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

Min Fang
University of Lausanne
& University of Geneva

Zibin Huang
Shanghai University of
Finance and Economics

December 13, 2021
@ Hong Kong Baptist University

Motivation

China's 40 years of growth is accompanied by rapidly rising inequality: [Inequality]

Motivation

China's 40 years of growth is accompanied by rapidly rising inequality: [Inequality]

(As documented by Piketty-Yang-Zucman-2019, Chinese income and asset inequality rose from a level similar to that of the Scandinavian countries to approaching that of the United States.)

Motivation

China's 40 years of growth is accompanied by rapidly rising inequality: [Inequality]

(As documented by Piketty-Yang-Zucman-2019, Chinese income and asset inequality rose from a level similar to that of the Scandinavian countries to approaching that of the United States.)

And it is very likely that much of this rise is driven by the uneven ownership of the dramatically appreciating housing assets in more developed cities: [Housing]

Motivation

China's 40 years of growth is accompanied by rapidly rising inequality: [Inequality]

(As documented by Piketty-Yang-Zucman-2019, Chinese income and asset inequality rose from a level similar to that of the Scandinavian countries to approaching that of the United States.)

And it is very likely that much of this rise is driven by the uneven ownership of the dramatically appreciating housing assets in more developed cities: [Housing]

(As documented by Fang-Gu-Xiong-Zhou-2016, this great housing boom is disproportionately concentrated in more developed cities. And we find that mainly the local Hukou residents benefit from the returns in these housing markets.)

Motivation

China's 40 years of growth is accompanied by rapidly rising inequality: [Inequality]

(As documented by Piketty-Yang-Zucman-2019, Chinese income and asset inequality rose from a level similar to that of the Scandinavian countries to approaching that of the United States.)

And it is very likely that much of this rise is driven by the uneven ownership of the dramatically appreciating housing assets in more developed cities: [Housing]

(As documented by Fang-Gu-Xiong-Zhou-2016, this great housing boom is disproportionately concentrated in more developed cities. And we find that mainly the local Hukou residents benefit from the returns in these housing markets.)

Meanwhile, this housing boom in developed cities has been accompanied by massive inflows of migrant workers as well as tightening housing constraints: [Migration]

Motivation

China's 40 years of growth is accompanied by rapidly rising inequality: [Inequality]

(As documented by Piketty-Yang-Zucman-2019, Chinese income and asset inequality rose from a level similar to that of the Scandinavian countries to approaching that of the United States.)

And it is very likely that much of this rise is driven by the uneven ownership of the dramatically appreciating housing assets in more developed cities: [Housing]

(As documented by Fang-Gu-Xiong-Zhou-2016, this great housing boom is disproportionately concentrated in more developed cities. And we find that mainly the local Hukou residents benefit from the returns in these housing markets.)

Meanwhile, this housing boom in developed cities has been accompanied by massive inflows of migrant workers as well as tightening housing constraints: [Migration]

(As calculated from Urban Statistics Yearbooks of China 2010, massive ($\approx$ 150 million) workers migrated from less developed cities to these more developed cities while construction land supply increased disproportionately slow in these more developed cities.)

Research Questions

Q1. Could the massive migration inflow and the tightening housing constraints in more developed cities explain the rapidly rising income inequality in China?

Research Questions

Q1. Could the massive migration inflow and the tightening housing constraints in more developed cities explain the rapidly rising income inequality in China?

Q2. If the answer to Q1 is true, then, are there any policies we could implement to alleviate this rapidly rising income inequality in China?

Our Story
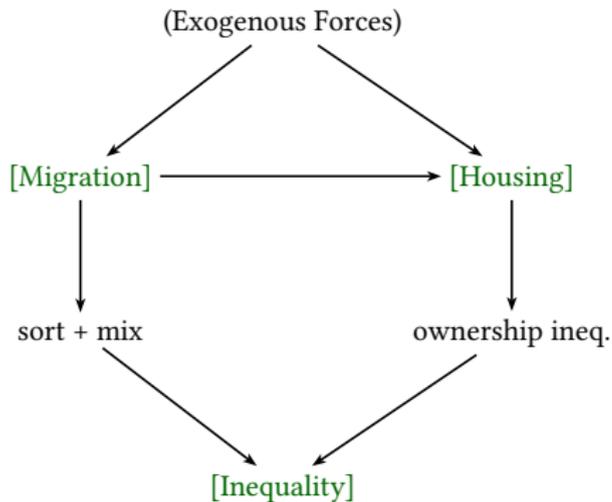
(Exogenous Forces)

[Migration] ⟶ [Housing]

sort + mix

ownership ineq.

[Inequality]

Exogenous Forces:
1. Migration Cost ↓ (universally)
2. Productivity ↑ (unevenly)
3. Land Supply (unevenly)

Our Story

(Exogenous Forces)

[Migration] ⟶ [Housing]

sort + mix   ownership ineq.

[Inequality]

Exogenous Forces:
1. Migration Cost ↓ (universally)
2. Productivity ↑ (unevenly)
3. Land Supply (unevenly)
Endogenous Responses:
Migration: low-prod → high-prod
Housing costs: high-prod city ↑

Our Story

(Exogenous Forces)

[Migration] → [Housing]

sort + mix

ownership ineq.

[Inequality]
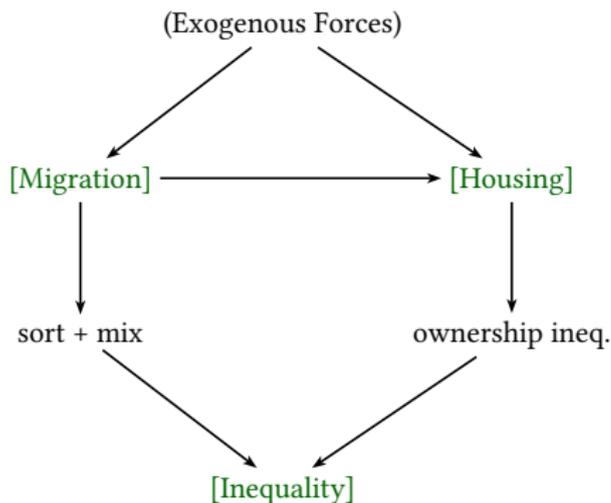
Exogenous Forces:
1. Migration Cost ↓ (universally)
2. Productivity ↑ (unevenly)
3. Land Supply (unevenly)
Endogenous Responses:
Migration: low-prod → high-prod
Housing costs: high-prod city ↑
House wealth income in high-prod city ↑
Sorting & mixing in high-prod city ↑

Our Story

Exogenous Forces:
1. Migration Cost $\downarrow$ (universally)
2. Productivity $\uparrow$ (unevenly)
3. Land Supply (unevenly)

Endogenous Responses:
Migration: low-prod $\rightarrow$ high-prod
Housing costs: high-prod city $\uparrow$
House wealth income in high-prod city $\uparrow$
Sorting & mixing in high-prod city $\uparrow$
Inequality within high-prod city $\uparrow$

Backgrounds and Literature

Backgrounds of Situation in China

▶ China's 40 year rapid economic growth fits the scenario;

▶ China has a very restrictive land supply policy in larger cities;

Core Literature (and many others which we did not put here for time & space limits)

▶ **Migration and Productivity Gain**: Ahlfeldt et al.'15, Tombe-Zhu'19, Bryan-Morten'19

▶ **Migration and Housing Constraint**: Hsieh-Moretti'18, Garriga et al.'19

▶ **Income Inequality**: Piketty et al.'19, Baum-Snow-Pavan'11,'13, Fan'19, Hao et al.'19

This is the first paper to study Mig. × H.C. for Income Inequality (spatially).

What we do in this paper

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

Q1. Could the massive migration inflow and the tightening housing constraints in more developed cities explain the rapidly rising income inequality in China?

Yes, migration inflows and tightening local housing constraints increases housing values which actually enlarges the inequality between housing owners and migrants.

Preview to Our Answers

Q1. Could the massive migration inflow and the tightening housing constraints in more developed cities explain the rapidly rising income inequality in China?

Yes, migration inflows and tightening local housing constraints increases housing values which actually enlarges the inequality between housing owners and migrants.

Q2. If the answer to Q1 is true, then, are there any policies we could implement to alleviate this rapidly rising income inequality in China?

Both a reform in land supply policy (losing housing constraints) and a property tax policy (only redistribution) could help to reduce inequality.

Outline

Data & Stylized Facts

Data

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.

Stylized Facts: An Overview

1. Migrant workers are highly & increasingly concentrated in certain cities;

2. Housing costs increase drastically with net stock of migrant workers and across time;

3. Income inequality within cities are positively correlated with net stock of migrant workers;

   ▶ Wage inequality within cities are not correlated with net stock of migrant workers;

   ▶ Cities with higher net stock of migrant workers contribute more to the national income inequality.

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

Figure: Net Stock of Migrant Workers by City in China
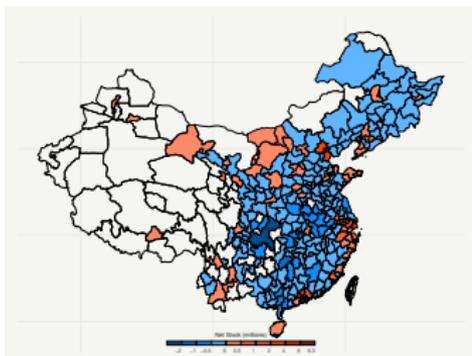
(a) Net Stock of Migrant Workers in 2005

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

Figure: Net Stock of Migrant Workers by City in China
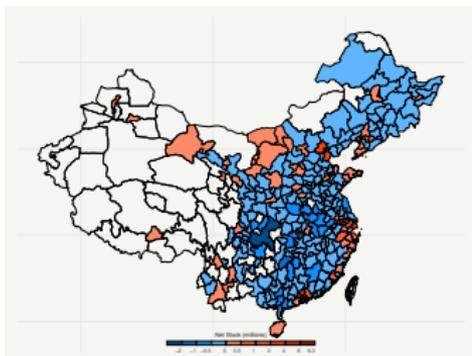
(a) Net Stock of Migrant Workers in 2005
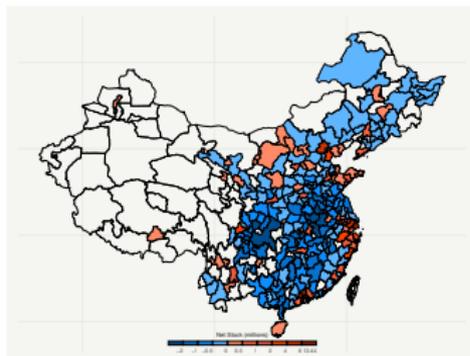
(b) Net Stock of Migrant Workers in 2010

▸ Maps in Net Stock (Percentage)   ▸ Tables for Map   ▸ Correlation Overtime

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

Figure: Net Stock of Migrants and Housing Cost
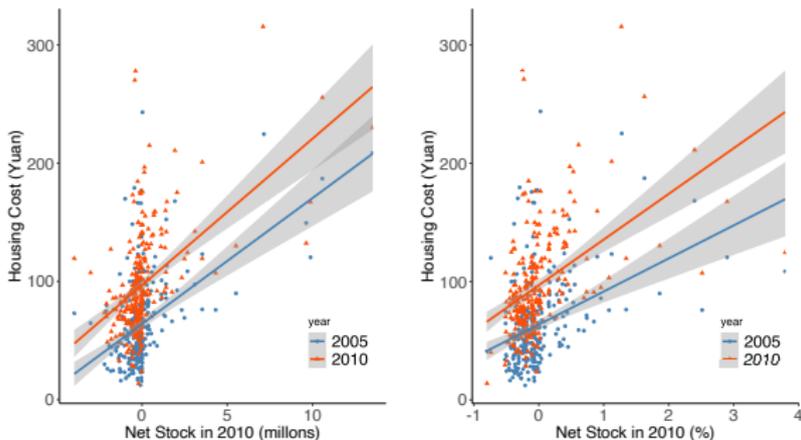
Quality-adjusted Housing Rents and Migration   Additional Results from CHIP

Income Measure: (between major groups: hukou city i, working city j, skill level s)

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

Inequality Measure: Theil Index

- Calculate Theil Index for each city
- Calculate National Theil Index and each city's share of contribution

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

Fact 3: Income inequality within cities are positively correlated with net stock

Figure: Net Stock of Migrants and Income Inequality
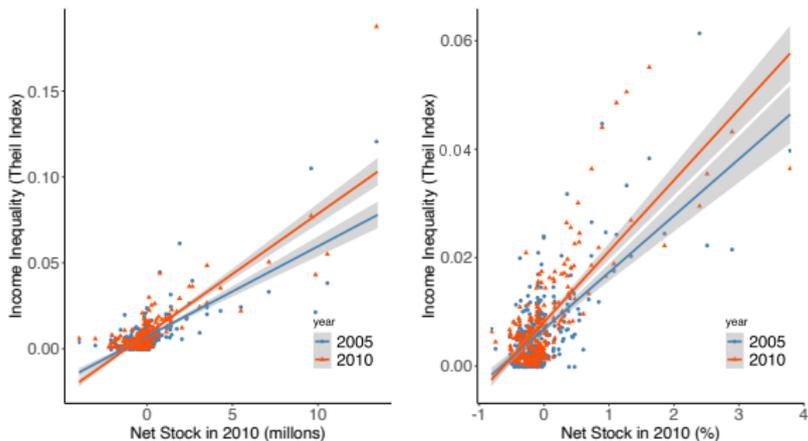
Supplement for Fact 3: Wage inequality within cities are not correlated with net stock

Figure: Net Stock of Migrants and Wage Inequality
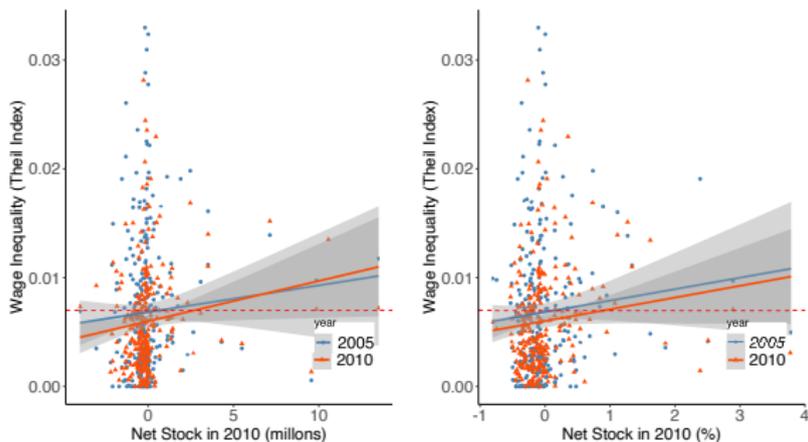
Supplement for Fact 3: high net stock cities contribute more to national inequality

Figure: Net Stock of Migrants and Share of Contribution to National Inequality
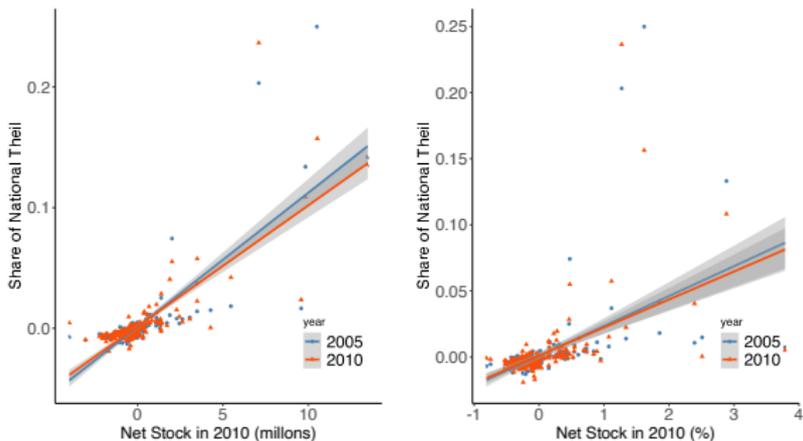
Takeaway of the Stylized Facts

1. Migration, Housing Constraints, and Inequality are highly correlated;

2. Cities with more migrant workers have higher housing costs and higher inequality;

3. The inequality pattern is mainly explained by housing inequality (not wage inequality);

A Spatial GE Model of Migration and Housing

Model: Overview

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.

Model I: Worker Preferences

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

Model I: Frechet Distribution of Utility

▶ Origin-Destination-Skill Pair:

$$G_{ij}^s(u) = Pr[U \leq u] = F\left(\frac{u\tau_{ij}^s Q_j^{1-\beta}}{v_{ij}^s}\right) \tag{3}$$

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

▶ Origin-Skill Pair:

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

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

Model I: Migration Flows and Income

- 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)

$$v_{ij}^s = w_j^s + \frac{Q_i S_i}{H_i^R} \tag{8}$$

Model II: Production

▶ 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:

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

Solving the Model

Model IV: Equilibrium and Estimation

- Spatial General Equilibrium Conditions:

  (1).Worker Optimization; (2).Firm Optimization;
  (3).Labor Market Clearing for each j; and (4).Floor Space Market Clearing for each j.

- Estimation of Parameters:

Table: **Estimated Parameters**

Parameter	Description	Value
β	share of consumption in utility	0.77
σ	elasticity of substitution between H/L-skills	1.40
ϵ	migration elasticity	1.90

▸ Equilibrium Conditions   ▸ Estimation   ▸ Estimation Results

Model V: Solving the Model (Productivity)

This model has a very nice accounting property: it can be solved directly from data (Data in Blue and Unknown in Red)

A.Productivity

From production function and FOC $A_j^h = A_j^l (H_j^h/H_j^l)^{1/(\sigma-1)} (w_j^h/w_j^l)^{\sigma/(\sigma-1)}$, we have:

$$X_j = A_j^l H_j^l \left[\frac{w_j^h H_j^h + w_j^l H_j^l}{w_j^l H_j^l} \right]^{\frac{\sigma}{\sigma-1}} = w_j^h H_j^h + w_j^l H_j^l$$

Defining $\Xi_j^l = \frac{w_j^l H_j^l}{w_j^h H_j^h + w_j^l H_j^l}$ as the share of labor income of low-skill workers, we can then calculate the productivities for both skill types as follows:

$$A_j^l = w_j^l (\Xi_j^l)^{\frac{1}{\sigma-1}} \qquad (9)$$

$$A_j^h = w_j^h (1 - \Xi_j^l)^{\frac{1}{\sigma-1}} \qquad (10)$$

Takeaway: higher wage and higher share of skill s in city j reflects of higher A_j^s.

B.Floor Space

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

$$= \frac{1 - \beta}{Q_j}\left[w_j^l H_j^l + w_j^h H_j^h\right] + (1 - \beta)S_j$$

$$= \frac{1 - \beta}{\beta} \cdot \frac{w_j^l H_j^l + w_j^h H_j^h}{Q_j}$$

and then back out the construction intensity ϕ_j by dividing the land supply data:

$$\phi_j = S_j/L_j$$

Takeaway: higher wage and larger population reflects larger floor space, while higher price reflects smaller floor space.

C.Migration Costs

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

Inserting Φ_i^s into the original gravity equation, we have the migration cost as follows:

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

Takeaway: migration cost from i to j for skill s is reflected in income v_{ij}^s, Q_j, π_{ij}^s, and Π_{is}.

Quantitative Results of the Model

Quantitative I: Unobserved Variables across Cities & Change Overtime

- ▶ Migration Costs (τ_{ij}^s):
  Annually drop of migration costs is 8.8%;

- ▶ Productivity (A_j^s):
  1.Annually growth of productivity is 13% (high-skill) & 14% (low-skill);
  2.Productivity in larger cities is much higher, especially for high-skill;

- ▶ Floor Space (S_j):
  Floor space per worker growth in much lower in more developed cities.

▸ Average Migration Costs   ▸ Average Productivity Growth   ▸ Construction Land Supply and Floor Space

Quantitative II: Within-city Theil Index

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

Table: **Within-city Theil Index**

Net Migrant Range(2010)	No. of City	Wage Theil Index			Income Theil Index		
		2005	2010	Relative	2005	2010	Relative
Average	233	0.0072	0.0070	97%	0.0100	0.0184	184%
(6,13)	5	0.0087	0.0097	111%	0.0442	0.0908	205%
(1,6)	19	0.0065	0.0079	122%	0.0092	0.0223	242%
(0, 1)	45	0.0075	0.0083	111%	0.0060	0.0092	153%
(-1,0)	134	0.0071	0.0058	82%	0.0049	0.0052	106%
(-4,-1)	30	0.0072	0.0058	80%	0.0054	0.0062	115%

Quantitative II: Share of Contribution to National Theil Index

1.National Theil Indexes drop overtime;
2.More developed cities' share of national inequality remains unchanged;

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

Net Migrant Range(2010)	No. of City	Share of Wage Theil			Share of Income Theil		
		2005	2010	Relative	2005	2010	Relative
National Theil	233	0.0985	0.0622	64%	0.1156	0.0921	80%
(6,13)	5	+1.49	+1.41	97%	+1.43	+1.27	89%
(1,6)	19	+0.58	+0.83	143%	+0.53	+0.70	132%
(0, 1)	45	+0.22	+0.26	118%	+0.19	+0.20	105%
(-1,0)	134	-0.92	-1.00	108%	-0.81	-0.78	96%
(-4,-1)	30	-0.37	-0.49	132%	-0.35	-0.39	111%

Quantitative II: Skill Premium & Housing Premium

1.Skill Premium does not change much;
2.Housing Premium accounts for the majority of the inequality changes;

Table: **Skill Premium and Housing Premium**

Net Migrant Range(2010)	No. of Cities	Skill Premium			Housing Premium		
		2005	2010	Relative	2005	2010	Relative
Average	233	1.47	1.40	95%	0.36	0.49	136%
(6,13)	5	1.35	1.39	103%	0.93	1.89	203%
(1,6)	19	1.40	1.40	100%	0.39	0.56	144%
(0, 1)	45	1.42	1.39	97%	0.31	0.35	113%
(-1,0)	134	1.50	1.40	93%	0.27	0.25	93%
(-4,-1)	30	1.58	1.45	92%	0.24	0.31	129%

Takeaways from Quantitative Analysis

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.

Counterfactual with Land Supply Reform

Counterfactual I: A Migration-based Land Supply Policy Reform

1.Redistributing the total land supply increment from 2005 to 2010 by net inflow;
2.Subtracting land income from the additional land allocated to land-gaining cities and compensate land-losing cities for their losses for redistribution.

Table: **Counterfactual Construction Land Supply**

Net Inflow Range(2010)	No. of Cities	Land Supply (Data)				Counterfactual		
		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

▶ algorithm to solve counterfactual

Counterfactual I Results: Migration Flow & Housing Cost

1.The reform motivates more migration into more developed cities;
2.It also lowers housing costs more developed cities;

Table: **Migration Flow and Housing Cost: Land Supply Reform**

Net Migrant Range(2010)	No. of Cities	Net Migrant			Housing Cost		
		2010	$\widetilde{2010}$	Relative	2010	$\widetilde{2010}$	Relative
Overall	233	96m	112m	117%	114	119	104%
(6,13)	5	+45m	+55m	122%	226	158	70%
(1,6)	19	+38m	+44m	116%	136	102	75%
(0, 1)	45	+13m	+13m	100%	118	132	112%
(-1,0)	134	-48m	-48m	100%	87	115	132%
(-4,-1)	30	-48m	-65m	135%	80	105	131%

The reform lowers income inequality but not much on wage inequality;

Table: **Within-city Theil Index: Land Supply Reform**

Net Migrant Range(2010)	No. of Cities	Wage Theil Index			Income Theil Index		
		2010	$\widehat{2010}$	Relative	2010	$\widehat{2010}$	Relative
Average	233	0.0070	0.0072	103%	0.0184	0.0121	66%
(6,13)	5	0.0097	0.0093	97%	0.0908	0.0428	47%
(1,6)	19	0.0079	0.0089	113%	0.0223	0.0139	62%
(0, 1)	45	0.0083	0.0082	99%	0.0092	0.0098	106%
(-1,0)	134	0.0058	0.0059	101%	0.0052	0.0045	86%
(-4,-1)	30	0.0058	0.0056	97%	0.0062	0.0051	82%

Counterfactual I Results: Share of national Theil Index

1.The reform further lowers national income inequality;
2.It, however, does not affect city's share of national inequality much;

Table: **Share of National Theil Index: Land Supply Reform**

Net Migrant Range(2010)	No. of Cities	Share of Wage Theil			Share of Income Theil		
		2010	$\widetilde{2010}$	Relative	2010	$\widetilde{2010}$	Relative
National Theil	233	0.062	0.062	100%	0.092	0.074	80%
(6,13)	5	+1.41	+1.46	104%	+1.27	+1.28	101%
(1,6)	19	+0.83	+0.84	101%	+0.70	+0.66	94%
(0, 1)	45	+0.26	+0.23	88%	+0.20	+0.30	150%
(-1,0)	134	-1.00	-0.95	95%	-0.78	-0.73	94%
(-4,-1)	30	-0.49	-0.58	118%	-0.39	-0.50	128%

The reform mainly works through the Housing Premium;

Table: **Skill Premium and Housing Premium: Land Supply Reform**

Net Migrant Range(2010)	No. of Cities	Skill Premium			Housing Premium		
		2010	$\widehat{2010}$	Relative	2010	$\widehat{2010}$	Relative
Average	233	1.40	1.40	100%	0.49	0.45	92%
(6,13)	5	1.39	1.39	100%	1.89	1.12	59%
(1,6)	19	1.40	1.43	102%	0.56	0.41	73%
(0, 1)	45	1.39	1.38	99%	0.35	0.40	114%
(-1,0)	134	1.40	1.39	99%	0.25	0.33	132%
(-4,-1)	30	1.45	1.43	98%	0.31	0.26	84%

Takeaways from Counterfactual I

A Land Supply Redistribution according to worker flows 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;

Counterfactual with Property Tax and Redistribution

(a US-like PT $\approx$ 20% of rent and redistribution to all residents in the same city)

1.The reform motivates slightly more migration into more developed cities;
2.It does not lower housing costs more developed cities;

Table: **Migration Flow and Housing Costs: Property Tax**

Net Migrant Range(2010)	No. of Cities	Net Migrant			Housing Cost		
		2010	$\widetilde{2010}$	Relative	2010	$\widetilde{2010}$	Relative
Overall	233	96m	97m	101%	114	115	101%
(6,13)	5	+45m	+46m	102%	226	230	102%
(1,6)	19	+38m	+39m	102%	136	137	101%
(0, 1)	45	+13m	+13m	100%	118	118	100%
(-1,0)	134	-48m	-47m	102%	87	87	100%
(-4,-1)	30	-48m	-50m	104%	80	80	100%

Counterfactual II: Within-city Theil Index

The reform lowers income inequality but not on wage inequality;

Table: **Within-city Theil Index: Property Tax**

Net Migrant Range(2010)	No. of Cities	Wage Theil Index			Income Theil Index		
		2010	$\overline{2010}$	Relative	2010	$\overline{2010}$	Relative
Average	233	0.0070	0.0071	101%	0.0184	0.0145	79%
(6,13)	5	0.0097	0.0100	103%	0.0908	0.0670	74%
(1,6)	19	0.0079	0.0080	101%	0.0223	0.0171	77%
(0, 1)	45	0.0083	0.0084	101%	0.0092	0.0081	88%
(-1,0)	134	0.0058	0.0058	100%	0.0052	0.0047	90%
(-4,-1)	30	0.0058	0.0058	100%	0.0062	0.0053	85%

Counterfactual II: Share of National Theil Index

1.The reform further lowers national income inequality;
2.It, however, also does not affect city's share of national inequality much;

Table: **Share of National Theil Index: Property Tax**

Net Migrant Range(2010)	No. of Cities	Share of Wage Theil			Share of Income Theil		
		2010	$\widehat{2010}$	Relative	2010	$\widehat{2010}$	Relative
National Theil	233	0.062	0.062	100%	0.092	0.074	80%
(6,13)	5	+1.41	+1.42	104%	+1.27	+1.31	103%
(1,6)	19	+0.83	+0.83	101%	+0.70	+0.73	104%
(0, 1)	45	+0.26	+0.26	88%	+0.20	+0.21	105%
(-1,0)	134	-1.00	-0.98	95%	-0.78	-0.82	111%
(-4,-1)	30	-0.49	-0.52	118%	-0.39	-0.44	116%

Counterfactual II: Skill Premium and Housing Premium

The reform also mainly works through the Housing Premium;

Table: **Skill Premium and Housing Premium: Property Tax**

Net Migrant Range(2010)	No. of Cities	Skill Premium			Housing Premium		
		2010	$\widehat{2010}$	Relative	2010	$\widehat{2010}$	Relative
Average	233	1.40	1.40	100%	0.49	0.46	94%
(6,13)	5	1.39	1.39	100%	1.89	1.60	85%
(1,6)	19	1.40	1.43	102%	0.56	0.51	91%
(0, 1)	45	1.39	1.38	99%	0.35	0.34	97%
(-1,0)	134	1.40	1.39	99%	0.25	0.26	104%
(-4,-1)	30	1.45	1.43	98%	0.31	0.21	68%

Takeaways from Counterfactual II

A US-like Property Tax and Redistribution:

▶ 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;

▶ However, not motivating much more workers into larger cities.

Conclusion

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.

Property tax and redistribution also lowers income inequality.

- ► Redistributing housing gain from owners to public amenity/services is also meaningful.

Appendix

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

Figure: Net Stock (%) of migrants by city in China

(a) Net Stock(%) of Workers in 2005

(b) Net Stock(%) of Workers in 2010

▸ Back

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

Table: **Distribution of Net Stock of Migrant Workers**

Panel A: Net Stock (measured in numbers, Unit: million)										
Year	No.	(-4,-2)	(-2,-1)	(-1,-0.5)	(-0.5,0)	(0, 0.5)	(0.5,1)	(1,2)	(2,4)	(4,8)	(8+)
2005	287	1	1	23	188	59	4	4	4	2	1
2010	266	6	29	41	115	39	9	13	7	3	4
Panel B: Net Stock (measured in percentage, Unit: %)										
Year	No.	(-80, -45)	(-45,-30)	(-30,-15)	(-15,0)	(0, 15)	(15,30)	(30,45)	(45,60)	(60,75)	(75+)
2005	287	0	11	63	139	48	9	5	3	3	6
2010	266	12	47	61	71	19	17	14	6	4	15

▸ Back

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

Figure: Correlation of Net Stock of Migrants in 2005 and 2010

(a) Net Stock (Numbers N)

(b) Net Stock (Percentage %)

Back

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

Quality-adjusted Housing Rents and Migration

$$rent_{ij} = \beta_0 + \beta_1 NetMig_j + \mathbf{Z_{ij}}'\alpha + \epsilon_{ij} \tag{11}$$

$\mathbf{Z_{ij}}$ is a vector of housing characteristics for house i, including whether the house is also used as a business facility, the total area of the house, the number of the floors, the construction structure of the house, the building year of the house, the main cooking equipment, whether it has a tap water system, whether it has an independent kitchen, the type of restroom, and the type of showering system.

Table: The Relation between Housing Rents and Migration

Variables	(1) OLS-2005	(2) OLS-2010
Net Stock of Migrant Workers (10k)	0.0113***	0.00396***
	(0.000173)	(0.0000516)
Observations	81,051	150,298
R-squared	0.207	0.181

▸ Back

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

Additional Results of Inequality from CHIP

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%

▶ Back

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.

▸ Back

Migration Elasticity (ϵ)

Migration Flows

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

Regression

$$ln(\pi_{ij}^s) = \epsilon ln(\nu_j^s) + \psi_{ij} + \gamma_{is} + \zeta_j + \varphi_{ijs}, \text{ for } i \neq j \tag{12}$$

where

$\psi_{ij} = -\epsilon \rho ln(d_{ij})$ is the origination-destination pair FE;

$\gamma_{is} = -\epsilon ln(\tau_i^s) - ln(\Phi_i^s)$ 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. ▶ Back

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

$\epsilon = 1.90$

▸ Back

Quantitative I: Unobserved Variables across Cities & Change Overtime

Table: **Average Migration Costs**

| | Share of Emp. | | | Migration Costs | | |
	2005	2010	2005	2010	Relative	Changes
Overall	11%	22%	11.0	7.2	65%	-3.8
Low-skill	11%	23%	11.2	7.3	65%	-3.9
High-skill	9%	17%	8.9	7.0	79%	-1.9

▸ Back

Quantitative I: Unobserved Variables across Cities & Change Overtime

Table: **Average Productivity Growth**

Net Migrant Range(2010)	No. of Cities	High-skill				Low-skill			
		2005	2010	Relative	Changes	2005	2010	Relative	Changes
Average	233	6.4	14.0	219%	+7.6	9.4	17.1	182%	+7.7
(6,13)	5	19.2	45.7	240%	+26.5	12.6	21.2	168%	+8.6
(1,6)	19	3.9	12.0	308%	+8.1	12.2	19.5	160%	+7.3
(0, 1)	45	3.7	10.5	184%	+6.8	10.2	16.3	160%	+6.1
(-1,0)	134	0.9	2.3	256%	+1.4	8.2	16.3	199%	+8.1
(-4,-1)	30	0.4	1.6	400%	+1.2	7.8	15.2	195%	+7.4

▸ Back

Quantitative I: Unobserved Variables across Cities & Change Overtime

Table: **Construction Land Supply and Floor Space**

Net Migrant Range(2010)	No. of City	Total Land Supply Floor Space				Total Floor Space			
		2005	2010	Relative	Changes	2005	2010	Relative	Changes
Overall	233	24,277	31,705	131%	+7,428	2.19	3.30	150%	+1.11
(6,13)	5	5,135	5,648	110%	+513	5.92	7.84	132%	+1.92
(1,6)	19	3,801	5,912	155%	+2,111	1.79	4.10	229%	+2.31
(0, 1)	45	5,555	7,250	131%	+1,695	1.53	2.48	162%	+0.95
(-1,0)	134	7,950	10,363	130%	+2,413	1.48	2.17	147%	+0.69
(-4,-1)	30	1,836	2,532	138%	+696	2.55	3.12	122%	+0.57

▸ Back

Algorithm to solve the counterfactual

An Iteration algorithm:

▶ Initiating with the Housing Block with counterfactual changes

▶ Update housing prices from housing market changes

▶ Move to Migration Block to determine migration changes

▶ Update labor prices from labor market changes

▶ Iteration until all variables convergences achieved

▶ Back