How Does Land Use Policy Affect Local Labor Market and Housing Market?

Jiakai Zhang, New Mexico Tech

March 1, 2024
Motivation

- Land use policy
  - the set of rules and regulations that directly influence the use of commercial land, industrial land, or residential land use.

Should the local government increase the share of productive land use to facilitate regional economic growth? Increase the share of residential land use to attract more households? The paper seeks to investigate the effects of land use policy on the local labor market to address one of the problems associated with urbanization in China: soaring housing prices.
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  - increase the share of productive land use to facilitate regional economic growth?
  - increase the share of residential land use to attract more households?

- **The paper seeks to**
  - investigate the effects of land use policy on the local labor market
  - address one of the problems associated with urbanization in China: soaring housing prices
Literature

▶ Land use policy
  ▶ agricultural land conversion
    Fu et al., 2021; Adamopoulos and Restuccia, 2014
  ▶ industrial and agricultural
    Adamopoulos and Restuccia, 2020; Chen et al., 2022; Ghatak and Roy, 2007; Tian et al., 2022; Cai et al., 2013
  ▶ urban land
    Fang et al., 2022; Fei, 2020; Zhao and Zhang, 2022; Zhang, 2022; Cai et al., 2017; Brueckner et al., 2017
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▶ Urbanization
  ▶ local labor market
    Sato and Zenou, 2015; Wheaton and Lewis, 2002; Tabuchi, 1986
  ▶ housing market
    Dasgupta et al., 2014; Liu et al., 2018; Lan et al., 2021; Du and Zheng, 2020
Agenda

1. Motivating Facts

2. Empirical Strategy

3. Benchmark Model

4. Model Results and Quantitative Analysis

5. Conclusion
Motivating Facts
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- Raising productive land use is associated with
  - more employment opportunities for local workers and immigrants
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  - higher wage level of employees
Motivating Facts

- Raising productive land use is associated with
  - more employment opportunities for local workers and immigrants
  - higher wage level of employees
  - higher housing price
Motivating Facts

- Around 63% of land revenue has been collected from residential land.
Empirical Strategy
Empirical Strategy

▶ Endogeneity
  ▶ Reverse causality
  ▶ Omitted variables
Empirical Strategy

- Endogeneity
  - Reverse causality
  - Omitted variables

- Instrumental variable
  - The residential development is curtailed by the presence of steep-sloped terrain (Saiz, 2010)
Empirical Strategy

▶ Endogeneity
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▶ Instrumental variable
  ▶ The residential development is curtailed by the presence of steep-sloped terrain (Saiz, 2010)
  ▶ Two Ratio
    ▶ the average slope of the city to the average slope of the province
    ▶ the average slope of the city to 15 degrees
Empirical Strategy

- Endogeneity
  - Reverse causality
  - Omitted variables

- Instrumental variable
  - The residential development is curtailed by the presence of steep-sloped terrain (Saiz, 2010)
  - Two Ratio
    - the average slope of the city to the average slope of the province
    - the average slope of the city to 15 degrees
  - Additional variation
    - the household registered population
    - the share of National Development Zones (NDZ)
Empirical Strategy

2SLS

\[ Y_{it} = \beta_0 + \beta_1 \left( \frac{L_p}{L} \right)_{it} + X_{it} \Phi + \mu_i + \theta_t + \varepsilon_{it} \]

<table>
<thead>
<tr>
<th></th>
<th>Unemployment rate</th>
<th>log(wage)</th>
<th>log(price)</th>
<th>Unemployment rate</th>
<th>log(wage)</th>
<th>log(price)</th>
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<tbody>
<tr>
<td>((L_p/L)_{it})</td>
<td>-0.1540***</td>
<td>1.0781***</td>
<td>1.0218**</td>
<td>-0.1249***</td>
<td>1.2990***</td>
<td>1.6745***</td>
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<td>(0.0506)</td>
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<td>(0.0128)</td>
<td>(0.0551)</td>
<td>(0.3603)</td>
<td>(0.5807)</td>
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<tr>
<td>City fixed effect</td>
<td>YES</td>
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<td>YES</td>
<td>YES</td>
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<td>YES</td>
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<tr>
<td>Year fixed effect</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
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</table>

First-stage results for \((L_p/L)_{it}\)

<table>
<thead>
<tr>
<th></th>
<th>(Ratio_{1i} \times Repop_{it})</th>
<th>(Ratio_{1i} \times NDZ_{it})</th>
<th>(Ratio_{2i} \times Repop_{it})</th>
<th>(Ratio_{2i} \times NDZ_{it})</th>
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<tbody>
<tr>
<td></td>
<td>-0.1138***</td>
<td>0.0078**</td>
<td>-0.1270***</td>
<td>0.0111**</td>
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<tr>
<td></td>
<td>(0.0186)</td>
<td>(0.0032)</td>
<td>(0.0238)</td>
<td>(0.0045)</td>
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<tr>
<td></td>
<td>-0.01089***</td>
<td>0.0046</td>
<td>-0.1200***</td>
<td>0.0078*</td>
</tr>
<tr>
<td></td>
<td>(0.0188)</td>
<td>(0.0033)</td>
<td>(0.0241)</td>
<td>(0.0045)</td>
</tr>
<tr>
<td></td>
<td>-0.1088***</td>
<td>0.0047</td>
<td>-0.1201**</td>
<td>0.0078*</td>
</tr>
<tr>
<td></td>
<td>(0.0038)</td>
<td>(0.0033)</td>
<td>(0.0241)</td>
<td>(0.0045)</td>
</tr>
</tbody>
</table>

Wk. instrument F stats

|                  | 20.71                            | 17.37                            | 17.46                            | 15.98                            | 13.06                            | 13.18                            |

N

|                  | 3,795                            | 3,979                            | 3,988                            | 3,795                            | 3,979                            | 3,988                            |
Benchmark Model
The Economy

- A unit measure of homogeneous worker-consumers consume final goods and housing to maximize their utility.
- There are search frictions in the labor market.
- One representative firm in each city produces final goods using labor and commercial land.
- The city developer converts residential land into housing.
- The regional government collects land revenue and rebates to household.
- No aggregate uncertainty, the steady-state equilibrium.
Model Results and Quantitative Analysis
Model Validation

- Increasing productive land use
  - increases the tightness of the labor market
  - increases the extra value that is created from job formation
  - increases the household’s expected income and reduces the supply of residential land

(a) Unemployment rate  (b) Wage  (c) Housing price
Quantitative Analysis

- Fitting the productive land share and TFP from data
Quantitative Analysis

- Fitting the productive land share and TFP from data
- Assume each city $i$ has its city-specific productivity $A_i$

$$A_i = \tilde{A}_i N_i^\xi$$

where $\tilde{A}_i$ denotes city-specific fundamental productivity and $\xi$ captures the degree of the agglomeration effect
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- The indirect utility

$$U_i = \frac{(1 - \alpha)^{1-\alpha} \alpha^\alpha W_i p_i^{-\alpha}}{L_{0i}}$$
Quantitative Analysis

- Fitting the productive land share and TFP from data
- Assume each city \( i \) has its city-specific productivity \( A_i \)

\[
A_i = \tilde{A}_i N_i^\xi
\]

where \( \tilde{A}_i \) denotes city-specific fundamental productivity and \( \xi \) captures the degree of the agglomeration effect

- The indirect utility

\[
U_i = (1 - \alpha)^{1-\alpha} \alpha^\alpha W_i p_i^{-\alpha} / L_{0i}
\]

- Mobility of labor among cities ensures that each city provides the same level of utility, \( U_i = U_j \)
## Calibration and Moments

<table>
<thead>
<tr>
<th>Assigned</th>
<th>Calibrated/Estimated</th>
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</thead>
<tbody>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>$\alpha = 0.30$</td>
<td>Housing expenditure share</td>
</tr>
<tr>
<td>$\sigma = 1/3$</td>
<td>1-Labor share</td>
</tr>
<tr>
<td>$s = 0.07$</td>
<td>Separation rate</td>
</tr>
<tr>
<td>$r = 0.04$</td>
<td>Interest rate</td>
</tr>
<tr>
<td>$\tau = 0.13$</td>
<td>VAT tax rates</td>
</tr>
<tr>
<td>$\xi = 0.08$</td>
<td>The degree of the agglomeration</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Moment

<table>
<thead>
<tr>
<th></th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tightness $\theta$</td>
<td>1.47</td>
<td>1.47</td>
</tr>
<tr>
<td>Replacement rate $b/\text{mean}(w)$</td>
<td>18.6%</td>
<td>18.6%</td>
</tr>
<tr>
<td>Unemployment rate $u$</td>
<td>4.89%</td>
<td>4.75%</td>
</tr>
<tr>
<td>Housing price wage ratio $p/w$</td>
<td>3.33</td>
<td>3.27</td>
</tr>
<tr>
<td>Residential land revenue share</td>
<td>63.16%</td>
<td>63.30%</td>
</tr>
</tbody>
</table>
TFP and Land Share
## TFP and Land Share

### Table 1: The Effect of Reallocating Land Share

<table>
<thead>
<tr>
<th></th>
<th>benchmark $x$</th>
<th>reallocation $x^*$</th>
<th>gain from reallocation ( \log(x^*/x) \times 100% )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output $Y$</td>
<td>2.57</td>
<td>2.61</td>
<td>0.65</td>
</tr>
<tr>
<td>Consumption $C$</td>
<td>4.32</td>
<td>4.36</td>
<td>0.50</td>
</tr>
<tr>
<td>Housing $H$</td>
<td>0.44</td>
<td>0.45</td>
<td>0.80</td>
</tr>
<tr>
<td>Unemployment rate $u$</td>
<td>4.75</td>
<td>4.79</td>
<td>0.18</td>
</tr>
<tr>
<td>Wage $w$</td>
<td>1.32</td>
<td>1.33</td>
<td>0.32</td>
</tr>
<tr>
<td>Housing price $p$</td>
<td>4.45</td>
<td>4.66</td>
<td>1.97</td>
</tr>
<tr>
<td>Welfare $U$</td>
<td>0.62</td>
<td>0.63</td>
<td>0.27</td>
</tr>
</tbody>
</table>
Uniform Land Share: Welfare

Welfare ($u$) vs. productive land share ($\lambda$)

Current $U=0.62$
Uniform Land Share: Output

![Graph showing the relationship between Output (Y) and productive land share (λ). The graph illustrates a curve where Output increases as the land share increases. At a current land share of 0.8, the output is approximately 2.57.](image-url)
Future Work

- Land supply: unitary to heterogeneity.
Future Work

- Land supply: unitary to heterogeneity.
Future Work

▶ Land supply: unitary to heterogeneity.

▶ The ratio of residential land should be restricted due to the steepness of the terrain.
Conclusion

▶ Empirics
  ▶ A 10% increase in the share of commercial land
    ▶ reduces the unemployment rate by 29.6%
    ▶ increases the wages by 11.06%
    ▶ increases the housing prices by 10.25%

Model
  ▶ land use policy
  ▶ search and matching

Findings
  ▶ Increasing the productive land share would reduce unemployment rates and raise wages and housing prices
  ▶ Reallocating the land use share with the rank of the city productivity accordingly would lead to Pareto improvement
  ▶ Uniform land use scheme can improve welfare by around 3.67%
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  ▶ Uniform land use scheme can improve welfare by around 3.67%
Appendix
## Summary Statistics

<table>
<thead>
<tr>
<th></th>
<th>Observations</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>((L_p/L)_{it})</td>
<td>4,465</td>
<td>0.456</td>
<td>0.107</td>
<td>0.084</td>
<td>0.755</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>4,427</td>
<td>0.052</td>
<td>0.033</td>
<td>0.001</td>
<td>0.323</td>
</tr>
<tr>
<td>log(wage)</td>
<td>4,703</td>
<td>10.271</td>
<td>0.646</td>
<td>8.641</td>
<td>11.917</td>
</tr>
<tr>
<td>log(price)</td>
<td>4,406</td>
<td>7.982</td>
<td>0.665</td>
<td>5.124</td>
<td>10.899</td>
</tr>
<tr>
<td>Population density</td>
<td>4,711</td>
<td>4.270</td>
<td>3.270</td>
<td>0.050</td>
<td>27.070</td>
</tr>
<tr>
<td>ln(GDP per capita)</td>
<td>4,710</td>
<td>15.961</td>
<td>1.112</td>
<td>12.643</td>
<td>19.605</td>
</tr>
<tr>
<td>ln(FDI)</td>
<td>4,528</td>
<td>9.495</td>
<td>2.137</td>
<td>0.000</td>
<td>14.941</td>
</tr>
<tr>
<td>Size of government</td>
<td>4,705</td>
<td>0.121</td>
<td>0.118</td>
<td>0.007</td>
<td>2.349</td>
</tr>
</tbody>
</table>
The Household

The representative worker-consumers maximize their utility

\[ U(c, h) = c^{1-\alpha} h^\alpha \]  \hspace{1cm} (1)

subject to the budget constraint

\[ c + p \times h = W \]
The Household

- The representative worker-consumers maximize their utility

\[ U(c, h) = c^{1-\alpha} h^\alpha \]  

subject to the budget constraint

\[ c + p \times h = W \]

- The demand for final goods

\[ c = (1 - \alpha)W \]

- The demand for housing

\[ h = \frac{\alpha W}{p} \]
Matching function

\[ M(u, v) = \phi u^{1-\gamma} v^\gamma \]  

\( \phi \) represents the efficiency of the matching process and \( \gamma \) denotes the matching elasticity.

\( \theta = v/u \) denotes the tightness of the labor market.
Labor Market

- Matching function

\[ M(u, v) = \phi u^{1-\gamma} v^\gamma \] (2)

- \( \phi \) represents the efficiency of the matching process and \( \gamma \) denotes the matching elasticity

- \( \theta = v/u \) denotes the tightness of the labor market

- In the steady state, unemployment inflows equals unemployment outflows

\[ s(1 - u) = \theta q(\theta)u \]

\[ \Rightarrow u = \frac{s}{s + \theta q(\theta)} \] (3)

- \( s \) denotes separation rate
The Firm

The representative firm in a city uses productive land and labor to produce consumption goods

\[ Y = AN^{1-\sigma}L_p^\sigma \]  \hspace{1cm} (4)

- \( A \) is the city-level productivity, \( N \) is the city-level employment, and \( L_p \) is the quantity of productive land
The Firm

The representative firm in a city uses productive land and labor to produce consumption goods

\[ Y = AN^{1-\sigma} L_p^\sigma \]  \hfill (4)

- \( A \) is the city-level productivity, \( N \) is the city-level employment, and \( L_p \) is the quantity of productive land.

Let \( y = Y/N \) and \( \ell_p = L_p/N \), the demand for productive land

\[ q_p = (1 - \tau)A\sigma\ell_p^{\sigma-1} \]  \hfill (5)

where \( \tau \) denotes a sales tax.
Job Creation

- Value of a firm posting a vacancy

\[ rJ^V = -\gamma_0 + q(\theta)(J^F - J^V) \]  \hspace{1cm} (6)
Job Creation

- Value of a firm posting a vacancy

\[ rJ^V = -\gamma_0 + q(\theta)(J^F - J^V) \] (6)

- Value of a filled job

\[ rJ^F = (1 - \tau)A\ell^\sigma_p - q_p\ell_p - w - sJ^F \] (7)
Job Creation

- Value of a firm posting a vacancy

\[ rJ^V = -\gamma_0 + q(\theta)(J^F - J^V) \]  

(6)

- Value of a filled job

\[ rJ^F = (1 - \tau)A\ell_p^\sigma - q_p\ell_p - w - sJ^F \]  

(7)

- The labor demand curve

\[ (1 - \tau)A\ell_p^\sigma - q_p\ell_p - w - \frac{(r + s)\gamma_0}{q(\theta)} = 0 \]  

(8)

- \( \gamma_0 \) denotes the cost of creating a vacancy
Wage Determination

- The expected income

\[ W = \theta q(\theta)w + [1 - \theta q(\theta)]b \]
Wage Determination

▶ The expected income

\[ W = \theta q(\theta)w + [1 - \theta q(\theta)]b \]

▶ Asymmetric Nash bargain

\[ ((1 - \tau)A\ell_p^\sigma - q_p\ell_p + \theta \gamma_0 - w)^{1-\beta} (w - b)^\beta \]
Wage Determination

▶ The expected income

\[ W = \theta q(\theta)w + [1 - \theta q(\theta)]b \]

▶ Asymmetric Nash bargain

\[ ((1 - \tau)A\ell_p^\sigma - q_p\ell_p + \theta \gamma_0 - w)^{1-\beta} (w - b)^\beta \]

▶ The wage equation

\[ w = (1 - \beta)b + \beta((1 - \tau)A\ell_p^\sigma - q_p\ell_p + \theta \gamma_0) \quad (9) \]

▶ \( \beta \) denotes the worker’s wage bargain power
Housing Market

- A residential housing developer produces houses

\[ H = Z L_r^n \] (10)
Housing Market

- A residential housing developer produces houses

\[ H = Z L_r^\eta \] (10)

- The demand for residential land

\[ q_r = Z \eta L_r^{\eta-1} p \] (11)
Housing Market

- A residential housing developer produces houses

\[ H = Z L_r^n \]  

(10)

- The demand for residential land

\[ q_r = Z \eta L_r^{n-1} \rho \]  

(11)

- Housing market clearing

\[ Z L_r^n = h \times L_0 \]

- \( L_0 \) denotes city population
The Regional Government

- A regional government collects revenue from land leases and taxes, and transfer $T$ to its citizens

$$T = q_p L_p + q_r L_r + \tau Y$$  \hspace{1cm} (12)
The Regional Government

- A regional government collects revenue from land leases and taxes, and transfer $T$ to its citizens

$$T = q_p L_p + q_r L_r + \tau Y$$  \hspace{1cm} (12)

- Let $L = L_p + L_r$ denote the overall land and normalize to unity
  - let $\lambda = L_p / L$ denote the share of land use for commercial purposes
  - the allocation of commercial land $L_p$ and residential land $L_r$ are governed by the parameter $\lambda$
Equilibrium

- A steady-state competitive equilibrium consists of a series of
  - prices: rent of productive land $q_p$, rent of residential land $q_r$, housing price $p$, and wage $w$
A steady-state competitive equilibrium consists of a series of:

- prices: rent of productive land $q_p$, rent of residential land $q_r$, housing price $p$, and wage $w$
- allocations: output $Y$, housing $H$, productive land $L_p$, residential land $L_r$, city population $L_0$, and workers $N$
Equilibrium

A steady-state competitive equilibrium consists of a series of
- prices: rent of productive land $q_p$, rent of residential land $q_r$, housing price $p$, and wage $w$
- allocations: output $Y$, housing $H$, productive land $L_p$, residential land $L_r$, city population $L_0$, and workers $N$
- such that
  - household, production firm, and housing developer are optimize
  - labor, land, housing, and goods markets are clear
Calibration Strategy

Matching Elasticity and Efficiency

\[ \ln e_{it} = \gamma \ln \theta_{it} + a_i + f(\text{trend}) + \varepsilon_{it} \]

where \( e_{it} = M_{it}/U_{it} \) is employment rate, \( \theta_{it} = V_{it}/U_{it} \) is the labor market tightness.
Calibration Strategy

- Matching Elasticity and Efficiency

\[ \ln e_{it} = \gamma \ln \theta_{it} + a_i + f(trend) + \varepsilon_{it} \]

where \( e_{it} = M_{it}/U_{it} \) is employment rate, \( \theta_{it} = V_{it}/U_{it} \) is the labor market tightness

- Labor Bargaining Power

\[ w_{it} = (1 - \beta)b + \beta p_{it} + \beta \gamma_0 \theta_{it} + c_i + c_t + \varepsilon_{it} \]
Calibration Strategy

- **Matching Elasticity and Efficiency**

  \[ \ln e_{it} = \gamma \ln \theta_{it} + a_i + f(trend) + \varepsilon_{it} \]

  where \( e_{it} = M_{it}/U_{it} \) is employment rate, \( \theta_{it} = V_{it}/U_{it} \) is the labor market tightness

- **Labor Bargaining Power**

  \[ w_{it} = (1 - \beta)b + \beta p_{it} + \beta \gamma_0 \theta_{it} + c_i + c_t + \varepsilon_{it} \]

- **Housing Elasticity and Productivity**

  \[ \ln H_{it} = \ln Z + \eta \ln(1 - \lambda_{it}) + h_i + h_t + \varepsilon_{it} \]
# Model Parameters Estimation

<table>
<thead>
<tr>
<th></th>
<th>Employment Rate</th>
<th>Real Wage</th>
<th>Housing Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td></td>
<td>OLS</td>
<td>2SLS</td>
<td>OLS</td>
</tr>
<tr>
<td>Tightness</td>
<td>0.8067***</td>
<td>0.5258***</td>
<td>0.8255**</td>
</tr>
<tr>
<td></td>
<td>(0.0691)</td>
<td>(0.1831)</td>
<td>(0.3868)</td>
</tr>
<tr>
<td>Unemployment Benefits</td>
<td>0.1509***</td>
<td>0.6402***</td>
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