Trade, Migration, and Productivity: A Quantitative Analysis of China

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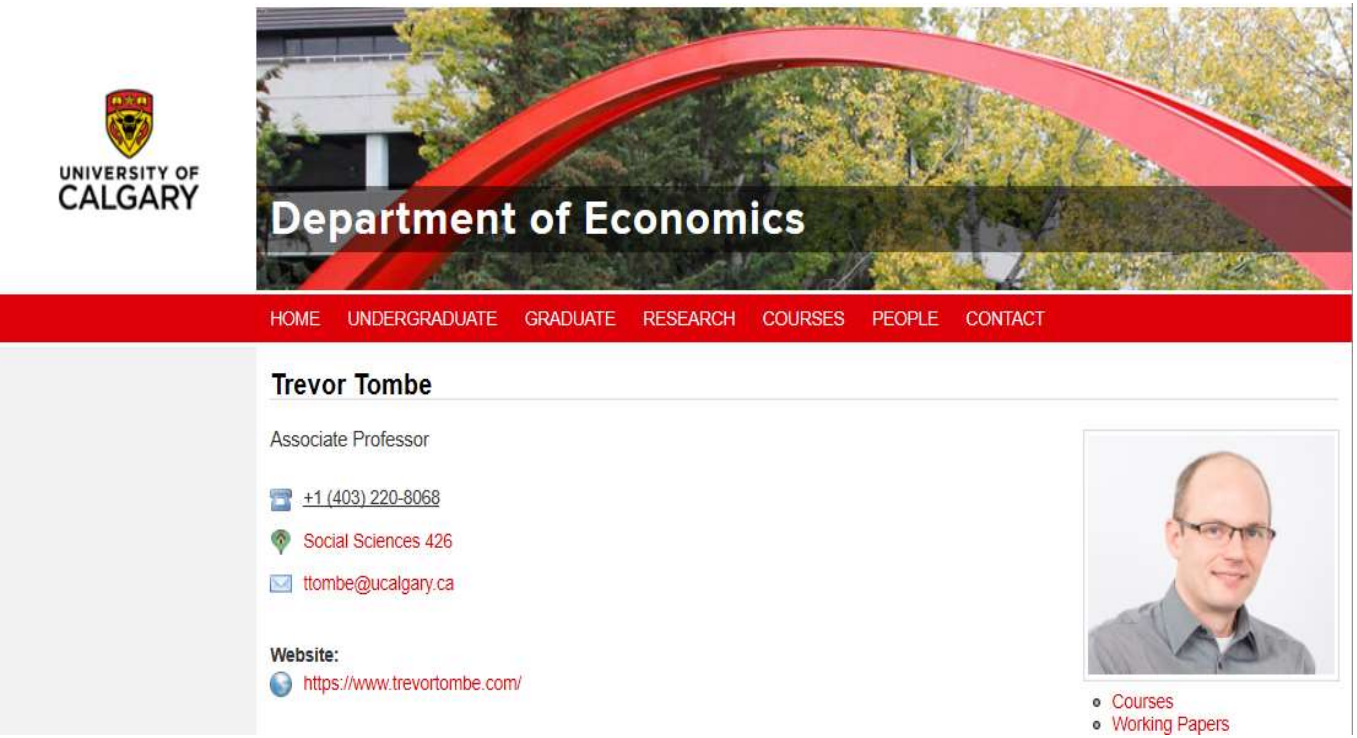

2011年获多伦多大学经济学博士学位，现为加拿大卡尔加里大学经济系副教授

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- **"Trade, Migration and Productivity: A Quantitative Analysis of China"**
- "Final and Unalterable — But Up for Negotiation: Federal-Provincial Transfers in Canada"
- "Internal Trade, Productivity, and Interconnected Industries: A Quantitative Analysis"

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- **"Trade, Migration, and Productivity: A Quantitative Analysis of China"**
- "Understanding China's Growth: Past, Present and Future"
- "Agriculture and Aggregate Productivity: A Quantitative Cross-Country Analysis"

Background

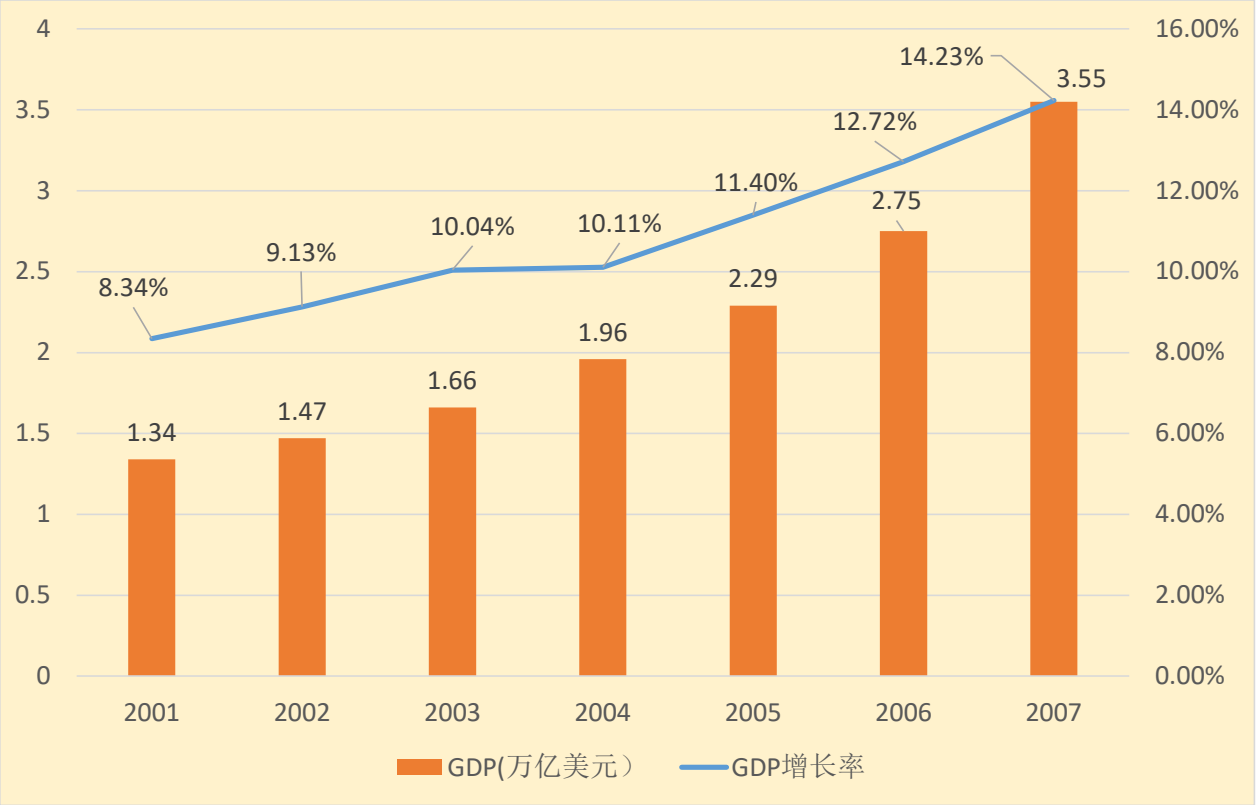
从2001年开始，中国经济高速增长。

这种增长从何而来？2001年发生了什么重要的大事呢？

2001年12月11日，中国正式加入世界贸易组织。

“入世” → 经济起飞飞飞飞？

或是背后存在神秘的“X”？



Abstract

- 数据

收入数据——包括《中国统计年鉴》中名义GDP、三次产业就业、价格指数等
劳动力转移数据——包括2000年普查样本的1%和2005年人口抽查样本的20%
贸易额数据——2002年和2007年的中国区域间投入产出表

- 模型

一个包含国内贸易、国际贸易和工人迁移的两部门多区域一般均衡模型

特色：（1）将土地集体所有纳入模型（使人口迁移变得困难）
（2）将户口制度引入模型（使迁移成本由沉没成本转为持续成本）

- 重要结论

2000至2005年间，国内贸易和移民成本的降低，以及引起的国内贸易和移民的增加，可以解释中国劳动生产率增长总量的28%；与此相对的，国际贸易成本的降低仅能解释经济增长的8%

这些结果凸显出内部改革对中国经济增长的重要性，与人们普遍认为的“出口推动型”增长形成鲜明对比

1. Data, Facts, and Back-of-the-Envelope Calculation

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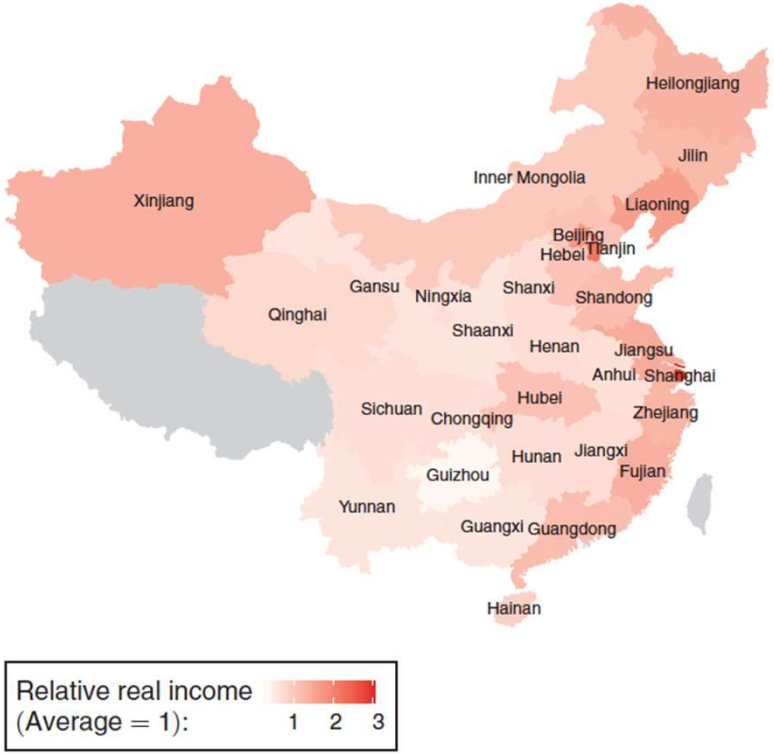
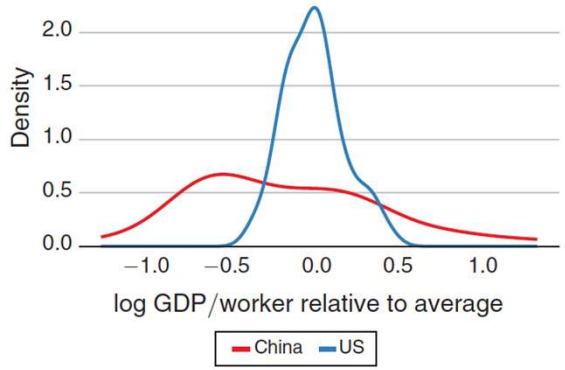
A. Spatial Distribution of Income

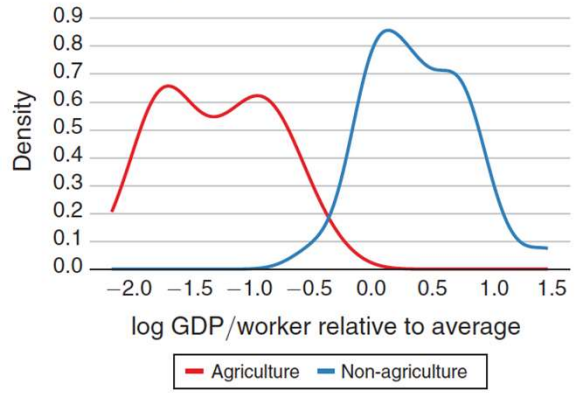
Panel A. Real GDP/worker, relative to mean



Panel A. Across regions within China and the US



Panel B. Across China's regions within ag and non-ag



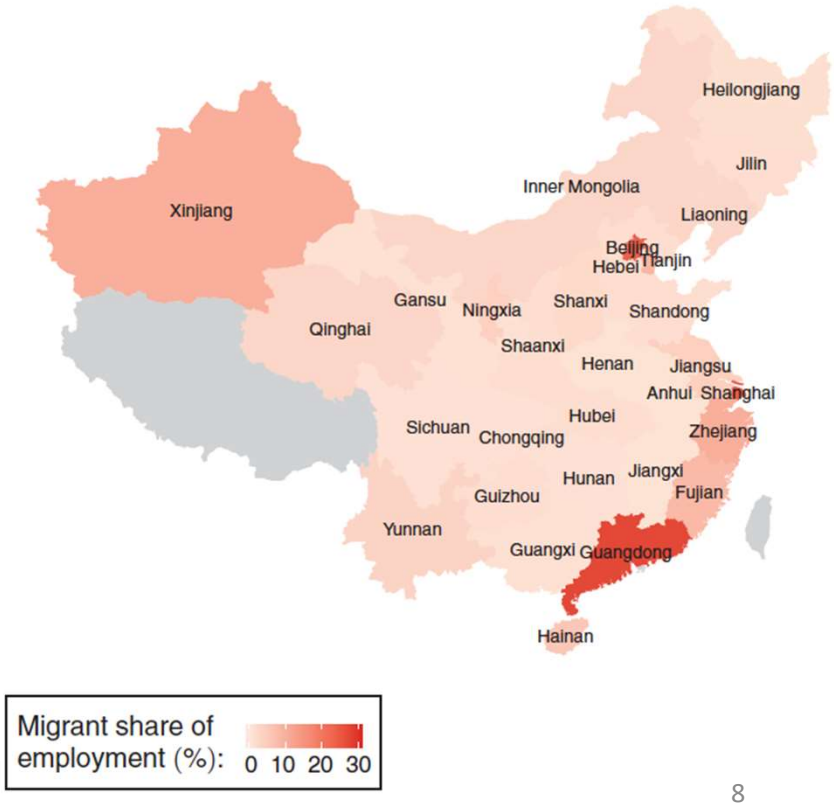
B. Migration Policies and Patterns

- “户口”制度：地区+生产部门
- 改革
- 省内移民 & 省际移民

TABLE 1—STOCK OF MIGRANT WORKERS IN CHINA

	Inter-provincial		Intra-provincial	
	2000	2005	2000	2005
Total migrant stock (millions)	26.5	49.0	90.1	120.4
Share of total employment (%)				
Total migrants	4.2	7.2	14.3	17.7
Agriculture-to-non-agriculture migrants	3.4	5.6	13.1	16.4

Panel B. Migrant share of total employment



C. Trade Policies and Patterns

- 改革
- 省内+省外+国外
- 省外进口占比与国际进口占比均出现上升

TABLE 2—INTERNAL AND EXTERNAL TRADE SHARES OF CHINA

Importer	Exporter: Northeast	Beijing Tianjin	North Coast	Central Coast	South Coast	Central region	Northwest	Southwest	Abroad	Total other prov.
Year 2002										
Northeast	87.9	0.7	1.0	0.8	1.3	1.1	0.8	0.9	5.5	6.6
Beijing/Tianjin	3.9	63.4	9.4	3.0	2.6	3.3	1.4	1.2	11.9	24.8
North Coast	1.8	3.3	79.8	3.4	1.8	3.8	0.9	0.8	4.4	15.8
Central Coast	0.2	0.2	0.6	81.0	1.5	2.4	0.5	0.5	13.3	5.7
South Coast	0.5	0.4	0.5	2.6	72.3	1.9	0.4	1.5	19.8	7.9
Central region	0.6	0.3	1.1	4.8	2.3	87.8	0.7	0.7	1.8	10.4
Northwest	2.0	0.8	2.1	3.3	4.5	3.6	77.4	3.8	2.6	20.0
Southwest	0.9	0.3	0.4	1.8	4.3	1.4	0.9	88.0	2.0	10.0
Abroad	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	99.6	–
Year 2007										
Northeast	78.7	2.0	2.0	0.9	2.7	1.0	1.4	0.9	10.4	10.9
Beijing/Tianjin	3.8	62.3	10.1	1.5	2.4	1.8	2.1	0.7	15.5	22.2
North Coast	2.1	5.8	76.8	1.5	1.5	3.7	2.3	0.8	5.5	17.7
Central Coast	1.1	0.7	1.4	76.8	1.8	4.8	1.7	0.9	10.8	12.4
South Coast	1.5	0.9	1.7	5.2	68.5	3.6	1.8	2.8	14.1	17.4
Central region	1.7	1.4	4.5	4.9	4.0	73.0	2.9	1.8	5.9	21.1
Northwest	2.3	2.2	4.8	2.7	5.5	3.6	65.6	3.6	9.8	24.6
Southwest	1.6	1.2	1.7	1.7	8.4	1.9	3.2	73.8	6.6	19.6
Abroad	0.0	0.1	0.1	0.4	0.2	0.0	0.0	0.0	99.1	9–

D. Potential Gains from Migration and Trade

- 给定n省j部门的人均实际GDP y_n^j 和劳动力在全国的占比l_n^j，可得全国总的人均GDP为 $y = \sum_{n,j} y_n^j l_n^j$，总人均GDP的相对变化率即为

$$\hat{y} = \sum_{n,j} w_n^j \widehat{y_n^j} \widehat{l_n^j} = 1 + \sum_{n,j} w_n^j g_{y_n^j} + \sum_{n,j} w_n^j g_{l_n^j} + \sum_{n,j} w_n^j g_{y_n^j} g_{l_n^j}$$

- 其中 $\hat{x} = x'/x$, $g_x = \hat{x} - 1$, $w_n^j \propto y_n^j l_n^j$

- 给定 $\hat{y}_n^j = \hat{A}_n^j \left(\hat{\pi}_n^j\right)^{-1/\theta}$，其中 A_n^j是自给自足下的劳动生产率；定义 π_{nn}^j ,π_{nc}^j ,π_{nw}^j分别为总支出中用于购买本省产品、外省产品及外国产品的部分，可以得到

$$g_y = \underbrace{\sum_{n,j} w_n^j \frac{1}{\theta} \frac{\Delta \pi_{nc}^j}{\pi_{nn}^j}}_{\text{Internal Trade } 4.9\%} + \underbrace{\sum_{n,j} w_n^j \frac{1}{\theta} \frac{\Delta \pi_{nw}^j}{\pi_{nn}^j}}_{\text{External Trade } 0.5\%} + \underbrace{\sum_{n,j} w_n^j g_{l_n^j}}_{\text{Migration } 10.8\%} + \underbrace{\left(\sum_{n,j} w_n^j g_{A_n^j} + \sum_{n,j} w_n^j g_{y_n^j} g_{l_n^j}\right)}_{\text{Residual } 40.9\%}$$

2. Quantitative Model

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Assumptions:

- N+1个地区：N个中国省份和世界 $n \in \{1, \ldots, N+1\}$
- 两个贸易部分：农业和非农业 $j \in \{ag, na\}$
- 固定要素：用于住房和生产的土地和建筑 $\overline{S_n^j}$
- 下标 ni: 从地区n向地区i的流向
- 上标 jk: 从部门j向部门k的流向
- 人口迁移：跨地区迁移、地区内从农村向城市的跨部门迁移

A. Worker Preferences & B. Production, Trade, and Goods Prices

A.工人偏好：

- 柯布道格拉斯效用函数: (1) $u_n^j = \varepsilon\left(C_n^{j,ag}\right)^{\alpha\Psi^{ag}}\left(C_n^{j,na}\right)^{\alpha\Psi^{na}}\left(S_n^{j,h}\right)^{1-\alpha}$ s.t. $P_n^{j,ag}C_n^{j,ag} + P_n^{j,na}C_n^{j,na} + r_n^j S_n^{j,h} \le v_{in}^{kj}$
- n地区工人对于商品j的最终需求：(2) $D_n^j = \alpha\Psi^j \sum_{k\in\{ag,na\}} v_n^k L_n^k$ 拉格朗日方法可求！

B.生产者:

- 在生产者完全竞争、以柯布道格拉斯技术生产下的边际成本:

(3) $$c_n^j(\varphi) \propto \frac{1}{\varphi}\left[\left(w_n^j\right)^{\beta^j}\left(r_n^j\right)^{\eta^j}\left(\prod_{k\in\{ag,na\}}\left(P_n^k\right)^{\sigma^{jk}}\right)\right] \quad ——c_n^j$$

- 由于冰山成本，生跨区销售和本地销售的商品价格存在差异： $p_{ni}^j(\varphi) = \tau_{ni}^j c_i^j(\varphi)$
- 通过最小化买价， 得到均衡时n地区中由i地区生产的j部门商品的贸易份额π_{ni}^j和最终产品价格P_n^j：

(4) $$\pi_{ni}^j = \frac{T_i^j\left(\tau_{ni}^j c_i^j\right)^{-\theta}}{\sum_{m=1}^{N+1} T_m^j\left(\tau_{nm}^j c_m^j\right)^{-\theta}}$$

(5) $$P_n^j = \gamma\left[\sum_{i=1}^{N+1} T_i^j\left(\tau_{ni}^j c_i^j\right)^{-\theta}\right]^{-1/\theta}$$

- 均衡时，结合需求函数，n地区j部门的总收益R_n^j和总支出X_n^j为：

(6) $$R_n^j = \sum_{i=1}^{N+1} \pi_{in}^j X_i^j$$

(7) $$X_n^j = D_n^j + \sum_k \sigma^{kj} R_n^k$$

C. Incomes of Workers

- 本地户口人在固定要素上的收入=对当地固定要素的总需求支出：

$$r_n^j \overline{S_n^j} = (1-\alpha) v_n^j L_n^j + \eta^j R_n^j = (1-\alpha) v_n^j L_n^j + \eta^j \beta^{j-1} w_n^j L_n^j.$$

- 地区n部门j的固定要素总收入为：

$$r_n^j \bar{S}_n^j = \left[\frac{(1-\alpha)\beta^j + \eta^j}{\alpha\beta^j}\right] w_n^j L_n^j \Longrightarrow$$ 本地户口收入： $$v_{nn}^{jj} = w_n^j + r_n^j \bar{S}_n^j / L_{nn}^{jj}$$

- 定义有效固定成本对工人的“返利率”： (9)

$$\delta_{ni}^{jk} = \begin{cases} 1 + \left(\frac{(1-\alpha)\beta^j + \eta^j}{\alpha\beta^j}\right)\frac{L_n^j}{L_{nn}^{jj}} & \text{if } n = i \text{ and } j = k \\ 1 & \text{if } n \neq i \text{ or } j \neq k \end{cases},$$

$\Longrightarrow$ 收入： $$v_{ni}^{jk} = \delta_{ni}^{jk} w_i^k$$

D. Internal Migration & E. Solving the Model

D.迁移占比：

- m_{ni}^{jk}: 户口为(n, j) 并流动至(i, k) 的工人比例
- 最大化工人的福利：$\varepsilon_i^k \delta_{ni}^{jk} V_i^k / \mu_{ni}^{jk}$

Proposition 1:

✓*The share of* (n, j) *-registered workers who migrate to* (i, k) *is* $m_{ni}^{jk} = \dfrac{\left(V_i^k \delta_{ni}^{jk} / \mu_{ni}^{jk}\right)^{\kappa}}{\sum_{k'} \sum_{i'=1}^{N} \left(V_{i'}^{k'} \delta_{ni'}^{jk'} / \mu_{ni'}^{jk'}\right)^{\kappa}}$ *(10)*

✓*Total employment at (i, k) is* $L_i^k = \sum_j \sum_{n=1}^{N} m_{ni}^{jk} \bar{L}_n^j$

E.均衡经济增长率：

Proposition 2:

✓*The change in aggregate welfare is* $\hat{W} = \sum_j \sum_{n=1}^{N} \omega_n^j \hat{V}_n^j \hat{\delta}_{nn}^{jj} \left(\hat{m}_{nn}^{jj}\right)^{-1/\kappa}$ *(11)*

where $\omega_n^j \propto \bar{L}_n^j V_n^j \delta_{nn}^{jj} \left(\hat{m}_{nn}^{jj}\right)^{-1/\kappa}$ *is region n and sector j's initial contribution to welfare*

✓*Similarly, the change in real GDP is* $\hat{Y} = \sum_j \sum_{n=1}^{N} \phi_n^j \hat{V}_n^j \hat{L}_n^j$ *(12)*

where $\phi_n^j \propto V_n^j L_n^j$ *is the contribution of region n and sector j to initial real GDP.*

F. Calibration

TABLE 3—CALIBRATED MODEL PARAMETERS AND INITIAL VALUES

Parameter	Value	Description
(β^{ag}, β^{na})	$(0.29, 0.22)$	Labor's share of output
(η^{ag}, η^{na})	$(0.28, 0.03)$	Land's share of output
$(\sigma^{ag,na}, \sigma^{na,ag})$	$(0.60, 0.06)$	Intermediate input shares
ψ^{ag}	0.095	Agriculture's share of final demand
α	0.87	Goods' expenditure share
θ	4	Elasticity of trade
κ	1.5	Elasticity of migration
π^j_{ni}	Data	Bilateral trade shares
m^j_{ni}	Data	Bilateral migration shares
$\bar{L}^j_n$	Data	Hukou registrations

$\boldsymbol{\beta}, \boldsymbol{\eta}, \boldsymbol{\sigma}, \boldsymbol{\psi}, \boldsymbol{\alpha}$: 根据真实数据估计

$\boldsymbol{m}, \boldsymbol{L}$: 观测值

$\boldsymbol{\pi}$： 由于缺乏2000年数据，故由2002年数据近似得到

$\boldsymbol{\theta}$: 基于大量文献研究设置 $\theta = 4$

$\boldsymbol{\kappa}$:

$$\ln\left(\frac{m^{jk}_{ni}}{m^{jj}_{nn}}\right) = \kappa \ln\left(V^k_i\right) + \gamma_{ni} + \gamma^j_n + \varsigma^{jk}_{ni}, \quad \text{for } (n,i) \neq (i,k)$$

(1) OLS

(2) IV:

a.邻近省份的距离加权平均收入

b.巴蒂克式的预期收入工具:

2005人口普查数据 & 2000UHS数据

3. Inferring Migration and Trade Costs

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A. Migration Costs

$$m_{ni}^{jk} = \frac{\left(V_i^k \delta_{ni}^{jk} / \mu_{ni}^{jk}\right)^{\kappa}}{\sum_{k'} \sum_{i'=1}^{N} \left(V_{i'}^{k'} \delta_{ni'}^{jk'} / \mu_{ni'}^{jk'}\right)^{\kappa}}$$

$$\delta_{ni}^{jk} = 1 \quad \text{if } n \neq i \text{ or } j \neq k$$

$$\mu_{ni}^{jk} = \frac{1}{\delta_{nn}^{jj}} \left(\frac{V_i^k}{V_n^j}\right) \left(\frac{m_{nn}^{jj}}{m_{ni}^{jk}}\right)^{1/\kappa}, \quad \text{for } n \neq i.$$

	Initial share of employment	Average migration costs μ_{in}^{kj} Level in 2000	Level in 2005	Relative change
Overall	0.174	2.82	2.31	0.82
Agriculture to non-agriculture migration cost changes				
Overall	0.16	2.63	2.16	0.82
Within province	0.13	2.21	1.83	0.83
Between provinces	0.03	25.21	15.43	0.61
Between provinces migration cost changes				
Overall	0.04	24.75	15.08	0.61
Within agriculture	0.003	47.67	42.22	0.89
Within non-agriculture	0.01	21.02	12.2	0.58

省际迁移工人面临的成本是最大的，省内跨部门迁移人员面临的成本则小很多

A. Migration Costs

虽然估计的迁移成本很大，但它们与我们认为对迁移很重要的因素有关，并且与来自个别调查数据的证据大致一致。

- 劳动力迁移成本随距离增加而增加
- 劳动力迁移成本随年龄增加而增加
- 为维持较大的收入差距，存在巨大的劳动力迁移成本
- 未考虑地区偏好，导致结果较大（但不影响成本变化）

政策因素

- 2003 年颁布的《行政许可法》简化了暂住证的办理流程
- 户口制度改革
- 政府大量投资公路建设

B. Trade Costs

$$\pi_{ni}^{j} = \frac{T_i^j \left(\tau_{ni}^j c_i^j\right)^{-\theta}}{\sum_{m=1}^{N+1} T_m^j \left(\tau_{nm}^j c_m^j\right)^{-\theta}} \Rightarrow \tau_{ni}^{j} = \left(\frac{\pi_{nn}^{j}}{\pi_{ni}^{j}}\right)^{1/\theta}$$

$$\Rightarrow \bar{\tau}_{ni}^{j} \equiv \sqrt{\tau_{ni}^j \tau_{in}^j} = \left(\frac{\pi_{nn}^j \pi_{ii}^j}{\pi_{ni}^j \pi_{in}^j}\right)^{1/2\theta}$$

优点

- 不受贸易量的影响或第三方效应的影响
- 不论贸易平衡与否，都适用

B. Trade Costs

TABLE 6—BILATERAL TRADE COSTS IN 2002 AND THE CHANGE TO 2007

Importer	Exporter: Northeast	Beijing Tianjin	North Coast	Central Coast	South Coast	Central region	Northwest	Southwest	Abroad
Average trade cost levels in 2002									
Northeast		2.61	2.89	3.65	2.71	3.32	2.57	3.36	3.43
Beijing/Tianjin	2.60		1.92	3.13	2.44	3.08	2.66	3.44	2.84
North Coast	2.79	1.87		2.69	2.51	2.58	2.53	3.61	3.30
Central Coast	3.80	3.27	2.89		2.21	2.27	2.70	3.34	2.43
South Coast	3.74	3.39	3.59	2.91		3.03	3.08	2.93	2.62
Central region	3.18	2.94	2.53	2.15	2.06		2.46	3.12	4.08
Northwest	3.02	3.07	2.96	2.94	2.50	2.95		2.89	4.61
Southwest	3.10	3.20	3.47	2.95	1.96	3.08	2.38		4.25
Abroad	4.94	4.10	4.75	3.37	2.63	6.05	5.79	6.32	
Average trade cost changes from 2002 to 2007									
Northeast		0.91	0.90	0.84	0.83	0.88	0.92	0.88	0.81
Beijing/Tianjin	0.84		0.89	0.91	0.89	0.80	0.75	0.85	0.78
North Coast	0.87	0.93		1.00	0.87	0.78	0.72	0.77	0.80
Central Coast	0.76	0.88	0.92		0.88	0.82	0.74	0.85	0.81
South Coast	0.77	0.93	0.87	0.92		0.81	0.72	0.80	0.92
Central region	0.88	0.91	0.85	0.96	0.90		0.78	0.84	0.75
Northwest	0.99	0.92	0.85	0.96	0.88	0.86		0.87	0.68
Southwest	0.89	0.94	0.83	0.97	0.85	0.82	0.78		0.74
Abroad	0.88	0.93	0.92	0.98	1.05	0.77	0.64	0.79	

贫困地区面临着更大的出口贸易成本，但相比于2002，2007 年各个区域的国内外贸易成本均显著下降

4.Quantitative Analysis

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A. Lower Migration Costs &
B. The Effect of Lower Trade Costs

TABLE 7—EFFECTS OF VARIOUS MIGRATION COST CHANGES

	Trade shares (p.p. change)		Migrant stock (%)		Real GDP per worker (%)	Aggregate welfare (%)
	Internal	External	Within province	Between province		
All	0.1	0.1	14.5	80.8	4.8	11.1
No land inputs	0.1	0.2	14.4	85.6	5.3	8.4
And no housing	0.1	0.2	13.8	90.4	6.5	7.6
And $\theta \rightarrow \infty$	−0.2	0.1	23.2	119.2	11.8	6.2
Agriculture to non-agriculture migration cost changes						
Overall	0.1	0.1	15.2	52.9	4.3	9.1
Within provinces	−0.0	−0.1	22.8	−9.7	2.0	5.9
Between provinces	0.1	0.2	−7.0	69.9	2.8	3.5
Between provinces migration cost changes						
Overall	0.2	0.3	−7.8	97.9	3.2	5.5
Within agriculture	−0.0	0.0	−0.1	2.3	−0.0	0.1
Within non-agriculture	0.1	0.1	−1.0	30.9	0.7	2.2

- 相比国际贸易，国内贸易和人口流动对GDP的贡献更显著
- 贸易成本下降带来的收益高于预估，人口流动成本的收益低于预估

TABLE 8—EFFECTS OF TRADE COST CHANGES

	Trade shares (p.p. change)		Migrant stock (%)		Real GDP per worker (%)	Aggregate welfare (%)
	Internal	External	Within province	Between province		
Internal trade	9.2	−0.7	0.8	−1.8	11.2	11.4
External trade	−0.7	3.9	1.8	2.4	4.0	2.9
All trade	8.2	2.8	2.5	0.5	15.2	14.1
No Change in migration						
Internal trade	9.1	−0.7	–	–	11.2	11.2
External trade	−0.7	3.9	–	–	3.4	3.4
All trade	8.2	2.8	–	–	14.5	14.5
No intermediate inputs						
Internal trade	8.6	−0.5	0.3	−1.4	3.0	3.3
External trade	−0.7	3.9	1.5	1.6	1.1	0.3
All trade	7.6	3.2	1.6	0.1	4.1	3.5
No intermediate inputs and no change in migration						
Internal trade	8.6	−0.5	–	–	3.1	3.1
External trade	−0.7	3.9	–	–	0.6	0.6
All trade	7.6	3.2	–	–	3.7	3.7

C. Decomposing China's Recent Economic Growth

TABLE 9—DECOMPOSING CHINA'S AGGREGATE LABOR PRODUCTIVITY GROWTH

	Marginal effects		
	Real GDP per worker growth (%)	Share of growth	Standard deviation (%)
Overall (all changes)	57.1	–	–
Productivity changes	36.9	0.64	1.3
Internal trade cost changes	10.2	0.18	0.3
External trade cost changes	4.5	0.08	0.7
Migration cost changes	5.6	0.10	0.9
Of the migration cost changes			
Between-province, within-non-agriculture	0.9	0.02	0.4
Between-province, within-agriculture	0.0	0.00	0.0
Between-province, agriculture-non-agriculture	3.2	0.06	0.9
Within-province, agriculture-non-agriculture	1.5	0.03	0.3

- 贸易及人口流动成本的降低总共贡献了1/3以上的产出增长，国内贸易成本及人口流动成本约占28%，而国际贸易成本仅占8%

5. Potential Gains from Further Reform

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A. Further Reductions in Trade and Migration Costs

TABLE 10—POTENTIAL GAINS FROM FURTHER TRADE AND MIGRATION LIBERALIZATION

	Relative to 2005 equilibrium	
	Change in real GDP (%)	Aggregate welfare (%)
Average internal trade costs as in Canada	12.5	16.3
A 1/3 inter-provincial migrant share	12.8	45.6
Both together	26.0	69.2

- 加拿大国内贸易成本&美国人口流动比例

B. Land Reform

TABLE 11—EFFECT OF INDIVIDUAL OWNERSHIP LAND REFORM

	Percent change
Welfare	11.8
Real GDP	−2.4
Migration, within-province	96.3
Migration, between-province	38.0

	Share of population (%)	
	Initial equilibrium	New equilibrium
Agricultural workers	52.9	56.6
Stock of migrants, urban-rural	2.1	10.9
Stock of migrants, rural-urban	14.0	19.1

- 土地所有制改革将使人口流动量与福利提升，但真实GDP有所下降

6. Conclusion

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Conclusion

- 相比于“入世”带来的贸易自由化与出口扩张，中国政府在同一时期进行的内部政策改革没有得到同样的重视。本文发现，这些改革有助于降低国内贸易和移民的成本，并且带来的经济增长远大于国际贸易成本的影响

- 尽管国内贸易和移民成本有所下降，但中国进一步降低这些成本的空间仍然很大

- 本文的结果可能会导致人们得出结论，认为国际自由化对总体结果影响不大，但文章中量化的贸易自由化的贡献只是贸易导致的资源重新分配的影响，但是，对外贸易自由化也可能通过我们没有研究的其他渠道促进生产力增长

Thanks for listening!

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