Land Offers and Fiscal Competition Between City Governments in China

Wending Liu

ANU Research School of Economics

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Motivation

- China's governance structure is unusual in combining a high degree of political centralization and economic decentralization (Kroeber, 2020; Xu, 2011).
- One of the most salient characteristics of the system is the competition among city governments which use special deals to attract businesses (Bai, Hsieh, & Song, 2020).
- A major type of the special deals is selling industrial lands at a low price to firms. (Su & Tao, 2017)
- Why local governments in China compete against each other to attract industrial firms so fiercely that they are willing to sacrifice the industrial land selling revenue?
- What and how much are the benefits city governments can get from this kind of fiscal competition?
- Can this kind of fiscal competition improve the allocation efficiency or does it lead to "race to bottom"?
- Can this kind of fiscal competition continue in the future?

Motivation

An industrial park in the author's hometown

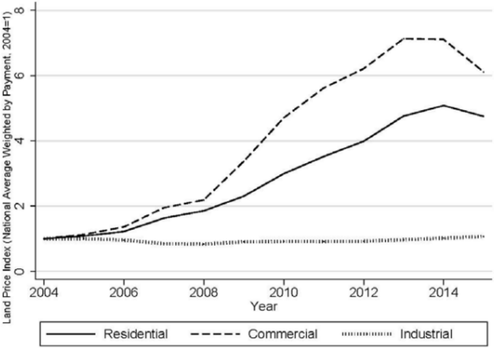
Work program of a vice-mayor (who takes charge of education!) in China (Bai et al., 2020)

Literature Review

- Fiscal Competition Theory
  - Tiebout Model: competition for mobile capitals creates efficient equilibrium (Tiebout, 1956).
  - Tax competition Model: downward pressure on fiscal revenues from the decentralization of fiscal power (Keen & Marchand, 1997).
  - The possibilities of a "race to bottom" in welfare benefits due to "fiscal externality" (Wilson, 1999).
- Fiscal Competition with Chinese characteristics
  - Studies observe that local governments use discounts in land sale as a main tool to attract businesses include Cheung (2014), Su and Tao (2017), Bai et al. (2020), etc.
  - No formal theoretical model and econometric analysis yet.
- Empirical Analysis
  - Mast (2020) uses structural estimation to analyze the county tax break for small businesses in the U.S.

Fiscal Competition and Land Market in China

- City governments (293 prefecture-level cities + 4 municipalities) control the land supply.
- Land revenue represented 30% of the total government revenue and 6% of total GDP by 2011 (Chen & Kung, 2019).
- But interestingly, the price of industrial land is significantly lower than the price of residential land.

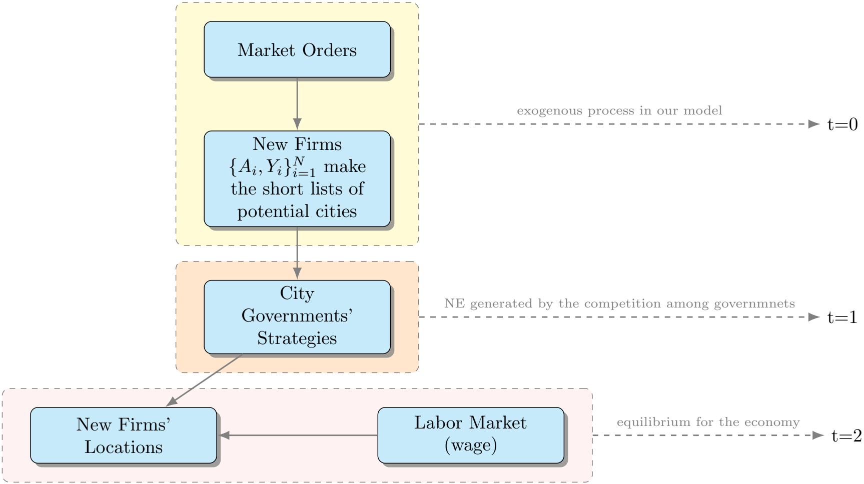


Land price index in China (Source: Liu and Xiong (2020))

Fiscal Competition and Land Market in China

- The reason behind the seemingly confusing phenomenon is deeply rooted in the fiscal structure of Chinese local governments.
- After the tax reform in 1993-1994, the main source of local government's fiscal revenue comes from 25% of value-added tax, business tax, and 40% of income tax plus the land lease fees.
- To maximize fiscal revenue, local governments use special deals to attract industrial firms. And a major type of special deals is to sell industrial lands at a very low price to firms.
- Why industrial firms are so important for local governments?
  - more (industrial) firms $\rightarrow$ more workers $\rightarrow$ prosperity of the tertiary industry $\rightarrow$ increasing housing demand and tax revenue.
  - City governments can maximize their revenues by limiting residential land supply given the increasing housing demand.
- This paper focuses on fiscal competition, i.e. attracting firms by lowering the land price, as well as its impact on fiscal revenue.

Main structure of the model



Firms

- Firm i's (Leontief) production function:

$$F_i(K, L, T) = \min\{A_i K^{\alpha} L^{1-\alpha}, g_i(T)\}$$

where T is the area of industrial land, which determines the limit of output. $g_i(T)$ is increasing in T.

- New firm i signs a contract to produce Y_i units of product with buyers on the global market. The price of product is normalized to 1 RMB.
- Firm i solves the following cost minimization problem:

$$\begin{aligned} &\min_{k \in \mathbf{C}_i, K_i, L_i, T_i} \left\{ rK_i + w_k L_i + \frac{p_{ik}}{m} T_i - \varepsilon_{ik} \right\} \\ &\text{s.t. } Y_i = \min\left\{ A_i K_i^{\alpha} L_i^{1-\alpha}, g_i\left(T_i\right) \right\} \end{aligned} \tag{1}$$

  - p_{ik}: land price for firm i offered by city k.
  - m: term (years) of land lease.
  - $\mathbf{C}_i$: firm i's choice set. $|\mathbf{C}_i|$ is nondecreasing in Y_i.
  - ε_{ik}: error term represents all other unobserved costs and benefits for firm i to produce in city k. I assume ε_{ik} has type I extreme value distribution with scale parameter σ.

Firms

- Fixing k in (1), the solution to cost minimization problem for firm i to produce in city k is:

$$\begin{aligned} \text{Labors:} \quad & L_i = \left(\frac{1-\alpha}{\alpha}\right)^{\alpha}\left(\frac{r}{w_k}\right)^{\alpha}\frac{Y_i}{A_i} = B_i w_k^{-\alpha} \\ \text{Capital:} \quad & K_i = \frac{\alpha}{1-\alpha}\cdot\frac{w_k}{r}\cdot L_i = \frac{\alpha}{r(1-\alpha)}B_i w_k^{1-\alpha} \\ \text{Land:} \quad & T_i = g_i^{-1}(Y_i) \end{aligned} \tag{2}$$

  where $B_i := \left(\frac{(1-\alpha)r}{\alpha}\right)^{\alpha}\frac{Y_i}{A_i} = L_i w_k^{\alpha}$ only depends on characteristics of firm i.

- The minimal cost of producing in city k for firm i:

$$\begin{aligned} c_{ik} &= w_k\cdot L_i + r\cdot K_i + \frac{p_{ik}}{m}\cdot T_i - \varepsilon_{ik} \\ &= \frac{1}{1-\alpha}B_i w_k^{1-\alpha} + \frac{p_{ik}}{m}T_i - \varepsilon_{ik} \end{aligned} \tag{3}$$

Firms

- After knowing c_{ik} for all $k \in \mathbf{C}_i$, the firm i just chooses the city k which has the minimal production cost:

$$k^* = \arg\min_{k \in \mathbf{C}_i} c_{ik}$$

- Since the distribution of ε_{ik} is common knowledge among all city governments in the choice set, city governments in $\mathbf{C}_i$ can calculate the probability of landing firm i successfully in their geographical jurisdiction:

$$\begin{aligned} Pr(\text{i lands in k}|p_{ik}, p_{i(-k)}) &= Pr(c_{ik} < c_{ij}\ \forall j \in \mathbf{C}_i \setminus k) \\ &= \frac{exp\big[(-\frac{1}{1-\alpha} B_i w_k^{1-\alpha} - \frac{p_{ik}}{m} T_i)/\sigma\big]}{\sum_{j \in \mathbf{C}_i} exp\big[(-\frac{1}{1-\alpha} B_i w_j^{1-\alpha} - \frac{p_{ij}}{m} T_i)/\sigma\big]} \end{aligned} \tag{4}$$

City Governments

- The city government's revenue gotten from attracting new firms:
  - the fiscal revenue generated by the new firm itself, which includes tax revenue, promotion of local business and housing market, political benefits, etc.
  - the fiscal revenue generated by selling the industrial land.
- I denote the expected fiscal revenue for city k to attract firm i by v_{ik}:

$$\begin{aligned} v_{ik} &= Pr(i \text{ lands in } k|p_{ik}, p_{i(-k)}) \cdot (\beta Y_i + p_{ik} T_i) \\ &= \frac{exp\left[(-\frac{1}{1-\alpha} B_i w_k^{1-\alpha} - \frac{p_{ik}}{m} T_i)/\sigma\right]}{\sum_{j \in \mathbf{C}_i} exp\left[(-\frac{1}{1-\alpha} B_i w_j^{1-\alpha} - \frac{p_{ij}}{m} T_i)/\sigma\right]} \cdot (\beta Y_i + p_{ik} T_i) \end{aligned} \tag{5}$$

- βY_i is the fiscal revenue generated by the new firm itself, and $\beta \geq 0$ can be interpreted as the revenue share of city governments in the output of the firm.
- $p_{ik} T_i$ is the land selling revenue.
- Trade-off between higher land selling revenue and higher probability of getting the firm.

Bertrand Pricing Game

- When a city government chooses the land price to maximize its expected fiscal revenue by attracting the firm, the city government should always consider other cities' land price offers.
- I use a Bertrand Game $\langle \mathbf{C}_i, (S_{ik}), (v_{ik}) \rangle$ to characterize the interaction between city governments when they compete for a firm i.
- I set city governments' pure strategy set $S_{ik} \equiv S_i = [p^i_{min},\ p^i_{max}]$ for $\forall i, k$.
- For all i, a strategy profile (price vector) $p^*_i \in S_i^{|\mathbf{C}_i|}$ is pure strategy Nash Equilibrium (NE) if for all $k \in \mathbf{C}_i$ and $p_{ik} \in S_i$:
$$v_{ik}(p_{ik},\ p^*_{i(-k)}) \leq v_{ik}(p^*_{ik},\ p^*_{i(-k)}).$$

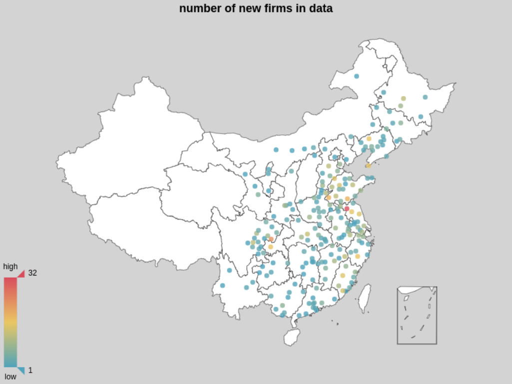
Numerical Method for Solving the Game

- It can be proved that every Bertrand game $\langle \mathbf{C}_i, (S_{ik}), (v_{ik}) \rangle$ has a unique pure strategy Nash Equilibrium p^* by constructing a contraction mapping on the compact action space.
- The pure NE is found by the Gauss-Seidel algorithm.
- I parallelize the tasks of solving all the games.

Data

- I match 2013 Chinese industrial firm survey data, 2012 Chinese city statistics year book and official land selling data (from www.landchina.com) to get 1019 observations of new firms established in 2012.
- There are 212 cities which at least gets one firm in our data set.

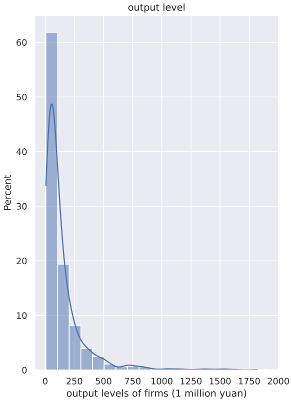
Number of firms each city lands in data



Data

- More than 80% of firms have output level have out put level between 5 million and 250 million yuan per year, and most of the firms buy land with price below 3 million yuan per hectare.

Sample distribution of output level and land price



Settings for Estimation

Inputs in the Bertrand Game model

	Name	Interpretation	Source	Value/Range/Formula
Parameters	β	governments' revenue share	estimation	$[0, 2]$
	σ	scale parameter in the distribution of ε_{ik}	estimation	$(0, 1000]$
	α	capital income share	calibration	$\{0.33, 0.5, 0.67\}$
Variables	Y_i	output level of firm	data	
	L_i	number of workers in the firm	data	
	T_i	area of land usage	data	
	w_k	city average wage	data	
	B_i	firm's characteristic	data	$L_i w_{k^*}^{\alpha}$
	$\mathbf{C}_i$	firm's choice set	random draws	$\lvert\mathbf{C}_i\rvert = 3, 4, 5$
	p^i_{obs}	observed land price for the firm	data	
	p^i_{min}	the minimum of possible land price	data	$\max\{0,\ p^i_{obs} - 2000\}$
	p^i_{max}	the maximum of possible land price	data	$p^i_{obs} + 2000$

Moment Conditions

- I use the method of simulated moments (MSM) to estimate $\theta = (\beta, \sigma)$.
- The information of firm i is $Q_i \equiv \{Y_i, T_i, B_i\}$, all the parameters is denoted by $\theta = (\alpha, \beta, \sigma)$. And θ_0 are the true parameters.
- Define $x_i \equiv [p_i, p_i^2]'$, and denote the conditional first and second-order moments of land price by $h(x_i; \theta_0) \equiv E(x_i | Q_i; \theta_0)$. By the definition of conditional land price:

$$E[x_i - h(Q_i; \theta_0) | Q_i] = 0$$

- I choose the instrument variables vector $Z_i = [1, Y_i, T_i, Y_i \times T_i]'$ for its simplicity. And the moment conditions are:

$$E[Z_i \otimes (x_i - h(Q_i; \theta_0))] = 0$$

Numerical Methods for Estimation

- I use a two-step method (estimating the optimal weighting matrix) to get the estimates and standard errors.
- Grid search + Quasi-Newton method to find the minimizer of MSM objective.

Estimation Results

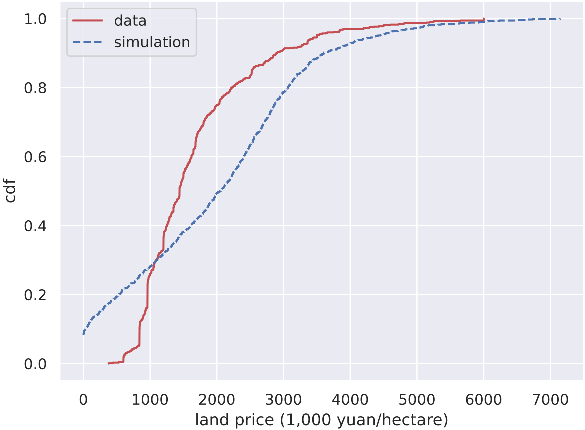
- The VAT rate is 17%, the share of city government in VAT revenue is 25%, and the back-of-envelop calculation shows that the city government's revenue share is at most $5 \times 80\% \times 17\% \times 25\% = 0.17$, which is 38% of $\hat{\beta} \approx 0.45$ (80% is an overestimated added value-output ratio).

Estimates of Parameters ($3 \leq |\mathbf{C}_i| \leq 5$)

Calibrated α	Parameters	Estimates	Standard Error
0.33	β	0.512	0.043
	σ	172.246	24.058
0.5	β	0.453	0.032
	σ	178.301	25.102
0.67	β	0.462	0.034
	σ	182.761	24.920

Fit of the Model

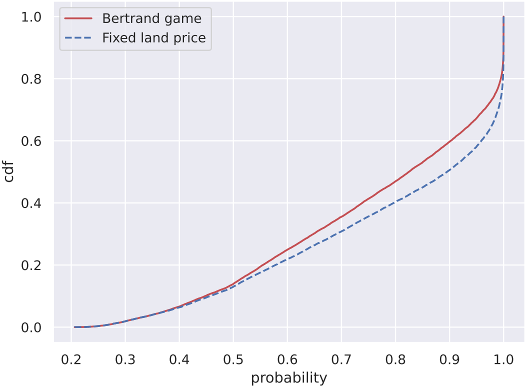
Comparison of distribution of real land prices and simulated land prices



Allocation Efficiency

- I fix land prices in the whole country, and calculate the probability of getting firms for advantaged cities in the Bertrand game.
- The impact of fiscal competition on the locations of firms (allocation efficiency) is very small.

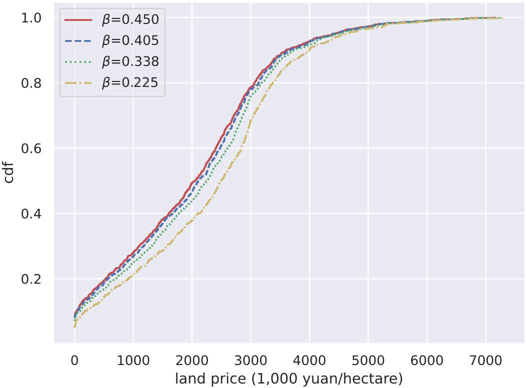
The empirical CDF of the probability of getting the firm for advantaged cities



Impacts of fiscal centralization

- I consider “fiscal centralization” after 2013 reflected by the decrease of β.
- If β decreases by 25%, the spillover effects of attracting firms are still sufficiently large, and the rise of land prices is limited.

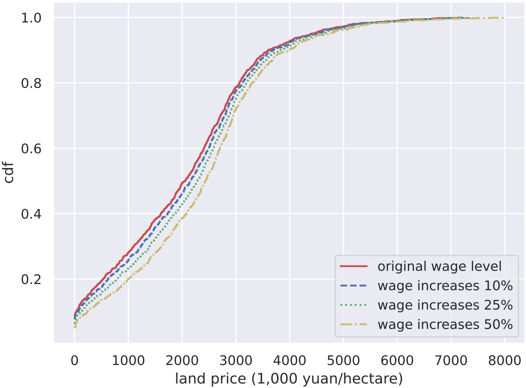
Change of land price distribution due to decrease of β



Impacts of the Rising Wage Level

- I consider the impacts of rising urban wages in China after the late 2000s on the land price.
- The average land price increases as the wage level increases, but the increase is not sharp.

Change of land price distribution due to increase of wage



Conclusion

- Local governments can get huge benefits from attracting industrial firms. And the ratio of fiscal revenue to firms' output is much higher than the official tax rate.
- The major tool for the fiscal competition: selling industrial land at low prices cannot improve the allocation efficiency of output but waste a lot of potential land-selling revenue.
- The real potential benefits of fiscal competition can only be the case that more firms (or output level) are created due to the lower production cost induced by the efforts of local governments to attract firms. But this issue is beyond the scope of the model.
- Fiscal centralization poses potential challenges to the mode of fiscal competition.

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