Educational Choice, Rural-Urban Migration and Economic Development

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Motivation

- Structural transformation from traditional agricultural societies to modern economies is usually accompanied by rural-urban migration
  - Since Todaro (1969) and Harris and Todaro (1970), most studies focus on the work-based channel
  - Lucas (2004) as an exception: accumulating human capital while working in cities
  - However, rural-urban migration could be due to educational purpose, i.e. migration could happen prior to the participation in the labor market
    - Cities provide education of better quality
    - Higher (tertiary) education is (only) provided in cities
    - The education-based migration channel has been overlooked in the literature

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  - Urban sector hires both high- and low-skilled workers, while human capital is useless in rural sector
  - College admission selectivity, intergenerational mobility and exogenous work-based migration in the model
- Apply the model to study the case of China

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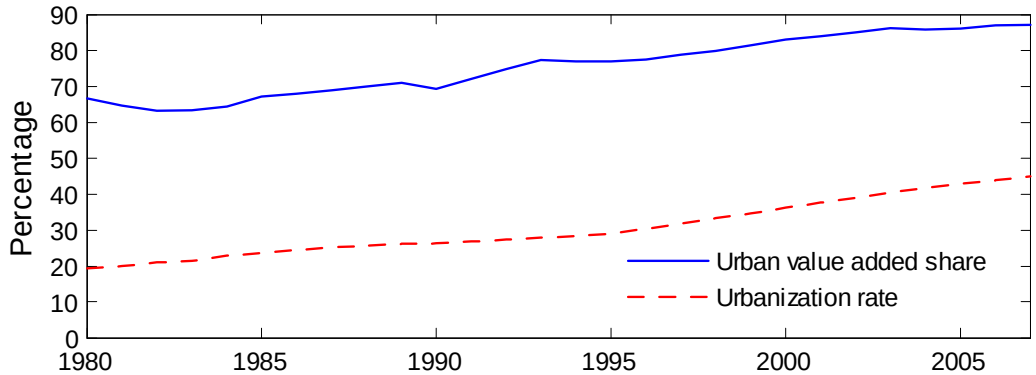
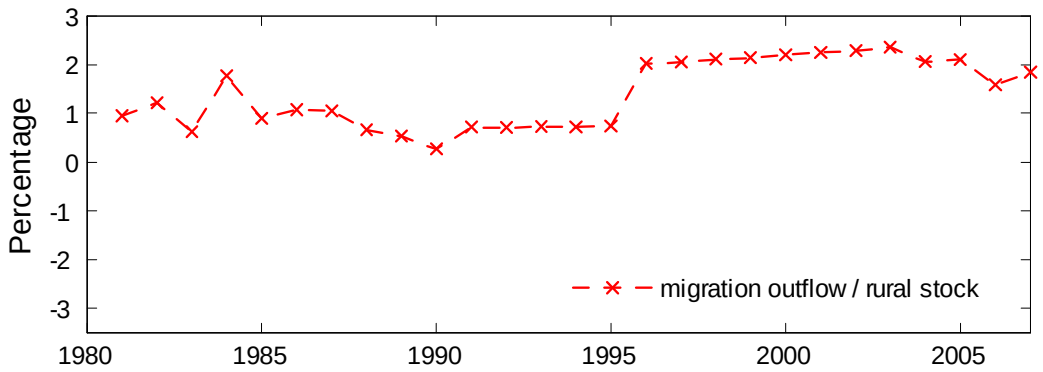
  - Increases in urban tertiary education employment shares: From less than 3% in 1980 to more than 14% in 2007
  - With rural-urban migration more work- than education-based, is it possible for the latter channel to still play a key role?

Urbanization and rural-urban migration in China



(A) URBANIZATION RATES AND URBAN OUTPUT SHARES



(B) MIGRATION OUTFLOWS

Source: Urbanization rates: Authors computed based on data from China Statistical Yearbook. Urbanization rate is defined as urban population share. Urban output share: Authors computed based on Bai and Qian (2010), excluding agricultural sector.

Migration by reason - percentage

Reasons of Migration	Total	Job Transfer	Job Assignment	Work or Business	Study or Training	Others
1985	100.00%	29.57%	8.04%	3.08%	11.26%	48.05%
2000	100.00%	5.32%	3.76%	33.55%	6.84%	50.53%
Average	100.00%	17.44%	5.90%	18.32%	9.05%	49.29%

Note: Others include "to relative and friend", "retired or resigned" (1985 data only), "moved with family", "marriage", "pull down and move" (2000 data only), and "other reasons". Source: *10 Percent Sampling Tabulation on the 1990 Population Census of the People's Republic of China* for the data of 1985; *Tabulation on the 2000 Population Census of the People's Republic of China* for 2000.

persons

Related Literature

- Classics work by Todaro (1969) and Harris-Todaro (1970), and later Glomm (1992) and **Lucas (2004)**
- The decision of rural-urban **work-based** migration in China
  - Theory and calibration: Hu (2002), Whalley and Zhang (2007), Hertel and Zhai (2006), Bond, Riezman and Wang (2015), Garriga, Tang and Wang (2014), Tombe and Zhu (2015)
  - Institutions: Wu and Treiman (2004), Li, Li, Wu and Xiong (2012).

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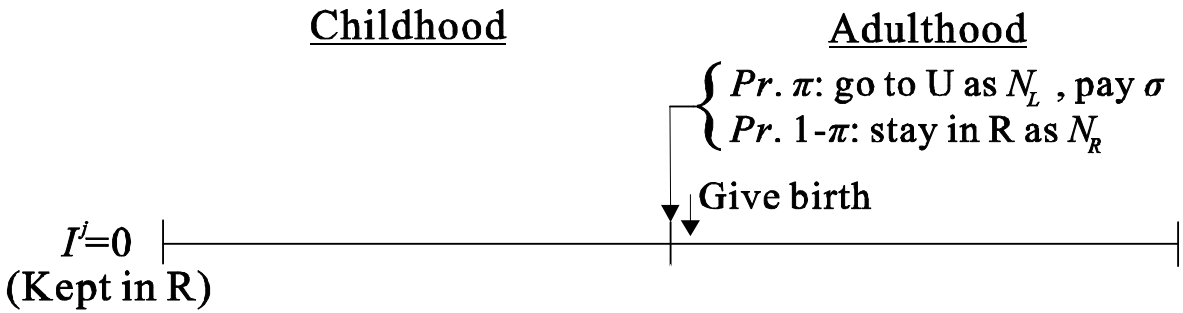
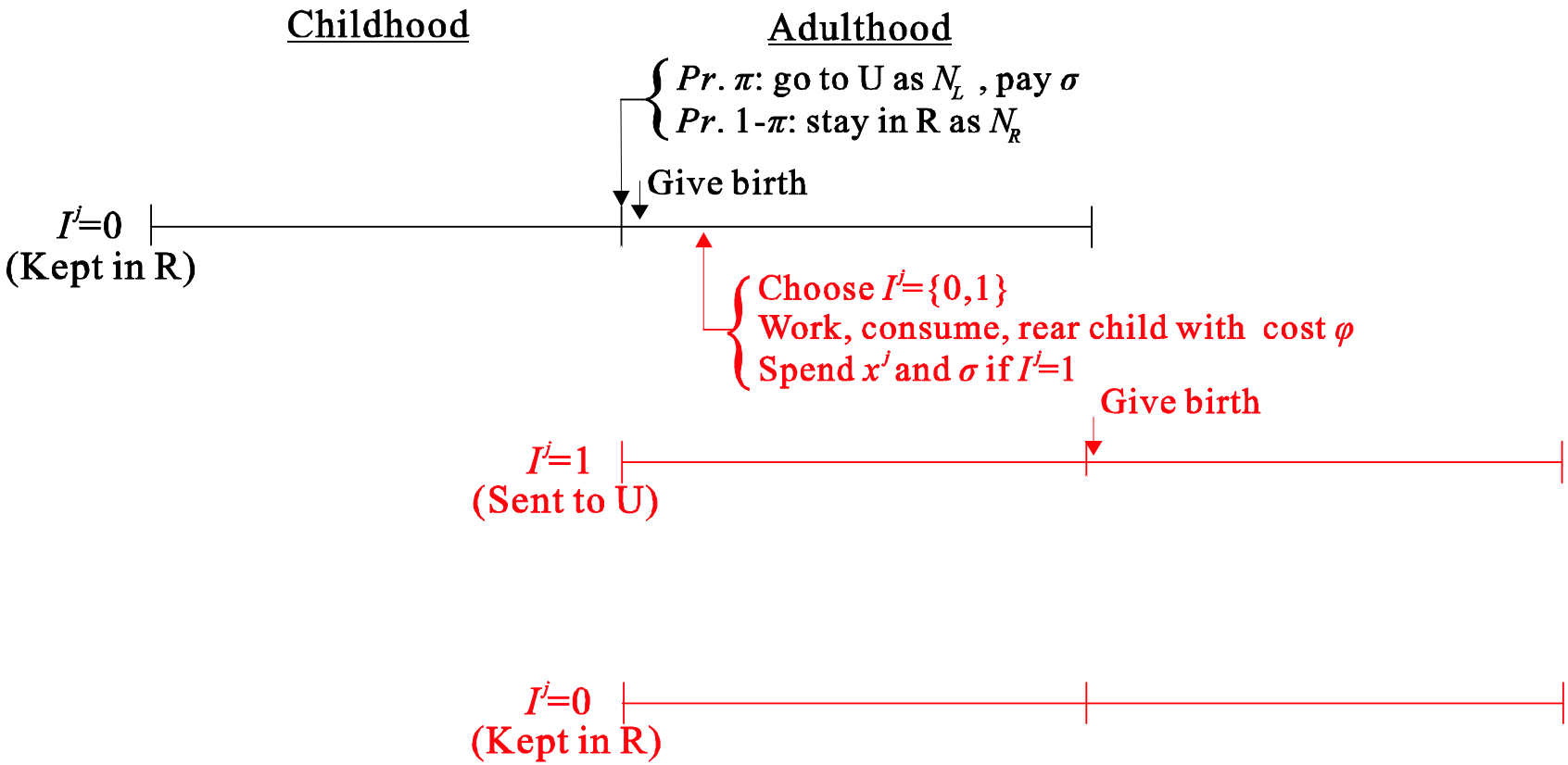
  - Probability of intergenerational mobility: δ_{jk}, where $j, k \in \{H, L\}$

Timeline


Childhood
Adulthood
Pr. π: go to U as N_L , pay σ
Pr. 1-π: stay in R as N_R
Give birth
I^j=0
(Kept in R)

Timeline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Choose I^j={0,1}
Work, consume, rear child with cost φ
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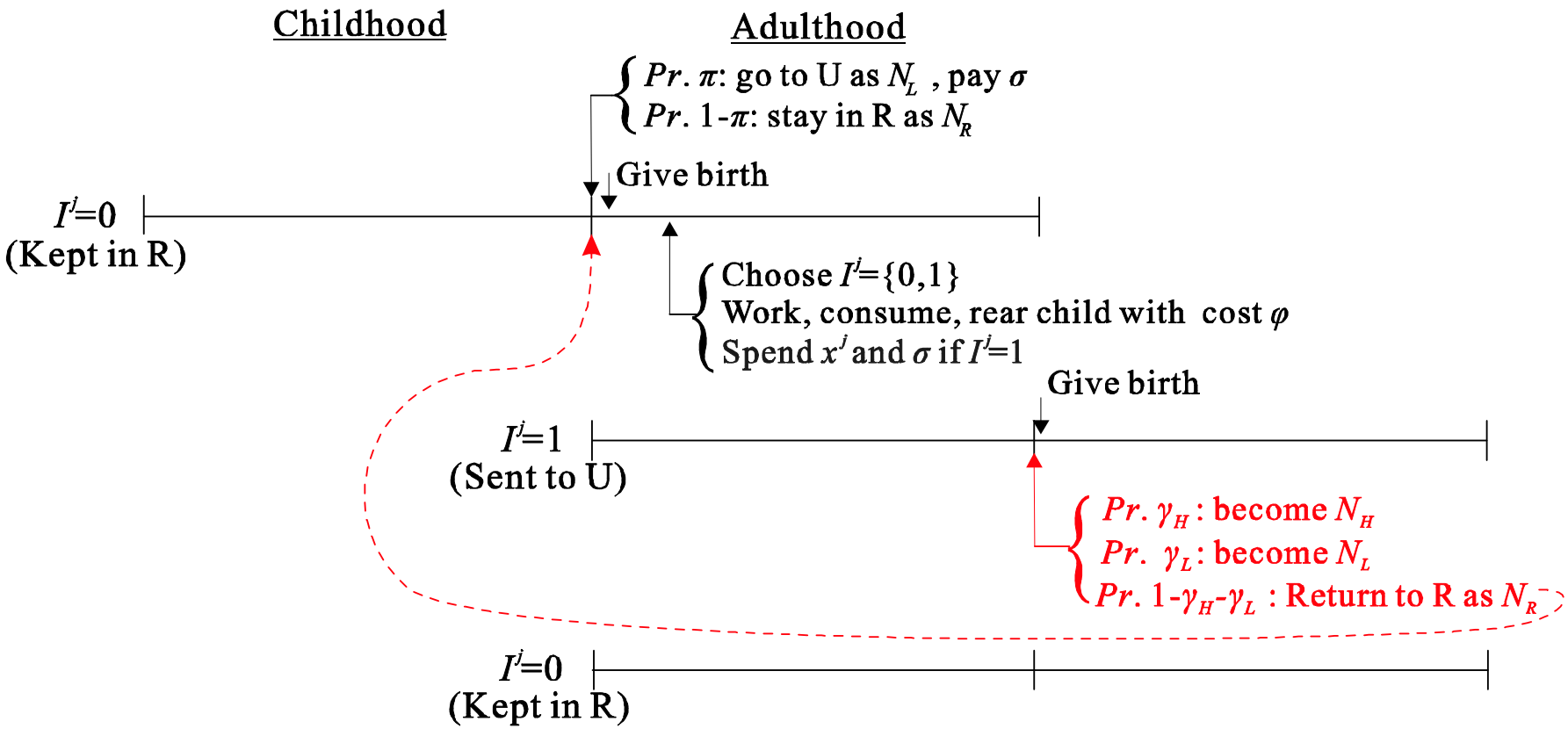
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Pr. γ_H : become N_H
Pr. γ_L : become N_L
Pr. 1-γ_H-γ_L : Return to R as N_R
I^j=0
(Kept in R)

Rural household's problem 1

- Rural parents' problem:

$$\mathbf{I}^j = \arg\max\{\Omega^i\left(\mathbf{I}^j|\mathbf{I}^i=0, I^k, x^j\right) = u\left(c^i\right) + \beta E_{\mathsf{X}} u\left(c^j\right)\}$$
$$s.t. \quad c^i + I^j \cdot (x^j + \sigma_e) + \phi^i = w_R$$

  - c^i: parent's consumption in adulthood
  - c^j: children's consumption
  - σ_e: education-based migration cost
  - $x^j \equiv 1/az^j + b$: cost of college education
    - a: admission selectivity
    - b: expenses associated with college education
  - ϕ^i: child-rearing cost

Rural household's problem 2

- Children's income and budget constraint in adulthood:

$$W^j = I^j \left[\gamma_H w_H h + \gamma_L w_L + \left(1 - \gamma_H - \gamma_L\right) w_R\right] + \left(1 - \mathbf{I}^j\right) \left[\left(1 - \pi\right) w_R + \pi \left(w_L - \sigma_w\right)\right]$$

$$c^j + I^k \cdot \left[\mathbf{I}^j \left(1 - \gamma_H - \gamma_L\right) + \left(1 - I^j\right) \left(1 - \pi\right)\right] \left(x^k + \sigma_e\right) + \phi^k = W^j$$

  where σ_w is work-based migration cost

- Discrete choice problem (the *indifference boundary* condition):

  There exists a threshold talent $\hat{z}^j$ s.t.

  $\Delta^i \left(\hat{z}^j\right) \equiv \Omega^i \left(\mathbf{I}^j = 1 | \mathbf{I}^i = 0, \mathbf{I}^k, \hat{z}^j\right) - \Omega^i \left(\mathbf{I}^j = 0 | \mathbf{I}^i = 0, \mathbf{I}^k, \hat{z}^j\right) = 0.$

  - Parents will send their children to urban area if $z^j \geq \hat{z}^j$; vice versa.

Production

- Production in urban area (non-homothetic CES)

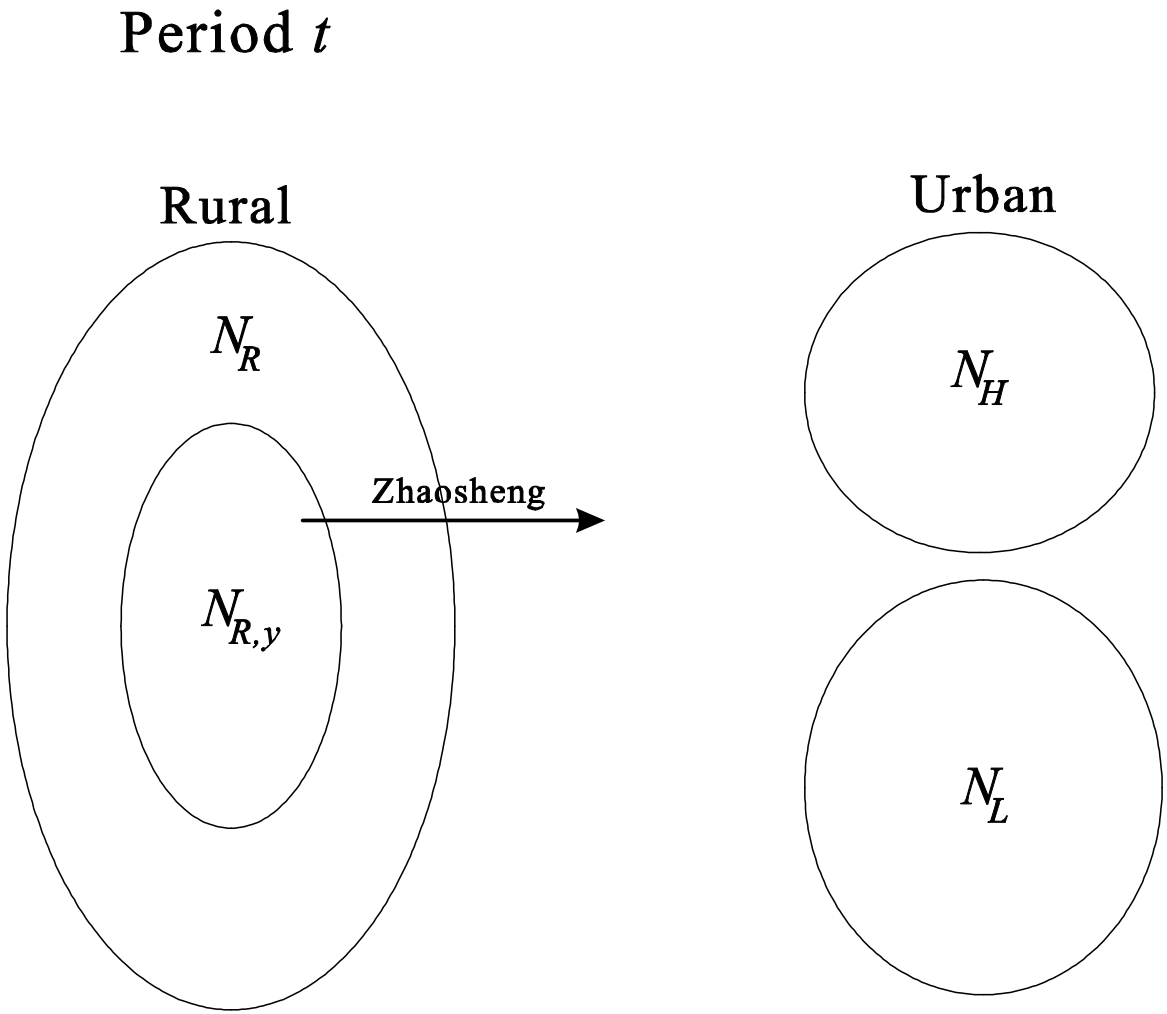
$$Y_U = AF[(N_H + \psi)h, N_L], \quad \psi > 0.$$

- Production in rural area:

$$Y_R = BN_R.$$

- Wedge $\tau \in (-1, \infty)$ facing by urban firms when hiring high skilled workers:
  - Maurer-Fazio (1999): skilled labor wage in China was depressed due to the planned economy system
- In equilibrium, (effective) wage rates (w_H, w_L, and w_R) are equal to the **wedge-adjusted** marginal product of labor.

Population flows



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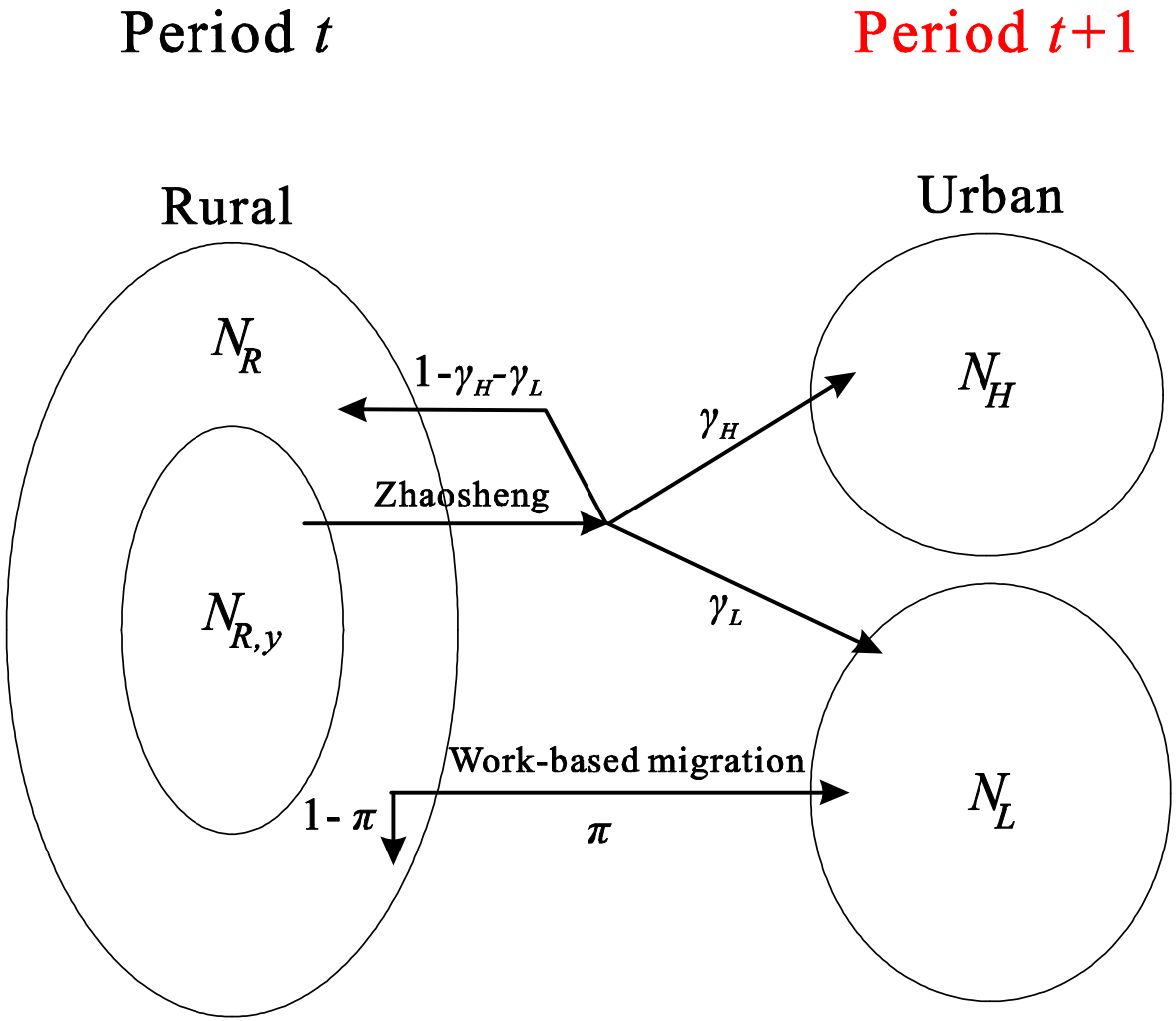

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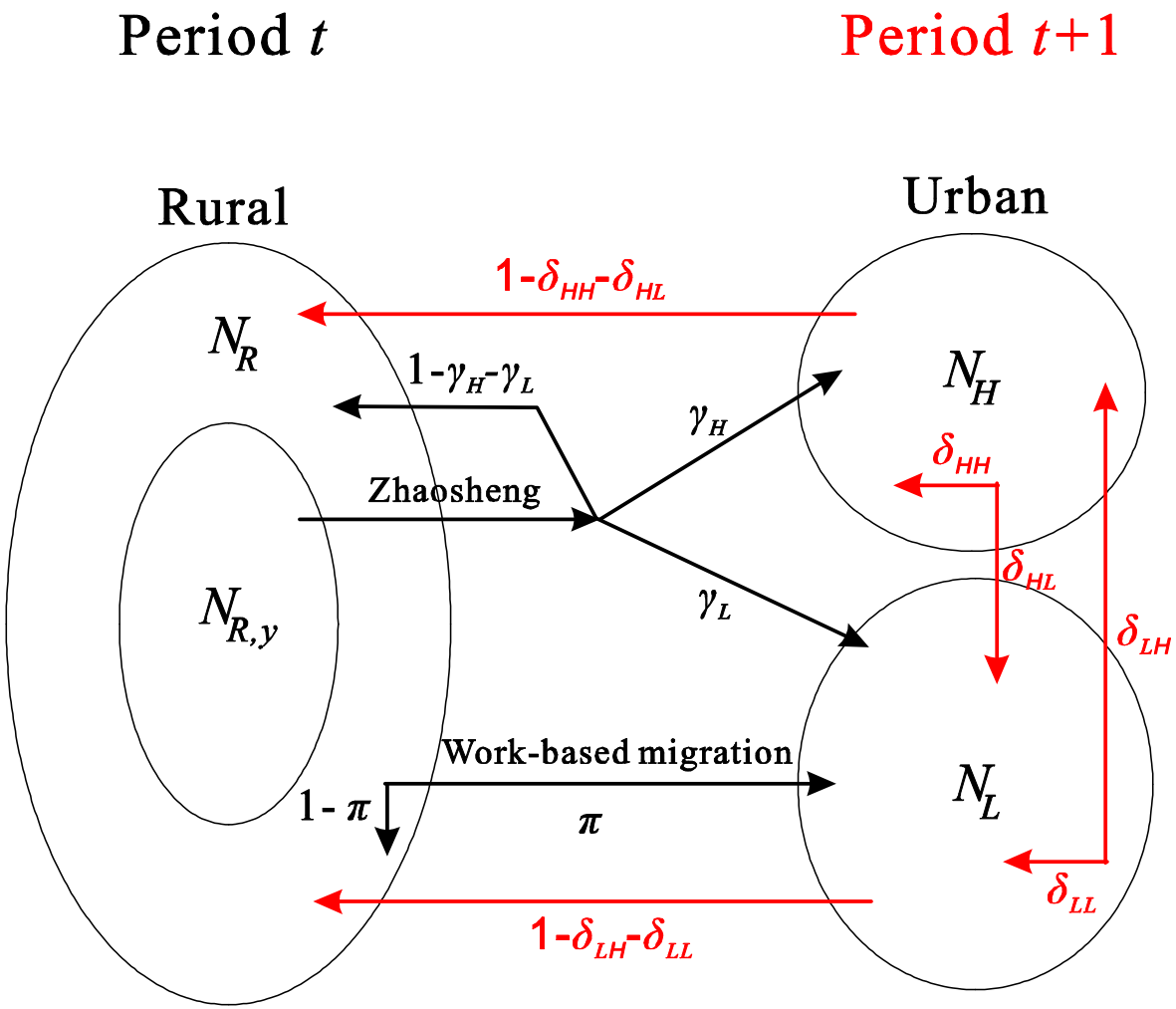


Labor Market Clearing and Population Identity

- Labor market clearing:

$$\begin{aligned} N_H^{dt} &= N_H^t \\ N_L^{dt} &= N_L^t \\ N_R^{dt} &= N_R^t \end{aligned}$$

- Population identity:

$$N_H^t + N_L^t + N_R^t = N.$$

Effects of Migration and Labor-Market Property

Effects of Migration

$$\Delta^i\left(\mathbf{I}^k, x^j\right) = \underbrace{u\left(w_R - x^j - \sigma - \phi^i\right) - u\left(w_R - \phi^i\right)}_{\text{direct consumption effect}}$$
$$+\underbrace{\beta \mathbb{E}_X\{u(c_U^j) - u(c_R^j)\}}_{\text{intergenerational effect}}.$$

Define $n \equiv (N_H + \psi)h/N_L$ and n_s s.t. $w_H(n_s)h/w_L(n_s)=1$ (no skill premium)

Assumption 1 $\gamma_H + \gamma_L > \pi$ (prob. of securing an urban job for a college graduate cannot be too low)

Condition S (sufficiency) $w_H(n_s)h = /w_L(n_s) > B + \sigma_w$ (any urban job pays better than rural job) figure

Comparative Statics

Under assumption 1 and condition S:

1. *When the positive intergenerational effect of migration dominates the negative direct consumption effect, parents will send their children to cities to attend college.*
2. *More parents will be willing to send their children to urban areas to attend college when the chance for low-skilled migration is lower (two migration channels are substitutes).*

Equilibrium

Definition 1 (Dynamic Competitive Equilibrium)

A **dynamic competitive spatial equilibrium** (DCSE) of the model consists of consumption, output levels and wage rates such that

1. given the wages, households maximize utility by choosing whether to send children to urban area or not;
2. all three labor markets clear;
3. the population laws of motion of N_R, N_H and N_L hold.

Quantitative Analysis

- Calibration:
  - Two-regime calibration (pre-1994: 1980-1994; post-1995: 1995-2007) and dynamics (relative TPF, wedges τ and $\hat{z}$ based on annual urban & skill premium and *zhaosheng* flow)
  - Main data used: urban employment rate, urban & skill premium, migration costs, , rural income etc., taken from UHS, CHIPS, NBS, etc.
- Decomposition analysis (based on dynamics):
  - Decompose the effects of education- and work-based migration on output per capita, urban output and employment shares, and skill share and skill premium
  - Factor decomposition: TFP, human capital, admission selectivity, migration costs, etc.
  - Policy experiments on GJA and work-based migration

Calibration

- Utility function: $u(c) = \frac{c^{1-\varepsilon}-1}{1-\varepsilon}$
- Talents follow Pareto: $G(z^j) = 1 - (z_{\min}/z^j)^{\theta}$ with $z_{\min}=1$
- Urban production function:

$$Y_U = A\left[\alpha\left[(N_H+\psi)h\right]^{\rho} + (1-\alpha)N_L^{\rho}\right]^{1/\rho},\ \alpha \in (0,1),\ \rho < 1$$

- Intergenerational mobility: $\delta_{HH}=1$, $\delta_{LH}=(1-\delta_{LL})>0$, $\delta_{HL}=0$
- Assume no population growth (total population is normalized to one)

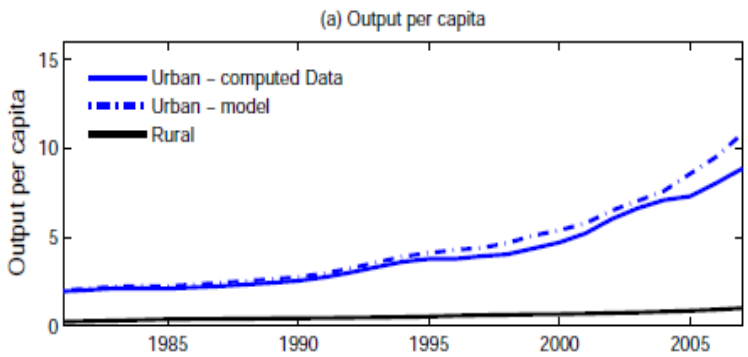
Calibration Result

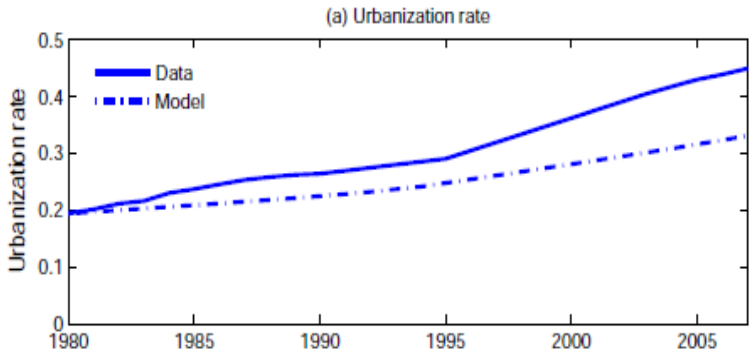
	Values			Values of targets		
	Pre-1994	Post-1995	Target	Pre-1994	Post-1995	Explanations
Preset						
δ_{HH}	1	1				Preset
γ_L	0	0.05				Preset
Calibrated: Regime-common						
α	0.8461		Y_U/Y	0.6922	0.8294	Match urban output shares
ψ	0.0618		Y_U/Y	0.6922	0.8294	Match urban output shares
Calibrated: Regime-specific						
γ	-	0.9209				Urban employment rate, CHIPS 1995, 2002, 2008
γ_H	1	0.8709				$\gamma_H = \gamma - \gamma_L$
π	0.0036	0.0083				Work-based migration flow/Rural population
δ_{LL}	0.9996	0.9883	N_H/N_L	0.0424	0.1466	Match high-low skill labor ratio
B	0.3685	0.7177	y_R			Rural per capita income. 2007 y_R=1
h	1.3529	1.5928				Mincerian rate of return
A	5.3877	11.0573	w_L/w_R	1.7781	2.0076	Match urban premium
τ	7.1103	5.4763	$w_H h/w_R$	1.2296	1.6576	Match skill premium
$\hat{z}$	17.7632	13.1391		0.0589%	0.1144%	Match average zhaosheng flow
σ_e	0.1841	0.1021				% of rural household income, He and Dong (2007)
σ_w	0.5554	0.3079				% of rural household income, CHIPS 2002
a	1.1489	0.4701				Solve from the indifference boundary condition
b	0.0048	0.0582				% of rural household income, UHS 2007 and 2008

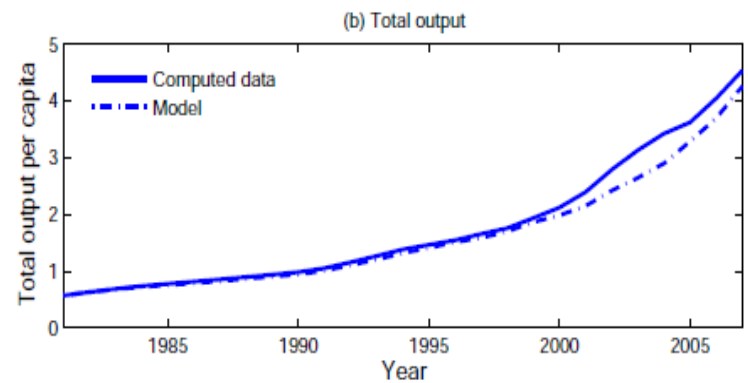
*Note: α, ψ, A and τ are solved together.

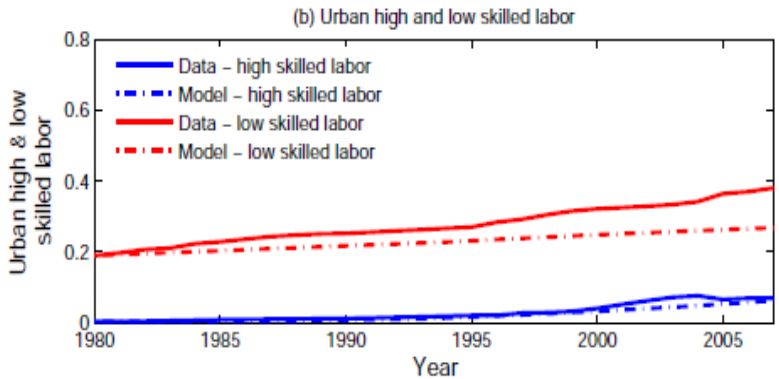
calibration: all results TFP

Model vs. Data









simulation: benchmark model

Decomposition: Education- vs. Work-based

Period	Total output per capita Y/N	Urban output Y_U/Y	Urban employment $(N_H+N_L)/N$	High-skilled employment share $N_H/(N_H+N_L)$	Skill premium $(w_H h/w_L)$
Zhaosheng					
Whole: 1981-2007	6.3%	1.9%	2.8%	30.8%	-3.1%
Regime 1: 1981-1994	2.0%	1.0%	1.1%	30.6%	-1.2%
Regime 2: 1995-2007	8.0%	2.8%	4.2%	30.8%	-4.7%
Work-based migration					
Whole: 1981-2007	4.5%	3.3%	19.9%	-21.7%	7.2%
Regime 1: 1981-1994	0.8%	1.7%	9.7%	-11.5%	3.5%
Regime 2: 1995-2007	5.9%	4.8%	28.1%	-24.5%	10.2%
Interactive migration					
Whole: 1981-2007	0.1%	0.4%	0.2%	11.0%	0.1%
Regime 1: 1981-1994	0.0%	0.0%	0.0%	4.4%	0.1%
Regime 2: 1995-2007	0.2%	0.7%	0.4%	12.8%	0.2%
Non-migration factors					
Whole: 1981-2007	89.1%	94.4%	77.1%	79.9%	95.8%
Regime 1: 1981-1994	97.3%	97.3%	89.2%	76.5%	97.6%
Regime 2: 1995-2007	85.8%	91.8%	67.2%	80.8%	94.3%

Factor Decomposition

Unit: Percentage change

Factors	Total output per capita Y/N	Urban output Y_U/Y	Urban employment $(N_H+N_L)/N$	High-skilled employment share $N_H/(N_H+N_L)$	Skill premium $(w_H h/w_L)$
Abolishment of the GJA (lower γ_H)	-0.9%	-0.2%	-0.4%	-2.9%	0.4%
Better work-based job opportunities (higher π)	1.5%	1.2%	8.2%	-7.3%	2.9%
$\Uparrow$ in the education-based migration cost (higher σ_e)	-0.3%	-0.1%	-0.1%	-0.8%	0.1%
$\Uparrow$ in the work-based migration cost (higher σ_w)	0.0%	0.0%	0.0%	0.0%	-0.0%
$\Uparrow$ in urban and rural TFP	52.9%	1.8%	1.0%	5.5%	-0.8%
An improvement in human capital (higher h)	10.8%	3.0%	0.3%	2.1%	9.8%
$\Uparrow$ in the child-rearing cost (higher ϕ)	-1.1%	-0.3%	-0.5%	-3.2%	0.5%
Lower market distortion (lower τ)	1.2%	0.3%	0.6%	3.5%	21.4%
Better intergenerational mobility (lower δ_{LL})	12.3%	3.2%	-0.0%	49.3%	-9.9%
Rising admission selectivity (lower a)	-24.8%	-4.9%	-12.4%	-64.2%	8.5%
An increase in college tuition (higher b)	-2.0%	-0.5%	-1.0%	-6.1%	0.9%

Policy Experiments

Unit: Percentage change

Period	Total output per capita Y/N	Urban output Y_U/Y	Urban employment $(N_H+N_L)/N$	High-skilled employment share $N_H/(N_H+N_L)$	Skill premium $(w_H h/w_L)$
No GJA in regime 1					
Whole: 1981-2007	-1.2%	-0.4%	-0.5%	-7.0%	0.7%
Regime 1: 1981-1994	-0.7%	-0.3%	-0.3%	-10.0%	0.4%
Regime 2: 1995-2007	-1.4%	-0.5%	-0.7%	-6.1%	0.9%
Better job oppertunities in regime 1: $\pi_1 = \pi_2$					
Whole: 1981-2007	2.8%	2.5%	14.4%	-6.6%	4.2%
Regime 1: 1981-1994	0.9%	2.2%	12.5%	-11.1%	4.1%
Regime 2: 1995-2007	3.6%	2.7%	16.0%	-5.4%	4.2%

Main Takeaways

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  - Effect of education-based migration is bigger (6.3% vs. 4.5%)

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  - Equal opportunity education policy can be rewarding

Migration reasons - persons

Reasons of Migration	Total	Job Transfer	Job Assignment	Work or Business	Study or Training	Others
1985	27701828	8190244	2228579	853302	3119497	13310206
2000	4929315	262394	185103	1653810	337120	2490888

Unit: person

percentage

Children's income and budget constraint

- Children's income in adulthood:

$$\begin{aligned} W^j &= I^j \left[\gamma_H w_H h + \gamma_L w_L + (1 - \gamma_H - \gamma_L) w_R\right] \\ &\quad + \left(1 - \mathbf{I}^j\right) \left[(1 - \pi) w_R + \pi (w_L - \sigma)\right] \end{aligned}$$

- Children's budget constraint:

$$c^j + I^k \cdot \left[\mathbf{I}^j (1\text{-}\gamma_H\text{-}\gamma_L) + \left(1 - I^j\right)(1 - \pi)\right]\left(x^k + \sigma\right) + \phi^k = W^j.$$

rural household problem

Evolution of workers 1

- Given the initial labor force (N_R^0, N_H^0, N_L^0), population (N_R^t, N_H^t, N_L^t) evolves according to the following transition rule:

$$
\begin{aligned}
N_H^{t+1} &= \delta_{HH} N_H^t + \delta_{LH} N_L^t + N_R^t \int \mathbf{I}^j \gamma_H dG(z^j) \\
N_L^{t+1} &= \delta_{HL} N_H^t + \delta_{LL} N_L^t \\
&\quad + N_R^t \left[\int \mathbf{I}^j \gamma_L dG(z^j) + \int (1 - \mathbf{I}^j) \pi dG(z^j) \right] \\
N_R^{t+1} &= (1 - \delta_{HH} - \delta_{HL}) N_H^t + (1 - \delta_{LH} - \delta_{LL}) N_L^t \\
&\quad + N_R^t \left\{ \begin{array}{l} \int \mathbf{I}^j (1 - \gamma_H - \gamma_L) dG(z^j) \\ + \int (1 - \mathbf{I}^j)(1 - \pi) dG(z^j) \end{array} \right\}.
\end{aligned}
$$

◂ population flows

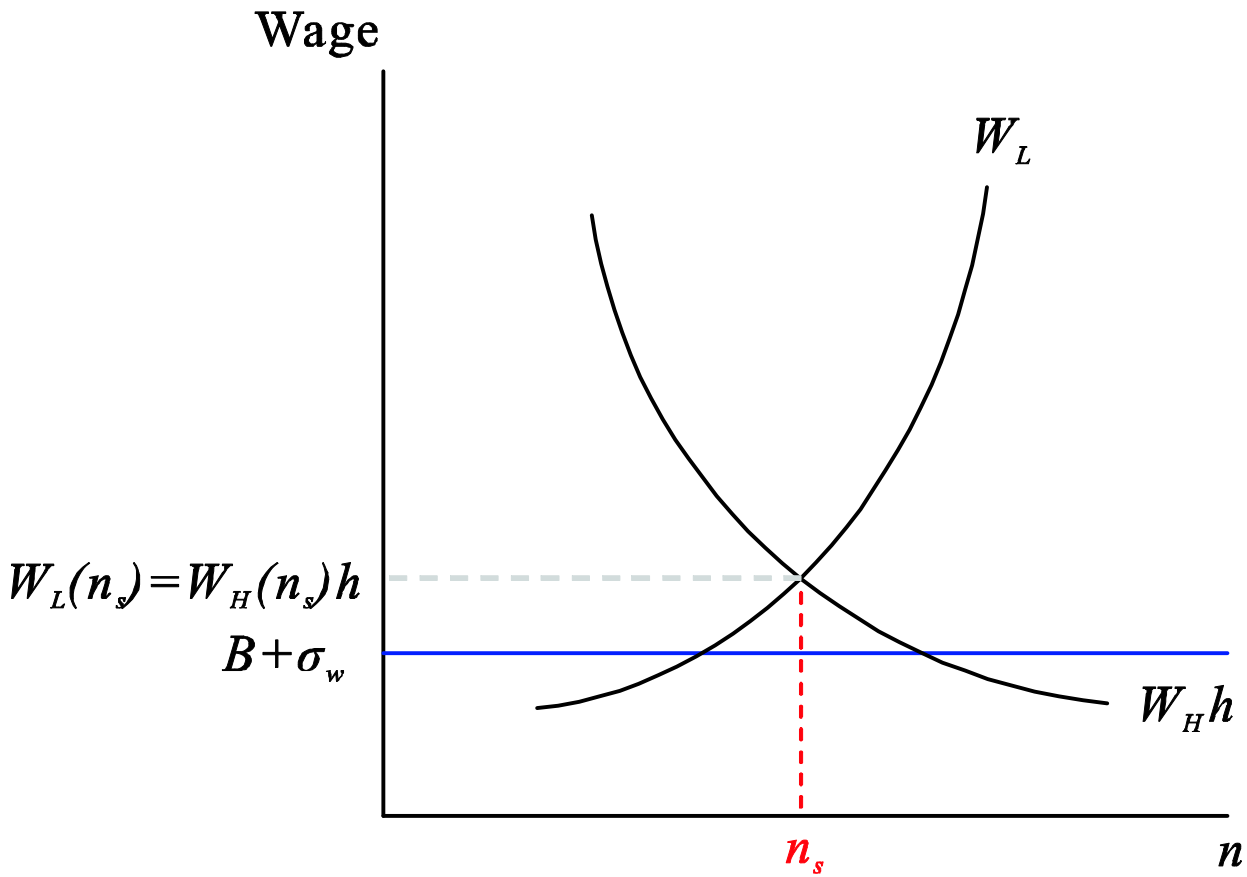
Evolution of Workers 2

- Flows of population via *zhaosheng* and work-based *migration* are

$$\begin{aligned} \tilde{N}_E^t &= N_R^t \int \mathbf{I}^j \left(\gamma_H + \gamma_L\right) dG(z^j) \\ \tilde{N}_W^t &= N_R^t \int \left(1 - \mathbf{I}^j\right) \pi dG(z^j). \end{aligned}$$

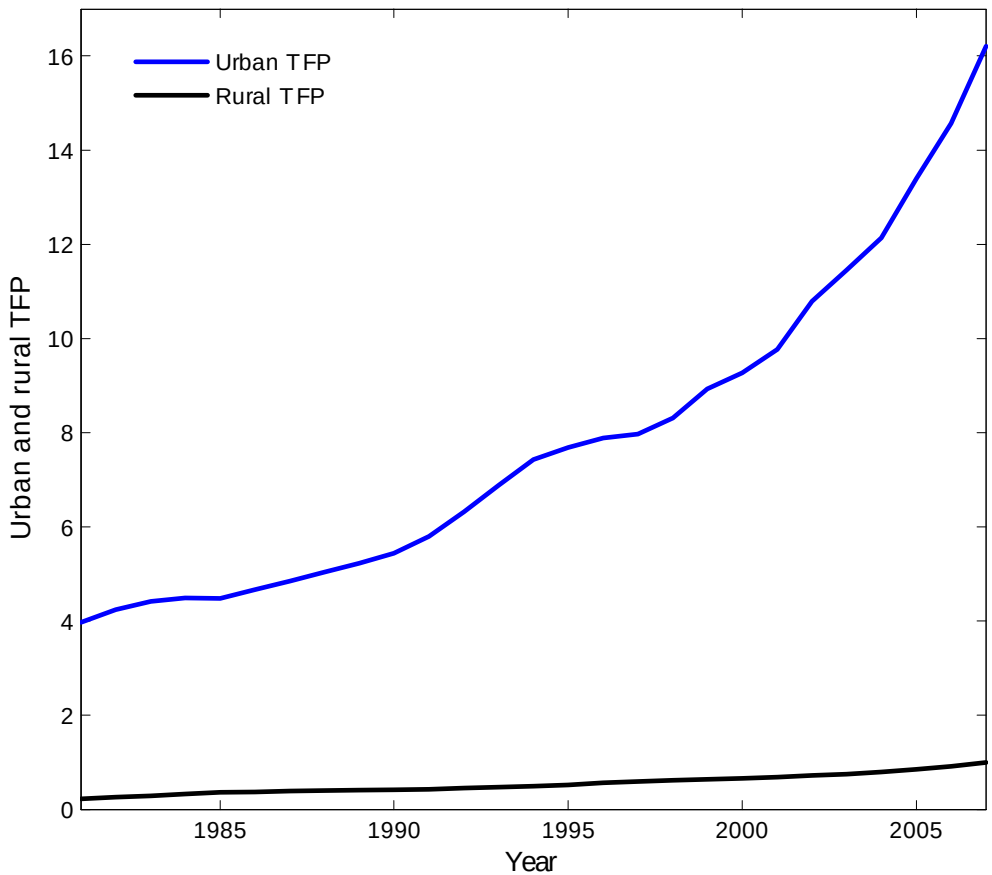
◂ population flows

Urban wages versus rural wage



labor-market-property

Calibrated series: TFP



◂ calibration result

Benchmark Model

Period	Total output per capita Y/N	Urban output Y_U/Y	Urban employment $(N_H+N_L)/N$	High-skilled employment share $N_H/(N_H+N_L)$	Skill premium $(w_H h/w_L)$
Whole: 1981-2007	1.6206	0.7148	0.2516	0.0784	1.4571
Regime 1: 1981-1994	0.8811	0.6585	0.2174	0.0327	1.2575
Regime 2: 1995-2007	2.4169	0.7754	0.2883	0.1277	1.6720

◂ Model vs. Data

◂ calibration

	Parameter values		Target	Target values		Explanation/Source
	Regime 1	Regime 2		Regime 1	Regime 2	
Preset						
γ_L	0	0.05				preset
δ_{HH}	1	1				preset
Calibrated: Regime-common						
β	0.7798					annual discount factor=1%
ε	1.5					elasticity of intertemporal substitution=2/3
z_{min}	1					standard setup in the literature
$\bar{\phi}$	0.174	0.174				percentage of rural income. Zhu and Zhang (1996)
θ	2.5					computed using rural household net income data in CHIPS 1995 and 2002
ρ	0.6667					elasticity of substitution between high/low skilled=3
α	0.8461		Y_U/Y	0.6922		Bai and Qian (2010)
ψ	0.0618		Y_U/Y		0.8294	Bai and Qian (2010)
Calibrated: Regime-specific						
γ	-	0.9209				urban employment rate, using data in CHIPS 1995, 2002 and 2008
γ_H	1	0.8709				$\gamma_H = \gamma - \gamma_L$
π	0.0036	0.0083				prob. of work-based migration in Table 2
δ_{LL}	0.9996	0.9883	N_H/N_L	0.0424	0.1466	see Appendix C for the detail
B	0.3685	0.7177				$w_R = 1$ in 2007, see Appendix C for the detail
h	1.3529	1.5928				Mincerian rate of return, see Appendix C for the detail
A	5.3877	11.0573	w_L/w_R	1.7781	2.0076	see Appendix C for the detail
τ	7.1103	5.4763	$w_H h/w_L$	1.2296	1.6576	Lee (1999), Zhang et al. (2005) and Ge and Yang (2014); see Appendix C for the detail
$\hat{z}$	17.7632	13.1391		0.059%	0.114%	match regime average of *zhaosheng* flow in Table 2
$\bar{\sigma}_e$	0.1841	0.1021				percentage of rural household income, according to He and Dong (2007)
$\bar{\sigma}_w$	0.5554	0.3079				percentage of rural household income, using data in CHIPS 2002
a	1.1489	0.4701				solved by the indifference boundary equations
b	0.0048	0.0528				percentage of rural household income, using data in UHS 2007 and 2008
Model implications						
$1-G(\hat{z})$	0.075%	0.160%				*zhaosheng* proportion
A/B	14.6188	15.4071				urban-rural TFP ratio
ψ_{cost}	0.6459	0.4380				unit cost reduced by ψ
A_g		5.47%				average annual growth rate of A in 1981-2007
$(A/B)_g$		0.39%				average annual growth rate of A/B in 1981-2007

Note: Calibrated results are not sensitive to the value of γ_L. α, ψ, A and τ are actually solved together to match the corresponding targets listed in the table.