Migration, Housing Constraints, and Inequality: A Quantitative Analysis of China

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Junior Migration Seminar

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Rapid growing emerging economy has significant spatial characteristics:

- Workers migrating from less developed cities to more developed cities;
- Rapid growth of housing costs, especially in more developed cities;
- Enlarged income inequality within and across regions.

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How does Migration + Housing Constraints $\Rightarrow$ Inequality?
This Paper: Mig + HC + Housing Ownership Inequality$\Rightarrow$ Income Inequality

1.China's 40 year rapid economic growth fits the scenario:

- 0.28 billion worker migrating to more developed cities in 2015;
  Hao, Sun, Tombe, and Zhu (2020)
- 300% ~ 700% growth in housing costs in more developed cities 2003-2013;
  Fang, Gu, Xiong, and Zhou (2016)
- Inequality levels grow fast among urban households
  Piketty, Yang, and Zucman (2019)

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- Inequality levels grow fast among urban households *Piketty, Yang, and Zucman (2019)*

2.China's restrictive land supply policy may strength the pattern.

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- Distribute more new land supply quota to less developed cities;
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2.Use an arable land minimum requirement to secure food security:

- Each city has a quota (Red-line) to keep "enough" farmland;
- As a result, more developed cities keep a massive amount of farmland. click

What we do in this paper

1. Document these significant spatial characteristics using comprehensive data;
2. Build a spatial GE model to match the data facts and quantify the causes;
3. Conduct counterfactuals to reduce inequality.

Core Literature

- **Migration and Productivity Gain**:
  Ahlfeldt et al.'15, Tombe and Zhu'19, Bryan and Morten'19
- **Migration and Housing Constraint**:
  Hsieh and Moretti'18, Garriga et al.'19
- **(Spatial) Income Inequality**:
  Piketty et al.'19, Baum-Snow and Pavan'11,'13, Hao et al.'19

  and many others which we did not put here for space limits.

Outline

I. Data and Stylized Facts
II. A Spatial GE Model of Migration and Housing
III. Estimation of Model Parameters
IV. Quantitative Results of Model
V. Counterfactual with Land Supply Reform
VI. Conclusion

I. Data & Stylized Facts

Population Census of China in 2005 & 2010:

- Household & Individual Survey (we have 0.2% in 2005, and 0.35% in 2010);
- Hukou, Location, Employment, Education, Wage(2005), Rent, Housing, ...

Statistic Yearbook of each city & Urban Statistic Yearbook in 2005 & 2010:

- Annual wage income by 19 sectors in 246-287 cities;
- Total construction land supply in each city above.

Urban Household Survey from 1993 to 2009:

- Long panel data of skill premium across provinces.

Stylized Facts: An Overview

1. Migrant workers are highly & increasingly concentrated in certain cities;
2. Housing costs increase drastically with migrant net inflow and across time;
3. Wage inequality within cities are not correlated with net inflow;
4. Income inequality within cities are positively correlated with net inflow;
5. Higher net inflow cities contribute more to the national income inequality.

Fact 1: Migrant workers are highly & increasingly concentrated in certain cities

1.Definition of migration workers & high-skill workers

- Migrant worker: current working location differs from Hukou location;
- High-skill worker: college graduate or higher;
- Calculation: $\textit{Net Inflow}_j = \text{Current Workers}_j - \text{Hukou Workers}_j$.

2.A summary table of migration

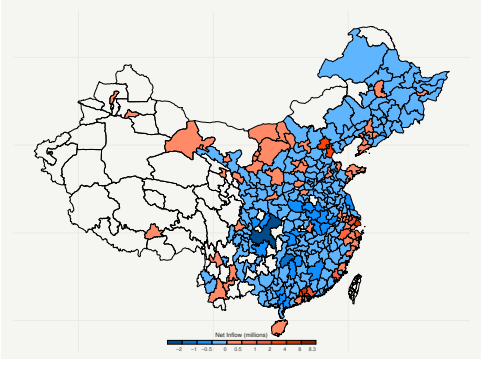
Table: **Migration Worker Net Inflow Statistics**

Range (m)		(-4,-2)	(-2,-1)	(-1,-0.5)	(-0.5,0)	(0, 0.5)	(0.5,1)	(1,2)	(2,4)	(4,8)	(8+)
NO. of City	Total										
2005	287	1	1	23	188	59	4	4	4	2	1
2010	266	6	29	41	115	39	9	13	7	3	4
		dark blue <—— ——> dark red									

*This Table is exactly the standard of coloring in the map in next slide.

Fact 1: Migrant workers are highly & increasingly concentrated in certain cities

Figure: Net Inflow of migrants by city in China



(a) Net Inflow of Workers in 2005

Fact 1: Migrant workers are highly & increasingly concentrated in certain cities

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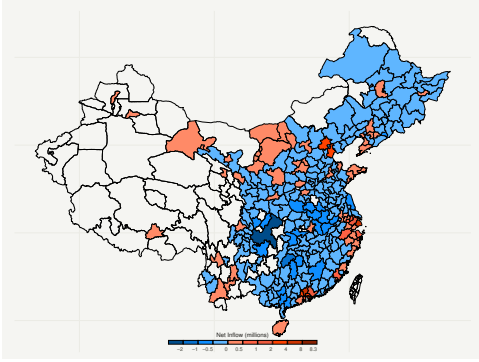

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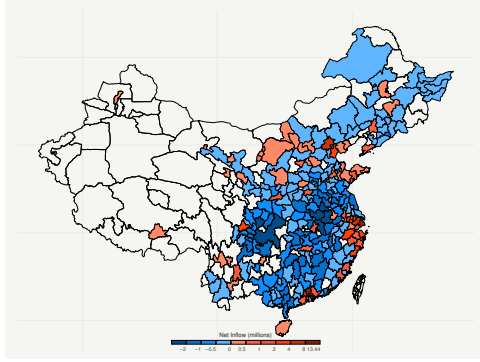
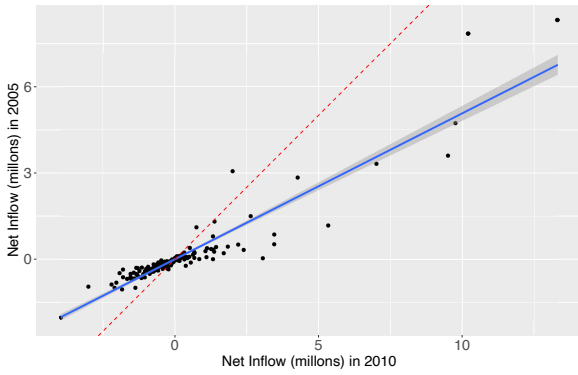


(b) Net Inflow of Workers in 2010

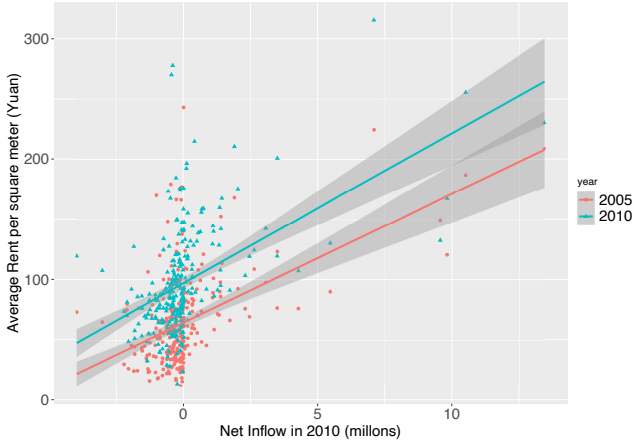
Fact 1: Migrant workers are highly & increasingly concentrated in certain cities

Figure: Correlation of Net Inflow in 2005 & 2010



Fact 2: Housing costs increase drastically with net inflow of migrants and across time

Figure: Net Inflow and Rent Cost



1.Definition: Theil Index (individual i, city j)

- By Income: $x_{ij} = \text{wage}_{ij} + \text{Imputed rent income}_{ij}$; By Wage: $x_{ij} = \text{wage}_{ij}$
- Imputed rent income = self-consumed space + actual rent income click
- Imputed rent income is potentially a lower bound for asset income

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2.Calculation

- City-level: $T_j = \frac{1}{N_j} \sum_{i=1}^{I} j \frac{x_{ij}}{\bar{x}_j} ln \frac{x_{ij}}{\bar{x}_j}$
- National: $T = \sum_{j=1}^{J} s_j (T_j + ln \frac{\bar{x}_j}{\bar{x}})$, for $s_j = \frac{N_j}{N} \frac{\bar{x}_j}{\bar{x}}$
- City's Contribution Share to national Theil Index: $s_j (T_j + ln \frac{\bar{x}_j}{\bar{x}})/T$
- i.e., Beijing's Income Theil Contribution Share: 21% in 2005 & 37% in 2010.

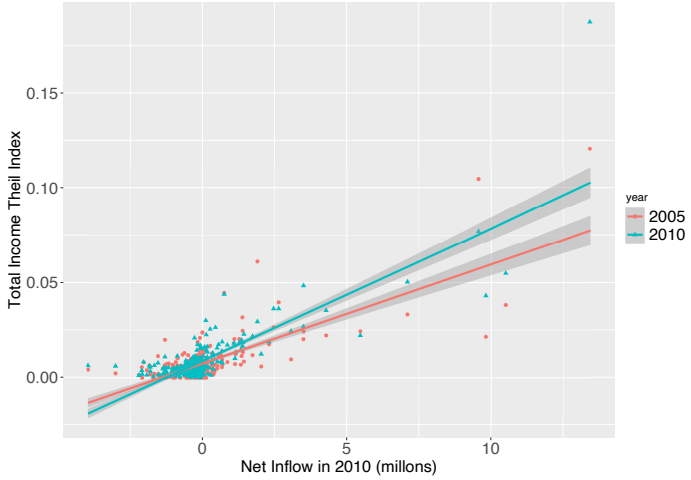
Limitations: "Inequality" documented here is only between major groups click

Fact 3: Wage inequality within cities are not correlated with net inflow

Figure: Net Inflow and Within-city Wage Inequality

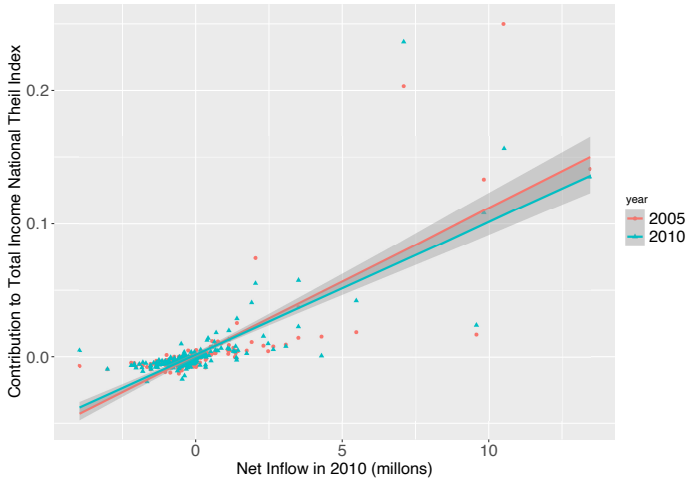
Fact 4: Income inequality within cities are positively correlated with net inflow

Figure: Net Inflow and Within-city Income Inequality



Fact 5: Cities with higher net inflows contribute more to the national income inequality

Figure: Net Inflow and Contribution to National Income Inequality



Migrant workers are highly & increasingly concentrated in certain cities (F1)

Correlation with migration net inflows:

- Strong Positive: Housing costs (F2)
- Uncorrelated: Wage inequality within cities (F3)
- Strong Positive: Income inequality within cities (F4)
  Cities' contribution to national income inequality (F5)

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Q1: How do the migration and housing costs explain the inequality patterns?
Q2: Any potential policy to lower inequality & motive migration?

II. A Spatial GE Model of Migration and Housing

Eaton-Kortum(2002) Framework for migration with H/L-skill workers

- Location choices s.t. preferences, income, migration costs;
- Local production combining H/L-skill workers.

Ahlfeldt et al.(2015) Framework for floor space market

- Floor space construction using fixed land supply;
- Endogenous floor space price due to both residential demand;
- Local residents gain all the returns from floor space market.

- Worker's Utility:

$$U_{ijo} = \frac{z_{ijo}}{\tau_{ij}^{s}} \left(\frac{c_{ijo}}{\beta} \right)^{\beta} \left(\frac{s_{ijo}}{1-\beta} \right)^{1-\beta} \tag{1}$$

- Shock (z_{ijo}) follows Frechet Distribution: $F(z_{ijo}) = e^{-z_{ijo}^{-\epsilon}}$
- FOCs: $c_{ijo} = \beta v_{ij}^{s}$, $s_{ijo} = (1-\beta)\frac{v_{ij}^{s}}{Q_j}$
- Indirect Utility:

$$U = \frac{z_{ijo} v_{ij}^{s} Q_j^{\beta-1}}{\tau_{ij}^{s}} \tag{2}$$

- Origin-Destination-Skill Pair:

$$G_{ij}^{s}(u) = Pr[U \leqslant u] = F\Big(\frac{u\tau_{ij}^{s}Q_{j}^{1-\beta}}{v_{ij}^{s}}\Big) \tag{3}$$

$$G_{ij}^{s}(u) = e^{-\Phi_{ij}^{s}u^{-\epsilon}},\ \Phi_{ij}^{s} = (\tau_{ij}^{s}Q_{j}^{1-\beta})^{-\epsilon}(v_{ij}^{s})^{\epsilon} \tag{4}$$

- Origin-Skill Pair:

$$1 - G_{i}^{s}(u) = 1 - \prod_{k=1}^{K} e^{-\Phi_{ik}^{s}u^{-\epsilon}} \tag{5}$$

$$G_{i}^{s}(u) = e^{-\Phi_{i}^{s}u^{-\epsilon}},\ \Phi_{i}^{s} = \sum_{k=1}^{K}\Phi_{ik}^{s} \tag{6}$$

- Gravity Equation of Migration Flow:

$$\pi_{ij}^{s} = \frac{(\tau_{ij}^{s} Q_j^{1-\beta})^{-\epsilon} (v_{ij}^{s})^{\epsilon}}{\sum_{k=1}^{K} (\tau_{ik}^{s} Q_k^{1-\beta})^{-\epsilon} (v_{ik}^{s})^{\epsilon}} = \frac{\Phi_{ij}^{s}}{\Phi_i^{s}} \tag{7}$$

- Income: (wage + rent)

$$v_{ij}^{s} = w_j^{s} + \frac{Q_j S_j}{H_{jj}} \cdot \mathbf{1}(i = j) \tag{8}$$

- City Production:

$$X_j = [(A_j^h H_j^h)^{\frac{\sigma-1}{\sigma}} + (A_j^l H_j^l)^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}}$$

- First Order Conditions:

$$w_j^l = A_j^{l\,\frac{\sigma-1}{\sigma}} X_j^{\frac{1}{\sigma}} H_j^{l\,-\frac{1}{\sigma}}$$

$$w_j^h = A_j^{h\,\frac{\sigma-1}{\sigma}} X_j^{\frac{1}{\sigma}} H_j^{h\,-\frac{1}{\sigma}}$$

- Skill Premium:

$$\omega_j = \frac{w_j^h}{w_j^l} = \left(\frac{A_j^h}{A_j^l}\right)^{\frac{\sigma-1}{\sigma}} \left(\frac{H_j^h}{H_j^l}\right)^{-\frac{1}{\sigma}}$$

Model III: Floor Space Market Clearing

- Floor Space Production:

$$S_j = \phi_j L_j$$

- Floor Space Market Clearing:

$$S_j = E[s_j]H_j = (1-\beta)\frac{E[v_j]H_j}{Q_j}$$

Model IV: Equilibrium

*A **Spatial General Equilibrium** for this economy is defined by a set of a list of exogenous economic conditions $\{\tau_{ij}^s, A_j^s, \phi_j, L_j, H_i^s\}$, a list of endogenous prices $\{Q_j, w_j^s\}$, quantities $\{v_{ij}^s, y_j, H_j^s, S_j\}$, and proportions $\{\pi_{ij}^s\}$ that solve firms' problem, workers' problem, floor space producers' problem, and market clearing such that:*

*(i).**[Worker Optimization]** Taking the exogenous economic conditions $\{\tau_{ij}^s\}$ and the aggregate prices $\{Q_j, w_j^s\}$ as given, workers' optimal choices of migration pins down the equilibrium labor supply in each city H_j^s and the migration flow between each city pairs π_{ij}^s.*

*(ii).**[Firm Optimization]** Taking the exogenous economic conditions $\{A_j^s\}$ and the aggregate prices $\{w_j^s\}$ as given, firms' optimal choices of production pins down the equilibrium labor demand H_j^s.*

*(iv).**[Market Clearing]** For all cities, labor supply equals labor demand and floor space supply equals floor space demand. This pins down the equilibrium aggregate prices $\{Q_j, w_j^s\}$, the equilibrium floor space S_j, and the equilibrium output y_j.*

III. Estimation of Model Parameters

Preference (β)

Definition

- $(1-\beta)$ = share of residential floor space in consumer expenditure

Data

- $(1-\beta)$ = 23% from *Chinese Urban Household Survey*

$$\beta = 0.77$$

Skill Premium

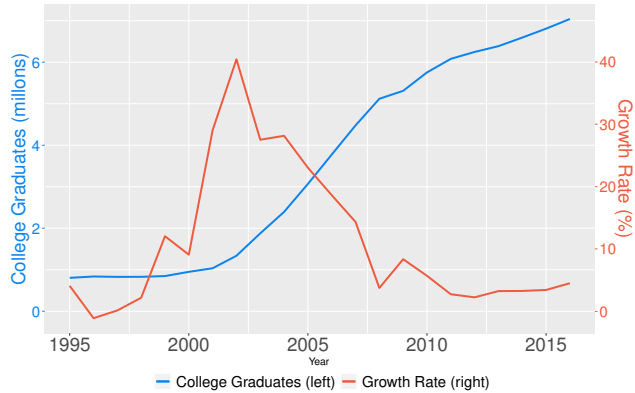
$$ln(\omega_j) = \frac{\sigma - 1}{\sigma} ln\left(\frac{A_j^h}{A_j^l}\right) - \frac{1}{\sigma} ln\left(\frac{H_j^h}{H_j^l}\right)$$

Regression

$$ln(\omega_{jt}) = \gamma_0' + \gamma_1 ln\left(\frac{H_{jt}^h}{H_{jt}^l}\right) + year_t + province_j + \epsilon_{jt} \quad (9)$$

Data: Urban Household Survey (UHS) 1993-2009
IV: College Admission Reform in 1999

Elasticity of Substitution between H/L-skills (σ)



Elasticity of Substitution between H/L-skills (σ)

- Instrument: $\mathbf{1}(2001 \leqslant t \leqslant 2004) \times \mathbf{1}(Province_j)$
- Variation for identification
  Differences in the effects of the college expansion *across* provinces
- Exclusion restriction: At province level

$$\text{Diff. in effects of college expansion} \implies \frac{H_j^h}{H_j^l} \implies \text{Skill premium}$$

$$\implies \epsilon_j \implies \text{Skill premium}$$

Elasticity of Substitution between H/L-skills (σ)

First Stage Regression (Dependent Variable: $ln\frac{H_j^h}{H_j^l}$)

Variables	OLS
expansion	0.645***
	(0.0904)
expansion × $\mathbf{1}(province = Beijing)$	-0.192**
	(0.0841)
expansion × $\mathbf{1}(province = Liaoning)$	-0.0947
	(0.0646)
expansion × $\mathbf{1}(province = Zhejiang)$	-0.198***
	(0.0548)
expansion × $\mathbf{1}(province = Guangdong)$	-0.0710
	(0.0545)
expansion × $\mathbf{1}(province = Sichuan)$	-0.131**
	(0.0657)
Province FE	YES
Year FE	YES
Observations	102
R-squared	0.898
Prob > F	0.0000

Elasticity of Substitution between H/L-skills (σ)

IV Regression of Estimating the Elasticity of Substitution

Variables	2SLS
Skilled/Unskilled Ratio	-0.333**
	(0.160)
City FE	YES
Year FE	YES
Observations	102
R-squared	0.726

$$\gamma_1 = -\frac{1}{\sigma} = -0.333 \Rightarrow \sigma = 3$$

We also solve model using $\sigma = 1.4$ from Katz & Murphy (1992) as robustness.

Migration Flows

$$\pi_{ij}^{s} = \frac{(\tau_{ij}^{s} Q_j^{1-\beta})^{-\epsilon} (v_{ij}^{s})^{\epsilon}}{\Phi_i^{s}}$$

Regression

$$ln(\pi_{ij}^{s}) = \epsilon ln(v_j^{s}) + \psi_{ij} + \gamma_{is} + \zeta_j + \varphi_{ijs}, \text{ for } i \neq j \tag{10}$$

where
$\psi_{ij} = -\epsilon\rho ln(d_{ij})$ is the origination-destination pair FE;
$\gamma_{is} = -\epsilon ln(\bar{\tau_i^{s}}) - ln(\Phi_i^{s})$ is the origination-skill FE;
$\zeta_j = -\epsilon(1-\beta) ln(Q_j)$ is the destination FE;
$\phi_{ijs} = -\epsilon \xi_{ij}^{s} + \nu_{ij}^{s}$ where ν_{ij}^{s} is the measurement error term.

Migration Elasticity (ϵ)

Table: Regression of Estimating the Migration Elasticity

Variables	(1)	(2)
$ln(v_j^s)\{Census\}$	1.847***	
	(0.0761)	
$ln(v_j^s)\{CSYB\}$		1.926***
		(0.138)
Origin-Destination FE	YES	YES
Origin-Skill FE	YES	YES
Observations	164,738	137,186
R-squared	0.568	0.577

$$\epsilon = 1.90$$

Summary of Estimation

Table: **Estimated Parameters**

Parameter	Description	Value
β	share of consumption in utility	0.77
σ	elasticity of substitution between H/L-skills	3.0
ϵ	migration elasticity	1.90

Quantitative Results of the Model

Solve for Unobserved Variables & Account for Inequality

I.Unobserved Variables across cities & change overtime

- Migration Costs (τ_{ij}^{s})
- Productivity (A_{j}^{s})

II.Inequality Measures across cities & change overtime

- Within-city Wage/Income Theil Index
- City's Contribution to national Wage/Income Theil Index
- Skill Premium & Housing Premium

I.Unobserved: How do we calculate $\{A_j^s\}$

Data: $\{H_j^s, w_j^s\}$**, Unobserved:** $\{A_j^s\}$

$$A_j^h = A_j^l \Big(\frac{H_j^h}{H_j^l}\Big)^{\frac{1}{\sigma-1}} \Big(\frac{w_j^h}{w_j^l}\Big)^{\frac{\sigma}{\sigma-1}} \tag{11}$$

Plug A_j^h into the production function of y_j and consider the zero profit, we have

$$X_j = A_j^l H_j^l \Big[\frac{w_j^h H_j^h + w_j^l H_j^l}{w_j^l H_j^l}\Big]^{\frac{\sigma}{\sigma-1}} = w_j^h H_j^h + w_j^l H_j^l \tag{12}$$

Define $\Xi_j^l = \frac{w_j^l H_j^l}{w_j^h H_j^h + w_j^l H_j^l}$ the share of labor income distributed to low-skill workers:

$$A_j^l = w_j^l (\Xi_j^l)^{\frac{1}{\sigma-1}} \tag{13}$$

$$A_j^h = w_j^h (1 - \Xi_j^l)^{\frac{1}{\sigma-1}} \tag{14}$$

I.Unobserved: How do we calculate $\{\phi_j\}$

Data: $\{H_j^s, w_j^s, Q_j\}$**, Unobserved:** $\{S_j, \phi_j\}$

$$\begin{aligned} S_j &= E[s_j]H_j = (1-\beta)\frac{E[v_j]H_j}{Q_j} \\ &= \frac{1-\beta}{Q_j}\left[w_j^l H_j^l + w_j^h H_j^h\right] + (1-\beta)S_j \\ &= \frac{1-\beta}{\beta}\frac{w_j^l H_j^l + w_j^h H_j^h}{Q_j} \end{aligned} \tag{15}$$

and then back out the construction intensity ϕ_j:

$$\phi_j = S_j / L_j \tag{16}$$

I.Unobserved: How do we calculate $\{\tau_{ij}^s\}$

Data: $\{H_j^s, w_j^s, Q_j, S_j, \pi_{ij}^s\}$**, Unobserved:** $\{v_{ij}^s, \tau_{ij}^s\}$

$$v_{ij}^s = w_j^s + \frac{Q_j S_j}{H_{jj}} \cdot \mathbb{1}(i = j) \tag{17}$$

We assume that the iceberg migration cost for staying is $\tau_{ii}^s = 1$:

$$\Phi_i^s = \sum_{k=1}^{K} (\tau_{ik}^s Q_k^{1-\beta})^{-\epsilon} (v_{ik}^s)^{\epsilon} = \frac{(Q_j^{1-\beta})^{-\epsilon} (v_{ii}^s)^{\epsilon}}{\pi_{ii}^s} \tag{18}$$

Then by inserting Φ_i^s into the original gravity equation, we have:

$$\tau_{ij}^s = \frac{v_{ij}^s}{Q_j^{1-\beta} (\pi_{ij}^s \Phi_i^s)^{1/\epsilon}} \text{ , for } i \neq j \tag{19}$$

Annually drop of migration costs is 8.8%;

Table: **Average Migration Costs and Active Linkage**

	Share of Emp.		Migration Costs				Active Linkage			
	2005	2010	2005	2010	Relative	Changes	2005	2010	Relative	Changes
Overall	11%	22%	9.2	5.8	63%	-3.4	12,640	26,335	208%	+13,695
Low-skill	11%	23%	9.3	5.8	62%	-3.5	9,173	18,477	201%	+9,304
High-skill	9%	17%	7.6	5.7	75%	-1.9	3,467	7,858	227%	+4,391

*This table displays migration-weighted harmonic means of migration costs in 2005 and 2010.

*Share of Employment among high-skill is high-skill migrants over high-skill population.

*τ_{ij}^{s} is proportional in the model, so we show % changes.

*The total amount of city pair linkage is 54,289 (233 cities) in the model.

1.Annually growth of productivity is 13% & 14%;
2.Productivity in larger cities is much higher, especially for high-skill;

Table: **Average Productivity Growth**

Net Inflow Range(2010)	No. of Cities	High-skill				Low-skill			
		2005	2010	Relative	Changes	2005	2010	Relative	Changes
Average	233	1.02	1.91	187%	+0.89	1.24	2.41	194%	+1.17
(6,13)	5	1.94	3.48	179%	+1.54	2.22	3.55	159%	+1.33
(1,6)	19	1.05	2.19	208%	+1.14	1.69	2.98	176%	+1.28
(0, 1)	45	0.87	1.84	211%	+0.97	1.38	2.53	183%	+1.15
(-1,0)	134	0.50	1.10	220%	+0.60	0.98	2.08	212%	+1.10
(-4,-1)	30	0.43	0.99	230%	+0.56	0.91	1.88	206%	+0.97

*This table displays population-weighted means in 2005 and 2010. Unit of Productivity is 1e4.
*The Net Inflow Range Groups are classified by net inflow in 2010 (unit: millions).
*Each Net Inflow Range Group consists of the same cities in 2005 and 2010.
*The total amount of cities is 233 in the model.

1.Wage Theil is similar across cities, but Income Theil is way different;
2.Wage Theil doesn't change much, but Income Theil grows fast in larger cities;

Table: **Within-city Theil Index**

Net Inflow Range(2010)	No. of City	Wage Theil Index			Income Theil Index		
		2005	2010	Relative	2005	2010	Relative
Average	233	0.0072	0.0070	97%	0.0126	0.0247	196%
(6,13)	5	0.0087	0.0097	111%	0.0575	0.1215	211%
(1,6)	19	0.0065	0.0079	122%	0.0154	0.0363	235%
(0, 1)	45	0.0075	0.0083	111%	0.0083	0.0144	173%
(-1,0)	134	0.0071	0.0058	82%	0.0049	0.0051	104%
(-4,-1)	30	0.0072	0.0058	80%	0.0047	0.0045	96%

Table: **Share of Contribution to National Theil Index**

Net Inflow Range(2010)	No. of City	Share of Wage Theil			Share of Income Theil		
		2005	2010	Relative	2005	2010	Relative
National	233	0.0972	0.0622	64%	0.1080	0.0873	81%
(6,13)	5	+1.49	+1.41	97%	+1.43	+1.21	84%
(1,6)	19	+0.58	+0.83	143%	+0.53	+0.66	125%
(0, 1)	45	+0.22	+0.26	118%	+0.20	+0.20	100%
(-1,0)	134	-0.92	-1.00	108%	-0.83	-0.71	86%
(-4,-1)	30	-0.37	-0.49	132%	-0.34	-0.35	103%

Table: **Skill Premium & Housing Premium**

Net Inflow Range(2010)	No. of Cities	Skill Premium			Housing Premium		
		2005	2010	Relative	2005	2010	Relative
Average	233	1.47	1.40	95%	0.39	0.56	143%
(6,13)	5	1.35	1.39	103%	0.94	2.03	216%
(1,6)	19	1.40	1.40	100%	0.41	0.62	151%
(0, 1)	45	1.42	1.39	97%	0.33	0.39	118%
(-1,0)	134	1.50	1.40	93%	0.31	0.31	100%
(-4,-1)	30	1.57	1.45	92%	0.30	0.30	100%

I.What Unobserved Variables are driving the observed stylized facts?

- National reduction of Migration Costs (τ_{ij}^{s});
- Uneven (growth) of Productivity (A_{j}^{s}) in larger cities;

II.Inequality Measures across cities & change overtime

- Wage Inequality doesn't change much, but Income Inequality spikes;
- Larger City's Contribution to national Wage/Income Theil Index is higher;
- Skill Premium remains the same, but Housing Premium spikes.

V. Counterfactual with Land Supply Reform

Redistributing the total land supply increment from 2005 to 2010 by net inflow:

- Denote ΔL the total land supply increment from 2005 to 2010;
- Denote $\Delta^+ H_j$ the changes of net inflow of each city with positive changes;
- Denote $\Delta^+ H$ the total changes of net inflow;
- Then city $j's$ counterfactual land supply increment is $\Delta^+ L_j = \Delta L \times \frac{\Delta^+ H_j}{\Delta^+ H}$;
- Because it is very costly to cut back current land supply, so for cities with negative changes of inflow, we distribute $\Delta^0 L_j = 0$ for them.

Table: **Counterfactual Construction Land Supply**

Net Inflow	No. of	Land Supply (Data)				Counterfactual		
Range(2010)	Cities	2005	2010	Relative	Changes	$\widehat{2010}$	$\widehat{Relative}$	$\widehat{Changes}$
National	233	24,277	31,705	131%	+7,428	31,705	131%	+7,428
(6,13)	5	5,135	5,648	110%	+513	7,762	151%	+2,627
(1,6)	19	3,801	5,912	155%	+2,111	7,131	188%	+3,330
(0, 1)	45	5,555	7,250	131%	+1,695	6,829	123%	+1,274
(-1,0)	134	7,950	10,363	130%	+2,413	7,988	100.5%	+38
(-4,-1)	30	1,836	2,532	138%	+696	1,836	100%	+0

Notes: This table displays the total land supply data by group in 2005 and 2010, as well as the counterfactual land supply in 2010 (unit: km^2). The Range is classified by net inflow in 2010 as in the data (unit: millions). Each Net Inflow Range Group consists of the same cities in 2005 and 2010.

Counterfactual Results: Migration Flow & Housing Cost

Table: **Migration Flow and Housing Cost**

Net Inflow Range(2010)	No. of Cities	Net Inflow			Housing Cost		
		2010	$\widehat{2010}$	Relative	2010	$\widehat{2010}$	Relative
Overall	233	96m	105m	109%	114	121	106%
(6,13)	5	+45m	+53m	118%	226	154	68%
(1,6)	19	+38m	+41m	108%	136	112	82%
(0, 1)	45	+13m	+11m	85%	118	129	109%
(-1,0)	134	-48m	-53m	110%	87	117	134%
(-4,-1)	30	-48m	-52m	108%	80	105	131%

Counterfactual Results: Within-city Theil Index

Table: **Within-city Theil Index**

Net Inflow Range(2010)	No. of Cities	Wage Theil Index			Income Theil Index		
		2010	$\widehat{2010}$	Relative	2010	$\widehat{2010}$	Relative
Average	233	0.0070	0.0070	100%	0.0247	0.0214	86%
(6,13)	5	0.0096	0.0089	93%	0.1215	0.0709	58%
(1,6)	19	0.0079	0.0080	101%	0.0363	0.0279	77%
(0, 1)	45	0.0083	0.0083	100%	0.0144	0.0151	105%
(-1,0)	134	0.0058	0.0058	100%	0.0051	0.0081	158%
(-4,-1)	30	0.0058	0.0058	100%	0.0045	0.0155	344%

Counterfactual Results: Share of national Theil Index

Table: **Share of National Theil Index**

Net Inflow Range(2010)	No. of Cities	Share of Wage Theil			Share of Income Theil		
		2010	$\widehat{2010}$	Relative	2010	$\widehat{2010}$	Relative
National	233	0.0622	0.0615	99%	0.0873	0.0717	82%
(6,13)	5	+1.41	+1.45	103%	+1.21	+1.05	87%
(1,6)	19	+0.83	+0.84	101%	+0.66	+0.57	86%
(0, 1)	45	+0.26	+0.23	88%	+0.20	+0.23	115%
(-1,0)	134	-1.00	-1.02	102%	-0.71	-0.53	75%
(-4,-1)	30	-0.49	-0.48	98%	-0.35	-0.32	91%

Counterfactual Results: Skill Premium & Housing Premium

Table: **Skill Premium & Housing Premium**

Net Inflow Range(2010)	No. of Cities	Skill Premium			Housing Premium		
		2010	$\widehat{2010}$	Relative	2010	$\widehat{2010}$	Relative
Average	233	1.40	1.40	100%	0.56	0.53	95%
(6,13)	5	1.39	1.39	100%	2.03	1.20	59%
(1,6)	19	1.40	1.40	100%	0.62	0.47	76%
(0, 1)	45	1.39	1.38	99%	0.39	0.41	105%
(-1,0)	134	1.40	1.39	99%	0.31	0.44	142%
(-4,-1)	30	1.45	1.44	99%	0.30	0.42	140%

A Land Supply Redistribution according to worker inflow would:

- Motivate more workers moving to higher productive cities;
- Lower the Housing Premium in the larger cities;
- Lower the Within-city Income Inequality in larger cities;
- Lower the share of national Income Inequality of the larger cities;

Other Counterfactual:

- A Property Tax and Redistribution Policy; click
- Reforming the construction intensity restriction;
- Directly increasing the land supply based on migration inflow;

Conclusion

Migration and Housing Constraints in China:

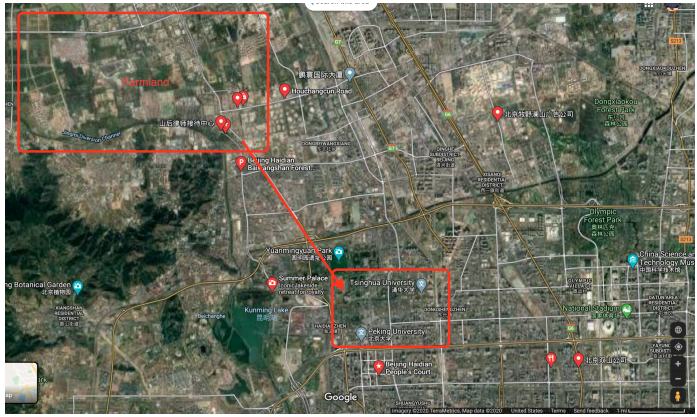
- Generate high housing costs in larger cities;
- Generate high income inequality in larger cities (whole nation);
- Generate high income inequality across cities;

A migration-based land supply redistribution lowers income inequality.

- Allowing "trade" of land quota between cities is meaningful!

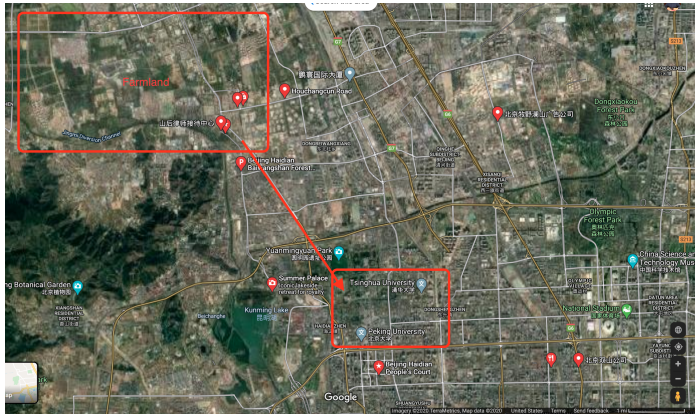
Appendix

Appendix: Beijing Farmland Example back



Haidian Distinct as the China's Education and Innovation Center (3.5m pop.)

Appendix: Beijing Farmland Example back



Haidian Distinct as the China's Education and Innovation Center (3.5m pop.) is required to keep 148 km^2 farmland (out of administrative land of 426 km^2).

Appendix: Institutional Background of China's Housing Market click

1.Hukou households favor house ownership (CHFS-2017):

- High Ownership: 92% HHs own houses/apts & 40% HHs own additional;
- Low Cost: No property Tax, No Insurance, Low property fee;

2.Migration households rent from Hukou households (CHFS-2017):

- High Ownership: <15% Mig-HHs own houses/apts at current working cities;
- Rental Market: Almost no professional rental market, so rent from locals;
- Hard to Buy: Policy Restriction & Financial Frictions;

Appendix: CHIP distribution of inequality

back

Table: Quantile Statistics

Variable	10%	25%	50%	75%	90%
Non-housing Asset Distribution (RMB)					
Locals	12000	30000	69700	154800	304500
Rural Migrants	7000	18925	40750	98400	185500
Urban Migrants	15000	32500	70000	140000	372000
Net Asset Income Distribution (RMB)					
Locals	-13000	0	10000	39600	66444
Rural Migrants	-10000	0	0	1000	20000
Urban Migrants	-12634	0	0	24000	60000
Expenditure Distribution (RMB)					
Locals	17000	25000	38000	56000	80000
Rural Migrants	12000	20000	30000	48548	77250
Urban Migrants	15200	28000	40500	74000	95000
Savings Rate Distribution					
Locals	3.2%	19.5%	37.4%	53.2%	65.3%
Rural Migrants	11.1%	25.0%	43.2%	60.1%	72.7%
Urban Migrants	6.3%	23.6%	41.4%	53.8%	66.7%

Appendix: Property Tax and Redistribution Policy Counterfactual click

- More than 75% of Chinese household wealth is accumulated in housing;
- We conduct a counterfactual to tax property owners' housing income by 20% and redistribute to all residences in the same city;
- Not very effective reducing Income Inequality.

Appendix: Property Tax and Redistribution Policy Counterfactual click

Table: **Migration Flow & Housing Cost**

Net Inflow Range(2010)	No. of City	Net Inlow			Housing Cost		
		2010	$\widehat{2010}$	Relative	2010	$\widehat{2010}$	Relative
Overall	233	96m	101m	105%	111	113	102%
(6,13)	5	+45m	+48m	107%	223	231	104%
(1,6)	19	+38m	+40m	105%	131	135	103%
(0, 1)	45	+13m	+13m	100%	118	119	101%
(-1,0)	134	-48m	-51m	106%	85	84	99%
(-4,-1)	30	-48m	-50m	104%	69	67	97%

Appendix: Property Tax and Redistribution Policy Counterfactual click

Table: **Within-city Theil Index**

Net Inflow Range(2010)	No. of City	Wage Theil Index			Income Theil Index		
		2010	$\widehat{2010}$	Relative	2010	$\widehat{2010}$	Relative
Average	233	0.0070	0.0071	101%	0.0246	0.0310	126%
(6,13)	5	0.0096	0.0100	104%	0.1215	0.1378	113%
(1,6)	19	0.0079	0.0080	101%	0.0363	0.0423	117%
(0, 1)	45	0.0083	0.0084	101%	0.0144	0.0176	122%
(-1,0)	134	0.0058	0.0058	100%	0.0051	0.0087	170%
(-4,-1)	30	0.0058	0.0058	100%	0.0045	0.0104	231%

Appendix: Property Tax and Redistribution Policy Counterfactual click

Table: **Share of national Theil Index**

Net Inflow Range(2010)	No. of City	Share of Wage Theil			Share of Income Theil		
		2010	$\widehat{2010}$	Relative	2010	$\widehat{2010}$	Relative
National	233	0.0622	0.0623	100%	0.0873	0.0944	108%
(6,13)	5	+1.41	+1.42	101%	+1.21	+1.17	97%
(1,6)	19	+0.83	+0.82	99%	+0.66	+0.62	94%
(0, 1)	45	+0.26	+0.24	92%	+0.20	+0.18	90%
(-1,0)	134	-1.00	-1.01	101%	-0.71	-0.66	93%
(-4,-1)	30	-0.49	-0.48	98%	-0.35	-0.32	91%

Appendix: Property Tax and Redistribution Policy Counterfactual click

Table: **Skill Premium & Housing Premium**

Net Inflow Range(2010)	No. of City	Skill Premium 2010	Skill Premium $\widehat{2010}$	Skill Premium Relative	Housing Premium 2010	Housing Premium $\widehat{2010}$	Housing Premium Relative
Net Inflow Range(2010)	No. of City	Skill Premium 2005	Skill Premium 2010	Skill Premium Relative	Housing Premium 2005	Housing Premium 2010	Housing Premium Relative
Average	233	1.40	1.40	100%	0.56	0.60	107%
(6,13)	5	1.39	1.40	101%	2.03	2.16	106%
(1,6)	19	1.40	1.41	101%	0.62	0.64	103%
(0, 1)	45	1.39	1.39	100%	0.39	0.39	100%
(-1,0)	134	1.40	1.39	99%	0.31	0.32	103%
(-4,-1)	30	1.45	1.44	101%	0.30	0.31	103%