | | | (0.194) | |
| fraction of 2-stage (industrial) | | | | 1.204** | | | | 0.998 |
| | | | | (0.606) | | | | (0.611) |
| Constant | 4.803*** | 1.718*** | -2.389*** | 1.285 | 7.875*** | 6.527*** | 3.313*** | 6.208*** |
| | (0.355) | (0.533) | (0.510) | (0.857) | (0.457) | (0.640) | (0.580) | (0.806) |
| Prefecture-Mayor FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,343 | 1,344 | 1,341 | 1,340 | 1,325 | 1,344 | 1,331 | 1,340 |
| R-squared | 0.892 | 0.867 | 0.825 | 0.844 | 0.938 | 0.911 | 0.882 | 0.895 |

Notes: (1) Standard errors are clustered at the province level and shown in parentheses. (2) ***: significant at 1% level; **: significant at 5% level; * significant at 10% level. (3) A prefecture-mayor fixed effect is actually prefecture-specific mayor fixed effects. That is, for each prefecture, there is a coefficient for each mayor to account for its specificity.

## Table 5: Corruption, Years in Office, and Change in Land Supply

| | Panel 1: Years in Office and Land Supply | | | | Panel 2: Corruption and Years in Office | | | |
|---|---|---|---|---|---|---|---|---|
| | ln(increase in land supply) | | | | corruption (fraction of two-stage auction) | | | |
| VARIABLES | (1) total | (2) residential | (3) commercial | (4) industrial | (1) | (2) | (3) | (4) |
| years in office | 1.137*** | 1.029*** | 1.671*** | 0.355 | -0.0130 | -0.0867*** | 0.105* | 0.00625 |
| | (0.345) | (0.237) | (0.352) | (0.386) | (0.0202) | (0.0330) | (0.0551) | (0.0127) |
| (years in office)^2 | -0.0692* | -0.0359* | -0.112*** | 0.0227 | 0.000500 | 0.00114 | 0.000425 | -9.23e-05 |
| | (0.0377) | (0.0187) | (0.0343) | (0.0425) | (0.00118) | (0.00209) | (0.00288) | (0.000842) |
| ln(GDP increase) | -0.00298 | -0.0603 | -0.00450 | 0.0274 | 0.00227 | -0.00731 | -0.000432 | 0.00914 |
| | (0.0383) | (0.0618) | (0.0749) | (0.0602) | (0.00597) | (0.0113) | (0.0139) | (0.00820) |
| ratio of GDPs (tertiary to secondary) | -0.180 | 0.0410 | -0.665* | -0.675 | -0.000269 | 0.118* | -0.166 | -0.0188 |
| | (0.286) | (0.434) | (0.374) | (0.647) | (0.0428) | (0.0667) | (0.126) | (0.0226) |
| fraction of 2-stage (total) | 1.457* | | | | 0.0159 | -0.0469 | 0.125 | 0.0761 |
| | (0.778) | | | | (0.712) | (0.712) | (0.769) | (0.768) |
| fraction of 2-stage (total)*(years in office) | -0.658* | | | | | | | |
| | (0.356) | | | | | | | |
| fraction of 2-stage (total)*(years in office)^2 | 0.0724* | | | | | | | |
| | (0.0408) | | | | | | | |
| fraction of 2-stage (residential) | | 1.204*** | | | | | | |
| | | (0.383) | | | | | | |
| fraction of 2-stage (residential)*(years in office) | | -0.426** | | | | | | |
| | | (0.192) | | | | | | |
| fraction of 2-stage (residential)*(years in office)^2 | | 0.0440* | | | | | | |
| | | (0.0224) | | | | | | |
| fraction of 2-stage (commercial) | | | 2.280*** | | | | | |
| | | | (0.619) | | | | | |
| fraction of 2-stage (commercial)*(years in office) | | | -0.981*** | | | | | |
| | | | (0.337) | | | | | |
| fraction of 2-stage (commercial)*(years in office)^2 | | | 0.112*** | | | | | |
| | | | (0.0384) | | | | | |
| fraction of 2-stage (industrial) | | | | 0.872 | | | | |
| | | | | (0.800) | | | | |
| fraction of 2-stage (industrial)*(years in office) | | | | 0.0918 | | | | |
| | | | | (0.424) | | | | |
| fraction of 2-stage (industrial)*(years in office)^2 | | | | -0.0320 | | | | |
| | | | | (0.0484) | | | | |
| Constant | 4.263*** | 2.321*** | -2.056*** | 4.851** | 0.902*** | 0.701*** | 0.669*** | 0.946*** |
| | (0.841) | (0.755) | (0.789) | (2.317) | (0.0601) | (0.0801) | (0.161) | (0.0595) |
| Prefecture-(Party-Secretary) FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,343 | 1,344 | 1,341 | 1,340 | 1,348 | 1,346 | 1,341 | 1,341 |
| R-squared | 0.894 | 0.868 | 0.817 | 0.827 | 0.801 | 0.845 | 0.637 | 0.702 |

Notes: (1) All the regressions in this table are for party secretaries. (2) Standard errors are clustered at the province level and shown in parentheses. (3) ***: significant at 1% level; **: significant at 5% level; * significant at 10% level.

## Table 6: Years in Office, Construction Land and Land Prices

| | Panel 1: Years in Office and Construction Land | | | | Panel 2: Years in Office and Land Prices | | | |
|---|---|---|---|---|---|---|---|---|
| | ln(increase in construction land) | | | | ln(average price) | | | |
| VARIABLES | (1) | (2) | (3) | (4) | (1) total | (2) residential | (3) commercial | (4) industrial |
| years in office | -0.186 | -0.212 | 0.00489 | 0.0189 | 0.323* | 0.369* | 0.0552 | 0.0145 |
| | (0.400) | (0.415) | (0.438) | (0.459) | (0.174) | (0.189) | (0.221) | (0.163) |
| (years in office)^2 | 0.0134 | 0.00819 | 0.0160 | 0.0128 | -0.00528 | -0.00620 | -0.00209 | -0.00389 |
| | (0.0176) | (0.0188) | (0.0168) | (0.0180) | (0.00413) | (0.00446) | (0.00574) | (0.00525) |
| ln(GDP increase) | 0.155 | 0.192 | | | | | | |
| | (0.159) | (0.169) | | | | | | |
| ln(GDP) | | | | | 0.282 | 0.342 | 0.547 | 0.129 |
| | | | | | (0.283) | (0.316) | (0.408) | (0.280) |
| ratio of GDPs (tertiary to secondary) | 0.840 | 0.896 | 0.510 | 0.537 | -0.00209 | 0.0150 | 0.271 | 0.141 |
| | (0.902) | (0.941) | (1.019) | (1.088) | (0.206) | (0.194) | (0.217) | (0.229) |
| fraction of 2-stage (total) | 0.0159 | -0.0469 | 0.125 | 0.0761 | -0.406** | | | |
| | (0.712) | (0.712) | (0.769) | (0.768) | (0.197) | | | |
| fraction of 2-stage (residential) | | | | | | -0.316*** | | |
| | | | | | | (0.108) | | |
| fraction of 2-stage (commercial) | | | | | | | -0.331** | |
| | | | | | | | (0.143) | |
| fraction of 2-stage (industrial) | | | | | | | | -0.0589 |
| | | | | | | | | (0.238) |
| ln(budget deficit) | | 0.195 | | -0.0129 | | | | |
| | | (0.851) | | (0.688) | | | | |
| Constant | 2.307 | 1.945 | 3.049** | 3.040** | 4.224** | 3.586 | 2.394 | 4.158** |
| | (1.488) | (1.765) | (1.348) | (1.515) | (2.003) | (2.253) | (2.871) | (1.982) |
| Prefecture-(Party-Secretary) FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Prefecture-Mayor FE | | | | | | | | |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 892 | 867 | 941 | 916 | 1,557 | 1,600 | 1,580 | 1,582 |
| R-squared | 0.769 | 0.772 | 0.760 | 0.763 | 0.872 | 0.903 | 0.809 | 0.759 |

Notes: (1) All the regressions in this table are for party secretaries. (2) Standard errors are clustered at the province level and shown in parentheses. (3) ***: significant at 1% level; **: significant at 5% level; * significant at 10% level. (4) In China, various uses of urban land are collectively called construction land, in contrast with the land not for "development".

## Table 7: Robustness Check -- Corruption -- With Budget Deficits

| | ln(increase in land supply) | | | | ln(land sales revenue) | | | |
|---|---|---|---|---|---|---|---|---|
| VARIABLES | (1) total | (2) residential | (3) commercial | (4) industrial | (5) total | (6) residential | (7) commercial | (8) industrial |
| ln(population increase) | 0.409*** | 0.388*** | 0.426*** | 0.443*** | 0.632*** | 0.677*** | 0.676*** | 0.565*** |
| | (0.0555) | (0.0647) | (0.0569) | (0.0635) | (0.0878) | (0.0908) | (0.0879) | (0.0904) |
| ln(increase in GDP per capita) | 0.0571*** | 0.0391*** | 0.0667*** | 0.0528*** | 0.0664*** | 0.0736*** | 0.101*** | 0.0737*** |
| | (0.0109) | (0.0134) | (0.0118) | (0.0140) | (0.0143) | (0.0160) | (0.0154) | (0.0175) |
| ratio of GDPs (tertiary to secondary) | -0.276*** | -0.194* | 0.0981 | -0.647*** | 0.00877 | 0.139 | 0.476** | -0.581*** |
| | (0.0946) | (0.103) | (0.130) | (0.194) | (0.174) | (0.172) | (0.232) | (0.196) |
| ln(budget deficit) | 0.597*** | 0.852*** | 0.569** | 0.515** | 0.143 | 0.115 | -0.0561 | 0.405 |
| | (0.226) | (0.286) | (0.236) | (0.259) | (0.371) | (0.381) | (0.356) | (0.357) |
| fraction of 2-stage (total) | 0.871*** | | | | 0.577** | | | |
| | (0.216) | | | | (0.276) | | | |
| fraction of 2-stage (residential) | | 0.816*** | | | | 0.274* | | |
| | | (0.133) | | | | (0.158) | | |
| fraction of 2-stage (commercial) | | | 1.206*** | | | | 0.474** | |
| | | | (0.216) | | | | (0.206) | |
| fraction of 2-stage (industrial) | | | | 0.762* | | | | 0.560 |
| | | | | (0.456) | | | | (0.423) |
| Constant | 4.486*** | 2.823*** | -2.970*** | 2.492*** | 9.548*** | 9.382*** | 3.712*** | 7.618*** |
| | (0.336) | (0.387) | (0.353) | (0.555) | (0.561) | (0.537) | (0.483) | (0.611) |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,403 | 1,402 | 1,402 | 1,394 | 1,375 | 1,402 | 1,391 | 1,394 |
| R-squared | 0.525 | 0.439 | 0.381 | 0.466 | 0.538 | 0.509 | 0.446 | 0.487 |

Notes: (1) Standard errors are clustered at the province level and shown in parentheses. (2) ***: significant at 1% level; **: significant at 5% level; * significant at 10% level. (3) The "fraction of 2-stage (type)" is the fraction of all transactions within that prefecture for that type of land (or total) that use 2-stage auction. It is used to proxy corruption.

## Table 8: Robustness Check -- Corruption -- With Prefecture Fixed Effects

| | ln(increase in land supply) | | | | ln(land sales revenue) | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| VARIABLES | total | residential | commercial | industrial | total | residential | commercial | industrial |
| ln(GDP increase) | 0.0456 | -0.00780 | 0.0492 | 0.00529 | -0.00646 | 0.00603 | 0.0192 | 0.00550 |
| | (0.0413) | (0.0560) | (0.0664) | (0.0700) | (0.0492) | (0.0656) | (0.0640) | (0.0585) |
| ratio of GDPs (tertiary to secondary) | -0.344 | -0.219 | -0.735** | -0.627* | -0.413* | -0.487 | -0.429 | -0.563* |
| | (0.216) | (0.322) | (0.286) | (0.374) | (0.239) | (0.366) | (0.276) | (0.340) |
| fraction of 2-stage (total) | 0.238 | | | | 0.250 | | | |
| | (0.158) | | | | (0.214) | | | |
| fraction of 2-stage (residential) | | 0.441** | | | | 0.0704 | | |
| | | (0.189) | | | | (0.187) | | |
| fraction of 2-stage (commercial) | | | 0.635*** | | | | 0.303* | |
| | | | (0.168) | | | | (0.161) | |
| fraction of 2-stage (industrial) | | | | 1.126** | | | | 1.051* |
| | | | | (0.539) | | | | (0.540) |
| Constant | 7.938*** | 6.452*** | 2.618** | 5.910*** | 15.35*** | 15.66*** | 10.42*** | 11.18*** |
| | (0.939) | (1.256) | (1.089) | (1.771) | (0.982) | (1.357) | (1.073) | (1.488) |
| Prefecture FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,343 | 1,344 | 1,341 | 1,340 | 1,325 | 1,344 | 1,331 | 1,340 |
| R-squared | 0.849 | 0.814 | 0.760 | 0.786 | 0.908 | 0.872 | 0.844 | 0.856 |

Notes: (1) Standard errors are clustered at the province level and shown in parentheses. (2) ***: significant at 1% level; **: significant at 5% level; * significant at 10% level. (3) The "fraction of 2-stage (type)" is the fraction of all transactions within that prefecture for that type of land (or total) that use 2-stage auction. It is used to proxy corruption.

## Table 9: Robustness Check -- Years in Office (Party Secretaries) and Land Supply

| | ln(increase in total land supply) | | | | ln(total land sales revenue) | | | |
|---|---|---|---|---|---|---|---|---|
| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| years in office | 0.541*** | 0.524*** | 0.596*** | 0.599*** | 1.175*** | 1.185*** | 1.131*** | 1.161*** |
| | (0.134) | (0.136) | (0.117) | (0.116) | (0.133) | (0.143) | (0.150) | (0.164) |
| (years in office)^2 | -0.00146 | -0.00185 | -0.00155 | -0.00210 | -0.00687 | -0.00652 | -0.00588 | -0.00598 |
| | (0.00689) | (0.00705) | (0.00646) | (0.00665) | (0.00753) | (0.00782) | (0.00663) | (0.00688) |
| ln(GDP increase) | 0.00243 | 0.00757 | | | -0.0373 | -0.0371 | | |
| | (0.0380) | (0.0386) | | | (0.0569) | (0.0594) | | |
| ratio of GDPs (tertiary to secondary) | -0.229 | -0.209 | -0.306 | -0.277 | -0.349 | -0.386 | -0.298 | -0.315 |
| | (0.282) | (0.293) | (0.257) | (0.259) | (0.283) | (0.308) | (0.354) | (0.376) |
| ln(budget deficit) | | 0.0780 | | -0.0864 | | 0.0202 | | -0.178 |
| | | (0.191) | | (0.219) | | (0.253) | | (0.352) |
| fraction of 2-stage (total) | 0.260 | 0.260 | 0.267 | 0.266 | 0.287 | 0.293 | 0.253 | 0.263 |
| | (0.225) | (0.226) | (0.185) | (0.187) | (0.310) | (0.312) | (0.251) | (0.253) |
| Constant | 5.411*** | 5.218*** | 5.310*** | 5.348*** | 10.05*** | 10.07*** | 9.866*** | 10.05*** |
| | (0.488) | (0.536) | (0.321) | (0.361) | (0.582) | (0.714) | (0.452) | (0.594) |
| Prefecture-(Party-Secretary) FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,343 | 1,309 | 1,599 | 1,559 | 1,325 | 1,292 | 1,557 | 1,518 |
| R-squared | 0.893 | 0.892 | 0.891 | 0.890 | 0.933 | 0.931 | 0.933 | 0.931 |

Notes: (1) Standard errors are clustered at the province level and shown in parentheses. (2) ***: significant at 1% level; **: significant at 5% level; * significant at 10% level. (3) A prefecture-(party secretary) fixed effect is actually prefecture-specific party-secretary fixed effects. That is, for each prefecture, there is a coefficient for each prefectural party secretary to account for its specificity.

## Table 10: Robustness Check -- Years in Office (Mayor) and Land Supply

| | ln(increase in total land supply) | | | | ln(total land sales revenue) | | | |
|---|---|---|---|---|---|---|---|---|
| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| years in office | 0.163*** | 0.171*** | 0.563*** | 0.600*** | 0.0122 | 0.00496 | 1.115*** | 1.169*** |
| | (0.0512) | (0.0498) | (0.134) | (0.138) | (0.0502) | (0.0520) | (0.187) | (0.212) |
| (years in office)^2 | -0.00187 | -0.00343 | 0.00129 | -0.000869 | -0.00379 | -0.00314 | -0.00111 | -0.000845 |
| | (0.00806) | (0.00774) | (0.00890) | (0.00855) | (0.00753) | (0.00776) | (0.00960) | (0.0101) |
| ln(GDP increase) | 0.0112 | 0.0147 | | | -0.0261 | -0.0331 | | |
| | (0.0414) | (0.0424) | | | (0.0620) | (0.0643) | | |
| ratio of GDPs (tertiary to secondary) | -0.0968 | -0.132 | -0.116 | -0.127 | -0.415 | -0.531 | -0.339 | -0.392 |
| | (0.341) | (0.359) | (0.334) | (0.348) | (0.399) | (0.451) | (0.496) | (0.545) |
| ln(budget deficit) | | 0.0697 | | -0.144 | | -0.0819 | | -0.263 |
| | | (0.214) | | (0.261) | | (0.274) | | (0.396) |
| fraction of 2-stage (total) | 0.0800 | 0.0788 | 0.110 | 0.111 | 0.0893 | 0.107 | 0.00534 | 0.0202 |
| | (0.244) | (0.244) | (0.186) | (0.186) | (0.290) | (0.291) | (0.247) | (0.248) |
| Constant | 4.803*** | 4.699*** | 5.468*** | 5.603*** | 7.875*** | 7.979*** | 10.09*** | 10.39*** |
| | (0.355) | (0.405) | (0.364) | (0.434) | (0.457) | (0.535) | (0.538) | (0.723) |
| Prefecture-Mayor FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,343 | 1,309 | 1,599 | 1,559 | 1,325 | 1,292 | 1,557 | 1,518 |
| R-squared | 0.892 | 0.890 | 0.890 | 0.889 | 0.938 | 0.937 | 0.937 | 0.936 |

Notes: (1) Standard errors are clustered at the province level and shown in parentheses. (2) ***: significant at 1% level; **: significant at 5% level; * significant at 10% level. (3) A prefecture-mayor fixed effect is actually prefecture-specific mayor fixed effects. That is, for each prefecture, there is a coefficient for each mayor to account for its specificity.

## Table 11: Robustness Check -- Years in Office for Prefectural Leaders -- Prefecture Specific Time Trend

| | party secretaries | | | | mayors | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| VARIABLES | ln(increase in total land supply) | ln(total land sales revenue) | ln(increase in total land supply) | ln(total land sales revenue) | ln(increase in total land supply) | ln(total land sales revenue) | ln(increase in total land supply) | ln(total land sales revenue) |
| years in office | 0.738*** | 1.634*** | 1.065*** | 1.880*** | 0.385*** | 0.254** | 0.435*** | 0.308*** |
| | (0.225) | (0.313) | (0.220) | (0.329) | (0.0961) | (0.127) | (0.0726) | (0.0953) |
| (years in office)^2 | -0.00189 | -0.0139 | 0.0161 | 0.0125 | 0.00106 | -0.0114 | 0.0127 | 0.00481 |
| | (0.0150) | (0.0199) | (0.0128) | (0.0157) | (0.0188) | (0.0239) | (0.0153) | (0.0195) |
| ln(GDP increase) | 0.0290 | 0.0848 | 0.00247 | -0.00272 | 0.00365 | 0.0641 | 0.000543 | -0.00981 |
| | (0.0413) | (0.0632) | (0.0443) | (0.0754) | (0.0487) | (0.0709) | (0.0474) | (0.0848) |
| ratio of GDPs (tertiary to secondary) | 0.467 | -0.266 | -0.00161 | -0.445 | 0.410 | -0.288 | -0.158 | -0.533 |
| | (0.486) | (0.694) | (0.481) | (0.731) | (0.624) | (0.807) | (0.634) | (0.870) |
| fraction of 2-stage (total) | -0.313 | -0.530 | -0.193 | -0.343 | -0.299 | -0.307 | -0.227 | -0.232 |
| | (0.470) | (0.494) | (0.454) | (0.426) | (0.493) | (0.510) | (0.470) | (0.457) |
| Constant | 3.088*** | 9.251*** | 3.764*** | 8.792*** | 2.289*** | 5.139*** | 2.809*** | 5.752*** |
| | (0.825) | (1.208) | (0.651) | (0.958) | (0.611) | (0.764) | (0.632) | (0.807) |
| Prefecture-Specific Time Trend | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Prefecture-(Party-Secretary) FE | Yes | Yes | Yes | Yes | | | | |
| Prefecture-Mayor FE | | | | | Yes | Yes | Yes | Yes |
| Year FE | No | No | Yes | Yes | No | No | Yes | Yes |
| Observations | 1,343 | 1,325 | 1,343 | 1,325 | 1,343 | 1,325 | 1,343 | 1,325 |
| R-squared | 0.934 | 0.955 | 0.945 | 0.966 | 0.928 | 0.959 | 0.939 | 0.967 |

Notes: (1) Standard errors are clustered at the province level and shown in parentheses. (2) ***: significant at 1% level; **: significant at 5% level; * significant at 10% level. (3) A prefecture-leader fixed effect is actually prefecture-specific leader fixed effects, and a leader can be a party secretary or a mayor. That is, for each prefecture, there is a coefficient for each prefectural leader to account for its specificity.