Financial Friction and Misallocation in China

Belton M. Fleisher
Ohio State University and
Hunan University

Ohyun Kwon
Drexel University

William H. McGuire
University of Washington Tacoma

Min Qiang Zhao
WISE, Xiamen University

Bank of Thailand, July 24th

Introduction

- Dispersion in marginal revenue product of capital (MRPK) leads to productivity loss. (Hsieh and Klenow, '09)
- Financial friction in China (barrier to borrow)
  - private vs. state (Poncet et al. '10)
  - between provinces (Boyreau-Debray and Wei '05, Qi '10)
- What is the consequence of financial friction in China?
  - migration, capital flow, wage and real income

Introduction

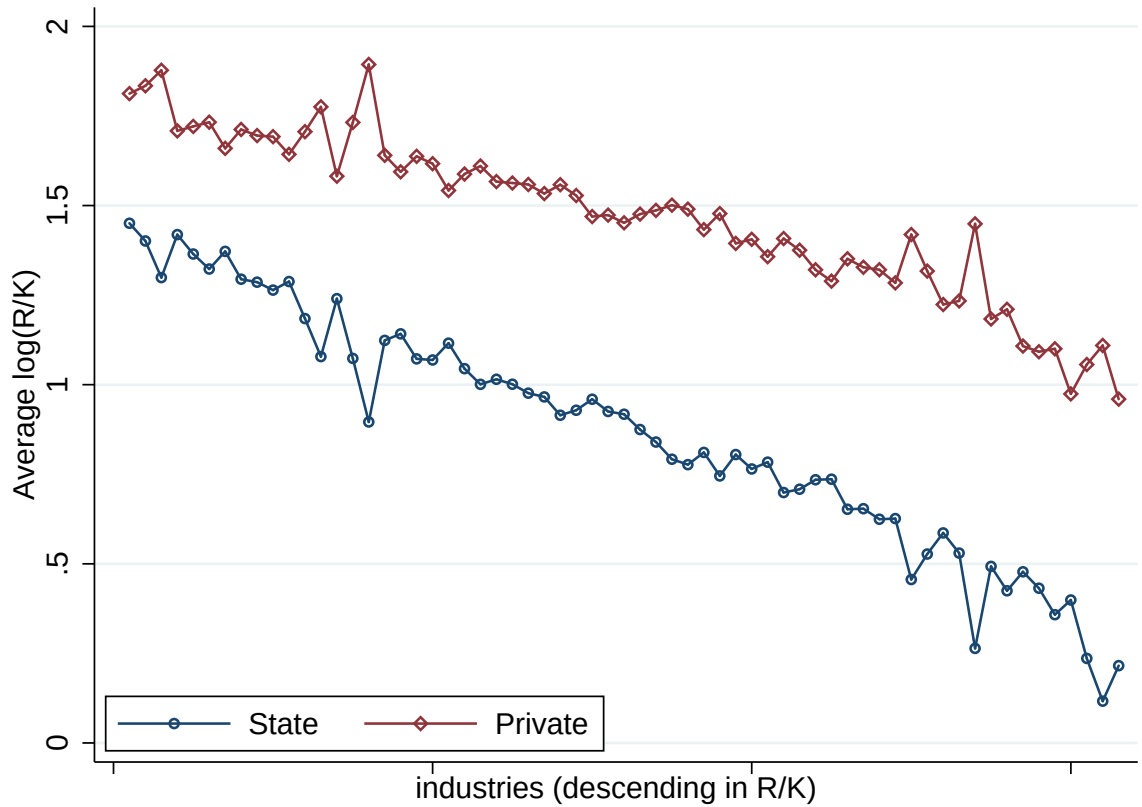
- We combine AC-type (Antràs and Caballero '09) financial friction (FF) with quantitative trade model to explain interregional capital flows and labor flows (migration) in China.

  - find strong consistency between model prediction and data

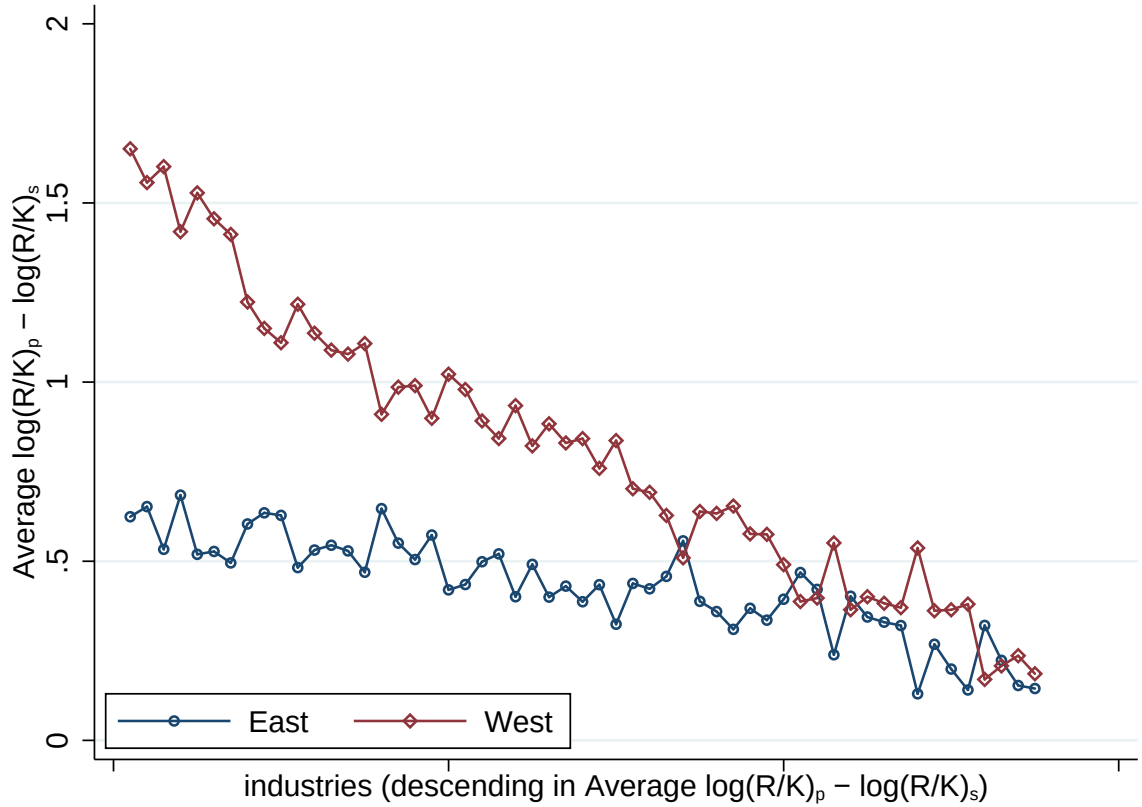
- Estimating parameters to match the model to the data around 2010
  - Removing FF between ownerships improves real income by 1.08% (4.73% for Guangxi)
  - Removing FF between provinces further improves real income by 3.88% (24.84% for Qinghai)
  - Complementarity between financial friction and migration cost

Comparison of Revenue/Capital Ratios between Ownership Types across Industries

- If the production function is Cobb-Douglas, revenue-capital ratio is: r/β (MRPK / capital share)



Comparison of Revenue/Capital Ratios between Regions for Private Firms across Industries

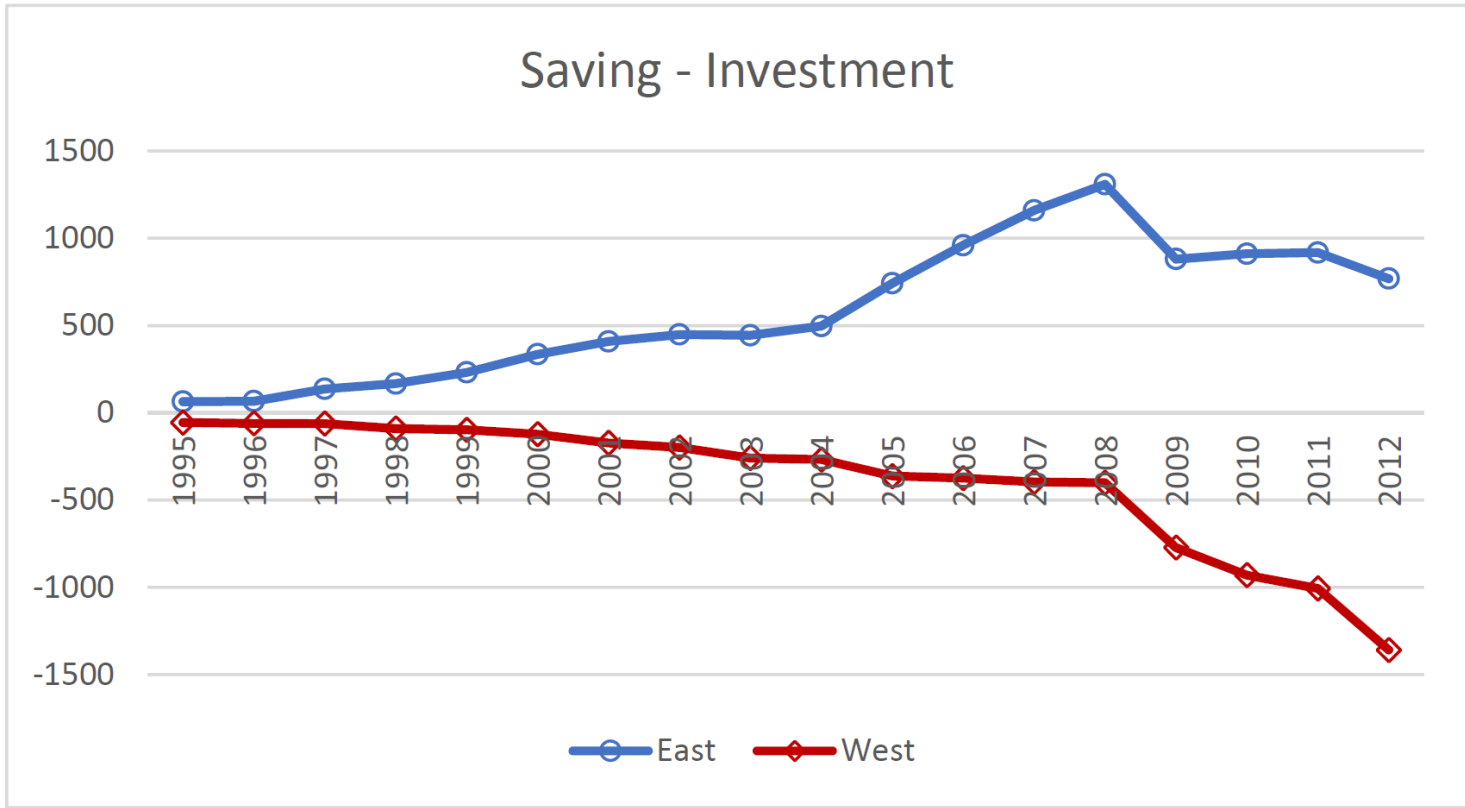


East: Beijing, Fujian, Guangdong, Hainan, Hebei, Jiangsu, Shandong, Shanghai, Tianjin, and Zhejiang.

West: Chongqing, Gansu, Guangxi, Guizhou, Inner Mongolia, Ningxia, Qinghai, Shaanxi, Sichuan, Tibet, Xinjiang, and Yunnan

Net Capital Flow

- Regional Gap in Gross Saving less Gross Investment



Unit: 1 bn (base: 2000)

Capital Flow and Migration

- Input-Ouput Tables

NCO	2002	2012
East $\rightarrow$ West	82.37	557.93

Unit: 1 bn (base: 2000)

- Census: current location vs. place of birth

Net Migration	2000 (9.5%)	2010 (10%)
East $\rightarrow$ West	-773377	-1813225

- Census: current location vs. location 5 years ago

Net Migration	2000 (9.5%)	2005 (1%)	2010 (10%)
East $\rightarrow$ West	-677176	-108696	-1119611

Outline

Outline

1. Introduction
2. **Model**
   - Utility
   - Production
   - Migration
   - Financial friction
   - Market clearing
3. Reduced-form Results
4. Model Estimation
5. Counterfactual Results
6. Conclusion

Model-Utility

- $n \in N$ provinces, $i \in \{p, s\}$ firm ownership type, sector $j \in J$
- Consumption goods produced in different sectors:

$$C_n = \prod_j \left(\frac{C_n^j}{\alpha_n^j} \right)^{\alpha_n^j}$$

- In each sector, varieties are aggregated in CES

$$C_n^j = \underbrace{\left[\sum_i \int_{\omega \in \Omega_{i,n}^j} C_{i,n}^j(\omega)^{\frac{\sigma^j - 1}{\sigma^j}} \, d\omega \right]^{\frac{\sigma^j}{\sigma^j - 1}}}_{\text{CES consumption aggregate of varities}}$$

  $\Omega_{i,n}^j$ is the set of varieties available in region n.

- C_n is also referred to as "real income".

Model-Production

- In each region, there is $M^j_{i,n}$ measure of firms who produce distinct varieties. Each firm has following production function:

$$Y^j_{i,n}(\omega) = z^j_{i,n} \left(\frac{L^j_{i,n}(\omega)}{1-\beta^j} \right)^{1-\beta^j} \left(\frac{K^j_{i,n}(\omega)}{\beta^j} \right)^{\beta^j}$$

- As the demand for each variety has negative elasticity, the pricing of each variety follows

$$p^j_{i,n}(\omega) = \underbrace{\frac{\sigma^j}{\sigma^j - 1}}_{\text{markup}} \underbrace{\frac{w_n^{1-\beta^j} r_{i,n}^{\beta^j}}{z^j_{i,n}}}_{\text{marginal cost}}$$

- Iceberg transport cost $d^j_{nn'}$
- Let $\pi^j_{i,nn'}$ denote the share of good from region n sold in region n'.

$$\pi^j_{i,nn'} = \left(\frac{P^j_{i,nn'}}{P^j_{n'}} \right)^{1-\sigma^j}$$

where $P^j_{n'}$ is the price index of sector j in region n' and $P^j_{i,nn'}$ is the price index of export from region n to n'.

Model-Migration

- In each province, there is $\bar{L}_n$ measure of workers
- A worker ϵ makes migration decision to maximize the utility:

$$U_n(\epsilon) = \underbrace{b_n(\epsilon)}_{\text{idiosyncratic regional preference}} \cdot \underbrace{C_n}_{\text{real income}}$$

  where $b_n(\epsilon)$ is worker ϵ's draw of regional preference from region n.

- The distribution of $b_n(\epsilon)$ is independent across regions and workers. Fréchet distribution:

$$G_n(b) = e^{-B_n b^{-\sigma^L}}$$

- Then the migration pattern can be expressed as:

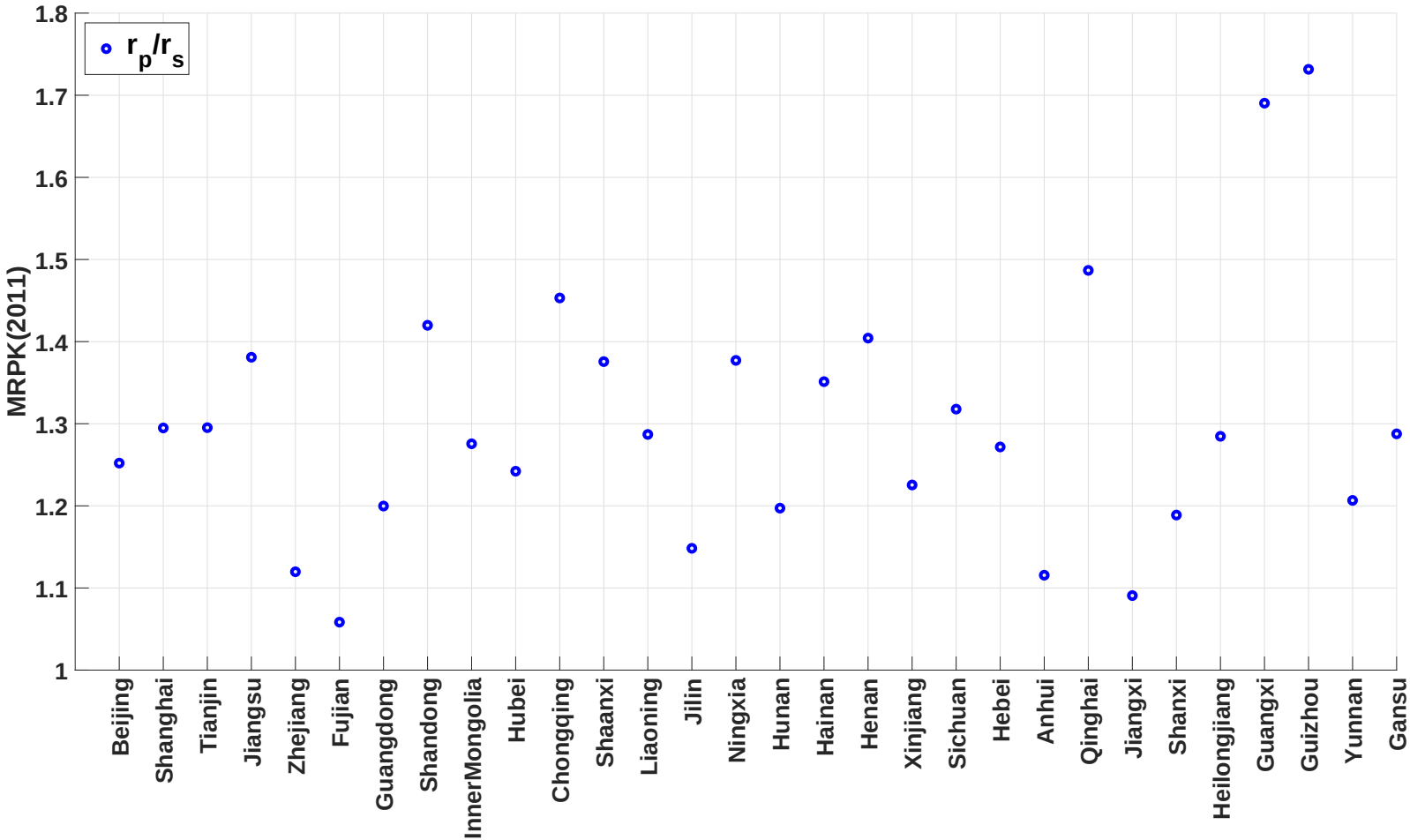
$$\pi^L_{n'n} = \frac{B_n \left(\frac{w_n}{P_n d^L_{n'n}} \right)^{\sigma^L}}{\sum_n B_n \left(\frac{w_n}{P_n d^L_{n'n}} \right)^{\sigma^L}}$$

Model-Financial Friction

- In each province, μ_n share of capital is owned by private firms.
- Due to credit constraints (rationing), private firms can borrow up to $(\theta_n - 1)$ of own capital. $(\theta_n > 1)$

  $\mu_n K_n \rightarrow \theta_n \mu_n K_n$
- Assumption 1: Credit constraint is always binding for private firms. Thus, the total amount of capital deployed in the private firms is given by $\mu_n \theta_n K_n$ and $r_{p,n} > r_{s,n}$.

Dispersion in Price of Capital across Provinces



Model-Market Clearing

- Capital market clearing

$$\mu_n \theta_n K_n r_{p,n} = \underbrace{\sum_j \sum_{n'} E_{n'} \alpha^j_{n'} \pi^j_{p,nn'} \beta^j (\sigma^j - 1)/\sigma^j}_{\text{private demand for capital}}$$

$$(1 - \mu_n \theta_n) K_n r_{s,n} = \underbrace{\sum_j \sum_{n'} E_{n'} \alpha^j_{n'} \pi^j_{s,nn'} \beta^j (\sigma^j - 1)/\sigma^j}_{\text{state demand for capital}}$$

- Migration and labor market clearing

$$L_n = \sum_{n'} \pi^L_{n'n} \bar{L}_{n'}, \quad L_n w_n = \underbrace{\sum_i \sum_j \sum_{n'} E_{n'} \alpha^j_{n'} \pi^j_{i,nn'} (1 - \beta^j)(\sigma^j - 1)/\sigma^j}_{\text{total demand for labor}}$$

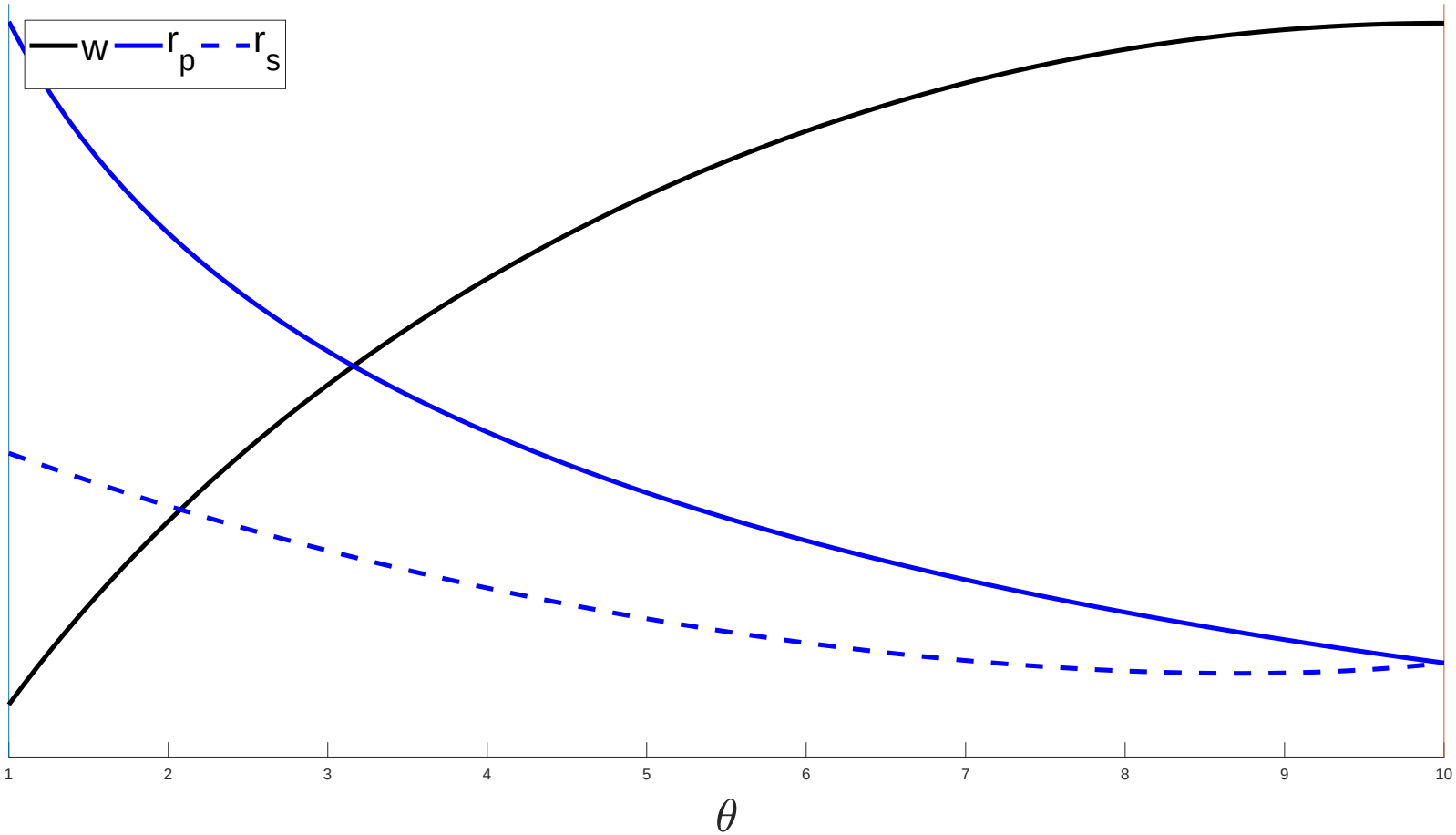
- Provincial budget constraint

$$E_n = \underbrace{w_n L_n + r_{p,n} \mu_n \theta_n K_n + r_{s,n}(1 - \mu_n \theta_n) K_n + \sum_i \sum_{n'} E_{n'} \pi_{i,nn'}/\sigma^j + Def_n}_{\text{factor income + profit + trade deficit}}$$

Testable Prediction Regarding θ_n - Proposition 1

- Two simplifying assumptions for **Proposition 1** regarding θ_n:
  - single sector
  - small open economy
- Proposition 1: Lower θ_n (worse financial contractability) leads to lower local wage (w_n), higher rental rate for private capital ($r_{p,n}$). When θ_n is sufficiently low, lower θ_n leads to lower rental rate for state capital ($r_{s,n}$).

Proposition 1



Proposition 1

- Intuitively, worse financial friction worsens efficient use of capital, thereby lowering wage.
- Impact on r is decomposed as:

$$\partial \ln r_{p,n} = \underbrace{-\frac{1}{(\sigma-1)\beta+1}\partial \ln \theta_n}_{\text{change in capital supply}} \underbrace{-\frac{(\sigma-1)(1-\beta)}{(\sigma-1)\beta+1}\partial \ln w_n}_{\text{wage complementarity effect}}$$

$$\partial \ln r_{s,n} = \underbrace{\frac{\mu_n\theta_n}{1-\mu_n\theta_n}\frac{1}{(\sigma-1)\beta+1}\partial \ln \theta_n}_{\text{change in capital supply}} \underbrace{-\frac{(\sigma-1)(1-\beta)}{(\sigma-1)\beta+1}\partial \ln w_n}_{\text{wage complementarity effect}}$$

- Regions with lower θ has higher r_s and experiences net capital inflow (in the dynamic extension).

Measure of FF - Proposition 2

- Proposition 2: Dispersion in rental rates increase with the degree of financial friction. Specifically,

$$\frac{\mu_n \theta_n}{1-\mu_n \theta_n} = \left(\frac{r_{p,n}}{r_{s,n}}\right)^{-1} \frac{\sum_j R^j_{p,n} \frac{\beta^j(\sigma^j-1)}{\sigma^j}}{\sum_j R^j_{s,n} \frac{\beta^j(\sigma^j-1)}{\sigma^j}}$$

where R is the revenue, β is capital share and σ is elasticity of substitution.

- Our measure of financial friction:

$$\underbrace{FF_n}_{\text{relative supply}} = \underbrace{\ln(r_{s,n}) - \ln(r_{p,n})}_{\text{price dispersion}} - \underbrace{\ln\left(\frac{\sum_j R^j_{s,n} \frac{\beta^j(\sigma^j-1)}{\sigma^j}}{\sum_j R^j_{s,n} \frac{\beta^j(\sigma^j-1)}{\sigma^j}}\right)}_{\text{relative demand}}$$

Measure of MRPK

- Idea follows Wu (18')
- A firm with Cobb-Douglas production function under monopolistic competition:

$$\ln(MRPK_{it}) \equiv \frac{\partial R_{it}}{\partial K_{it}} = \ln(ARPK_{it}) + \ln(\beta_i(1 - 1/\sigma_i))$$

- After first-order approximation and arrangement:

$$\ln(ARPK_{it}) = \gamma_0 + \gamma_{1t} \ln\left(1 - \frac{\Pi_{it}}{R_{it}}\right) + Ind_{it} + \ln(MRPK_{it})$$

- Estimate of MRPK

$$\ln(\hat{MRPK}_{it}) = \ln(ARPK_{it}) - \hat{\gamma}_0 + \hat{\gamma}_{1t} \ln\left(1 - \frac{\Pi_{it}}{R_{it}}\right) + \hat{Ind}_{it}$$

- We then average $MRPK_{it}$ by ownership and region.

Outline

Regression Specifications

- Province-pair net export

$$\begin{aligned} ln(NX_{nn't}) = \quad & \gamma_1(FF_{n',t-1} - FF_{n,t-1}) + \gamma_2 \ln(d_{nn'}) \\ & + \gamma_3(NT_{n',t-1} - NT_{n,t-1}) + D_n + D_{n'} + D_t + \epsilon_{nn't} \end{aligned}$$

- Province-level net export

$$NX_{nt} = \lambda_1 FF_{n,t-1} + \lambda_2 \ln(NT_{n,t-1}) + D_t + \epsilon_{nt}$$

- Province-level wage

$$\ln(Wage_{nt}) = \eta_1 FF_{n,t-1} + \eta_2 \ln(NT_{n,t-1}) + D_t + \epsilon_{nt}$$

- Migration ratio

$$\ln \pi^L_{nn't} = \xi_1 FF_{n',t-1} + \xi_2 \ln(d_{nn'}) + D_n + D_{n'} + D_t + \epsilon_{nn't}$$

Data

- Net export by pair
  - inter-provincial trade data (2002, 2012)
- Financial friction
  - Chinese firm-level data (1998-2011)
- Provincial wage, Net export
  - statistical yearbook (1998-2011)
- Migration ratio
  - census survey (2000, 2010)

Reduced Form Evidence

Table 2: Panel Results Using Provincial Paired Data

VARIABLES	(1) Log NX *Lagged one year*	(2) Log NX *Average of the last three years*	(3) Log Net GFCF *Lagged one year*	(4) Log Net GFCF *Average of the last three years*
Diff (FF)	0.267*	0.311***	0.629***	0.615***
	(0.144)	(0.111)	(0.169)	(0.142)
Log Distance	-1.096***	-1.106***	-1.140***	-1.147***
	(0.0895)	(0.0888)	(0.115)	(0.115)
Diff (Net Transfers)	-1.569	-0.941	-0.199	-0.168
	(1.587)	(1.462)	(1.809)	(1.770)
Observations	869	869	864	864
Adjusted R^2	0.608	0.610	0.767	0.769
Origin FE	YES	YES	YES	YES
Destination FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Reduced Form Evidence

Table 3: Panel Results Using Provincial Data

VARIABLES	(1) NX *Lagged one year*	(2) NX *Average of the last three years*
FF	-0.472***	-0.605***
	(0.0720)	(0.0872)
Net Transfers	-0.489	-0.283
	(0.397)	(0.396)
Observations	370	371
Adjusted R^2	0.163	0.179
Year FE	YES	YES

Reduced Form Evidence

Table 4: Panel Results Using Provincial Data

VARIABLES	(1) ln(Wage) *Lagged one year*	(2) ln(Wage) *Average of the last three years*
FF	-0.0457***	-0.0471***
	(0.0173)	(0.0176)
Net Transfers	0.388***	0.372***
	(0.126)	(0.131)
Observations	370	371
Adjusted R^2	0.790	0.781
Year FE	YES	YES

Reduced Form Evidence

Table 5: Panel Results Using Provincial Data

VARIABLES	(1) ln(Migration Share) *Lagged one year*	(2) ln(Migration Share) *Average of the last three years*
Destination FF	-0.158***	-0.216***
	(0.0381)	(0.0574)
Log Distance	-1.052***	-1.049***
	(0.0170)	(0.0172)
Observations	1,922	1,891
Adjusted R^2	0.822	0.822
Origin FE	YES	YES
Destination FE	YES	YES
Year FE	YES	YES

Outline

Parameters

Table 6: Parameters For Quantitative Model

σ^L	migration elasticity	Tombe and Zhu (2018)
$\{\sigma^j\}_{j\in J}$	elasticity of substitution	Caliendo et al. (2017)
	Agriculture and Mining	8.2
	Manufacturing Sectors	4.4
	Nontraded services	2.8
$\{\alpha_n^j\}_{n\in N,\ j\in J}$	expenditure share	input-output table
$\{\beta^j\}_{j\in J}$	capital share	firm level data
$\{K_n\}_{n\in N}$	capital stock	Holz and Yue (2018)
$\{\bar{L}_n\}_{n\in N}$	hukou registration	2010 census data
$\{d_{nn'}^j\}_{n,n'\in N,j\in J}$	iceberg trade cost	estimated following Novy (2013)
$\{d_{nn'}^L\}_{n,n'\in N}$	migration cost	estimated following Novy (2013)
B_n	local amenities	jointly estimated to fit the
$\tilde{M}_n^j$	productivity measure of firms	migration share, provincial output
$\mu\theta_n$	private capital share	and dispersion in rental rates

Novy 13'

- Migration ratio can be expressed as:

$$\pi^L_{n'n} = \frac{B_n \left(\frac{w_n}{P_n d^L_{n'n}} \right)^{\sigma^L}}{\sum_n B_n \left(\frac{w_n}{P_n d^L_{n'n}} \right)^{\sigma^L}}$$

$$\pi^j_{i,nn'} = \frac{M^j_{i,n} \left(w_n^{1-\beta^j} r_{i,n}^{\beta^j} d^j_{nn'} / z^j_{i,n} \right)^{1-\sigma^j}}{\sum_n \sum_i M^j_{i,n} \left(w_n^{1-\beta^j} r_{i,n}^{\beta^j} d^j_{nn'} / z^j_{i,n} \right)^{1-\sigma^j}}$$

- Under the symmetric trade/migration cost assumption,

$$d^L_{nn'} = d^L_{n'n} = \left(\frac{\pi^L_{nn'} \pi^L_{n'n}}{\pi^L_{n'n'} \pi^L_{nn}} \right)^{-\frac{1}{2\sigma^L}}$$

and

$$d^j_{nn'} = d^j_{n'n} = \left(\frac{\sum_i \pi^j_{i,nn'} \sum_i \pi^j_{i,n'n}}{\sum_i \pi^j_{i,n'n'} \sum_i \pi^j_{i,nn}} \right)^{\frac{1}{2(1-\sigma^j)}}$$

Estimation

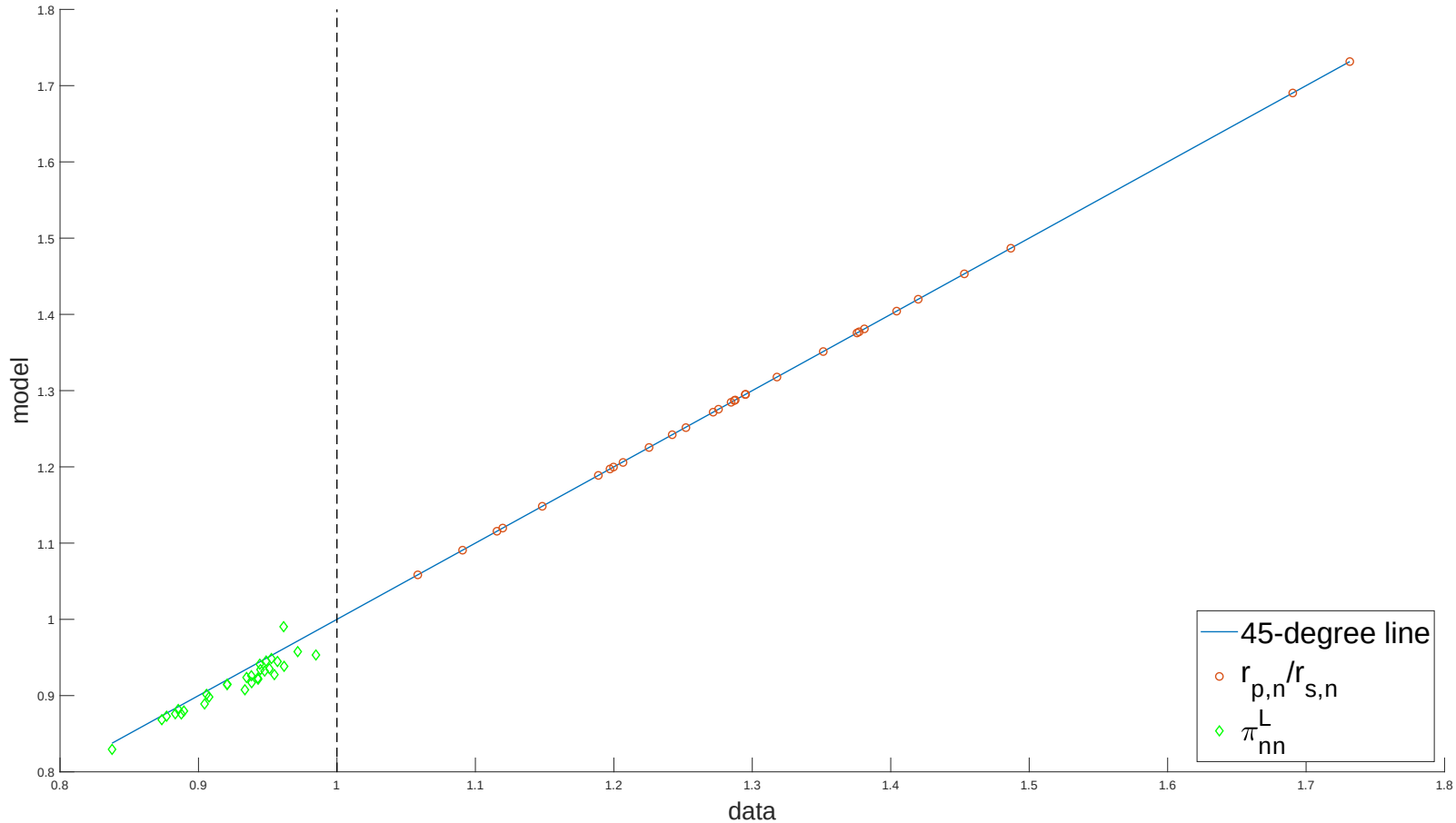
- Estimate $\hat{\tilde{M}}^{j}_{p,n}, \hat{B}_n, \hat{\mu_n \theta_n}$ to minimize the sum of squared error of model and data:

$$\left\{\hat{\tilde{M}}^{j}_{p,n}, \hat{B}_n, \hat{\mu_n \theta_n}\right\} \equiv \operatorname{argmin} \sum_{j} \sum_{n} \sum_{n'} \left(\hat{X}^{j}_{n} - X^{j}_{n}\right)^2 + \sum_{n} \left(\hat{\pi}^{L}_{nn} - \pi^{L}_{nn}\right)^2 + \sum_{n} \left(\frac{\hat{r}_{p,n}}{\hat{r}_{s,n}} - \frac{r_{p,n}}{r_{s,n}}\right)^2$$

where X^{j}_{n} is provincial sectoral output (relative to Beijing), π^{L}_{nn} is migration share, $r_{p,n}/r_{s,n}$ is dispersion in rental rates.

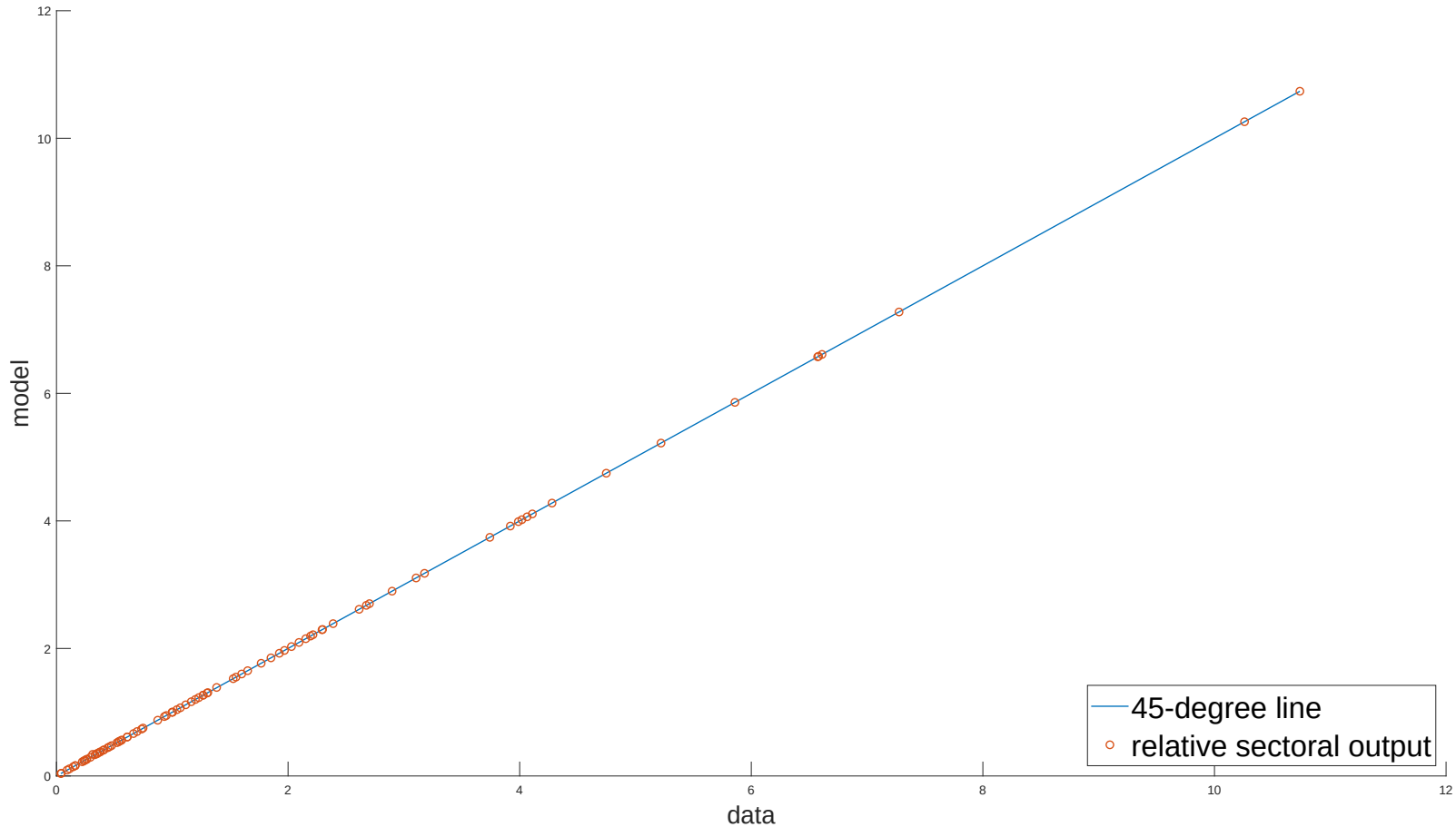
Model Goodness of Fit

- Migration ratio and dispersion in rental rates



Model Goodness of Fit

- Relative provincial sectoral output



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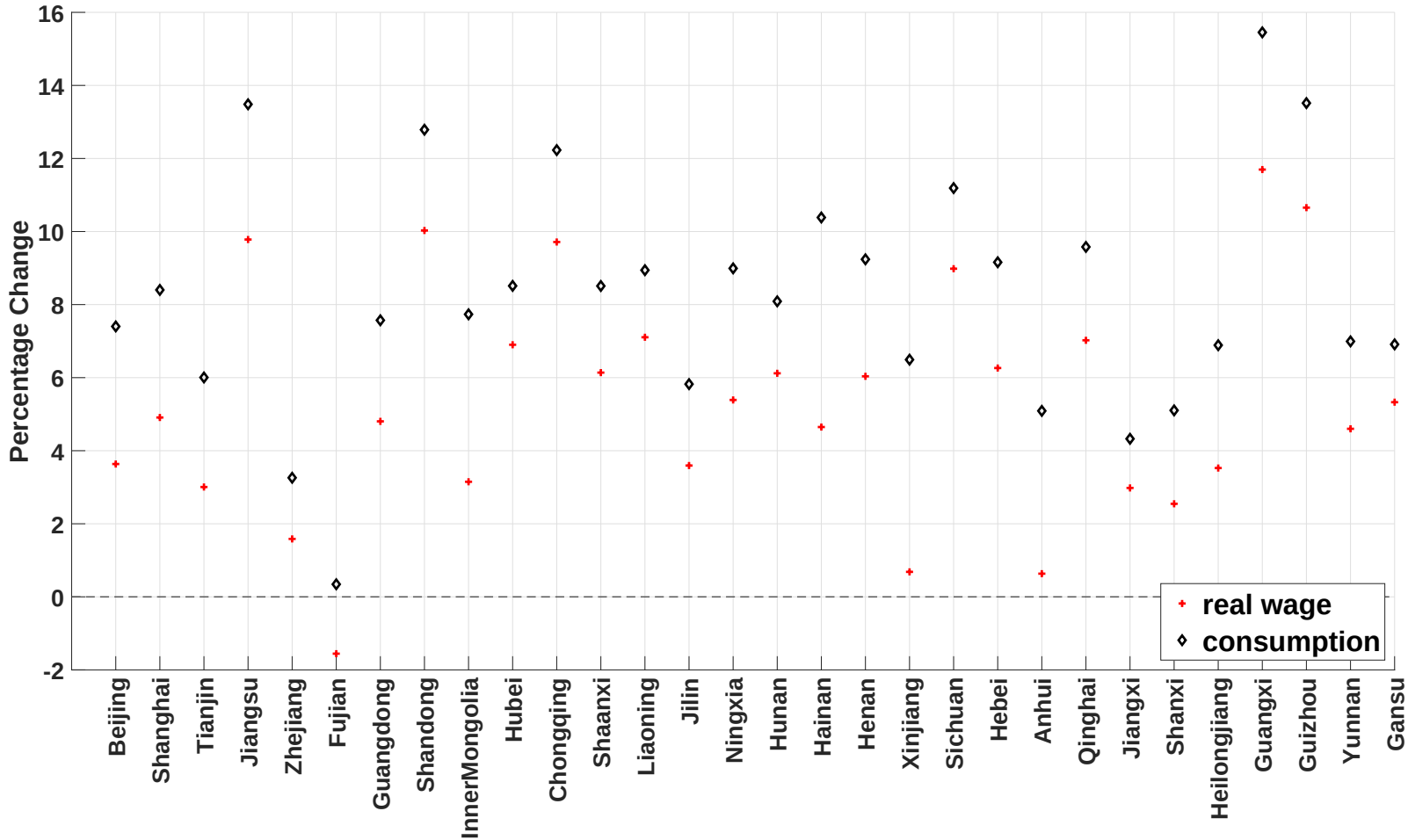
1. Introduction
2. Model
3. Reduced-form Evidence
4. Model Estimation
5. **Counterfactual Results**
6. Conclusion

Counterfactual Results

- Benchmark: model estimated to data around 2010
- NoFF: no financial friction between private and state firms in a given province
  - increase θ_n until rental rates between private and state firms are equalized
- NoNFF: no national financial friction, no financial friction between ownership and provinces
  - integrated capital market

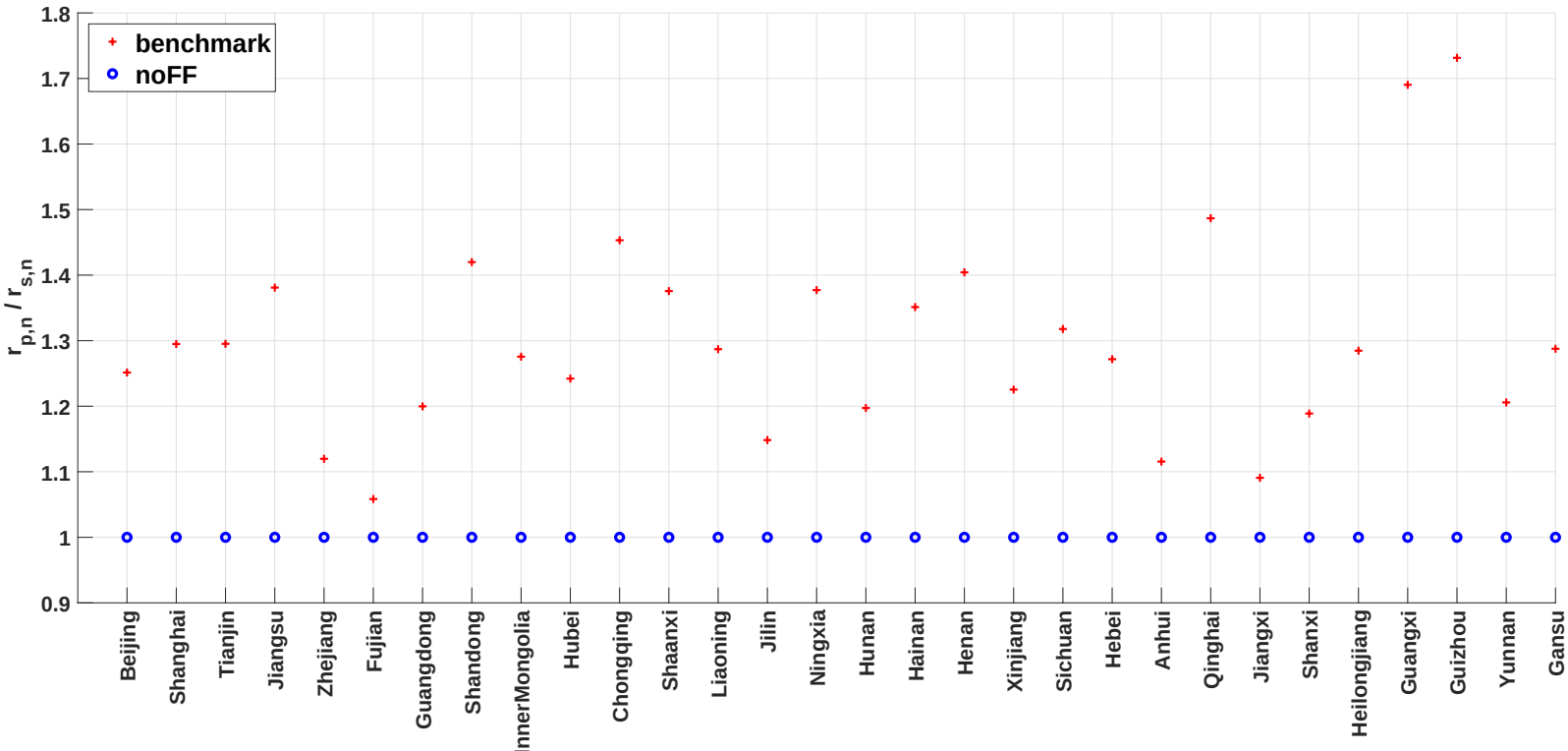
Perturbation of θ_n

- 1% increase in θ_n from the Benchmark



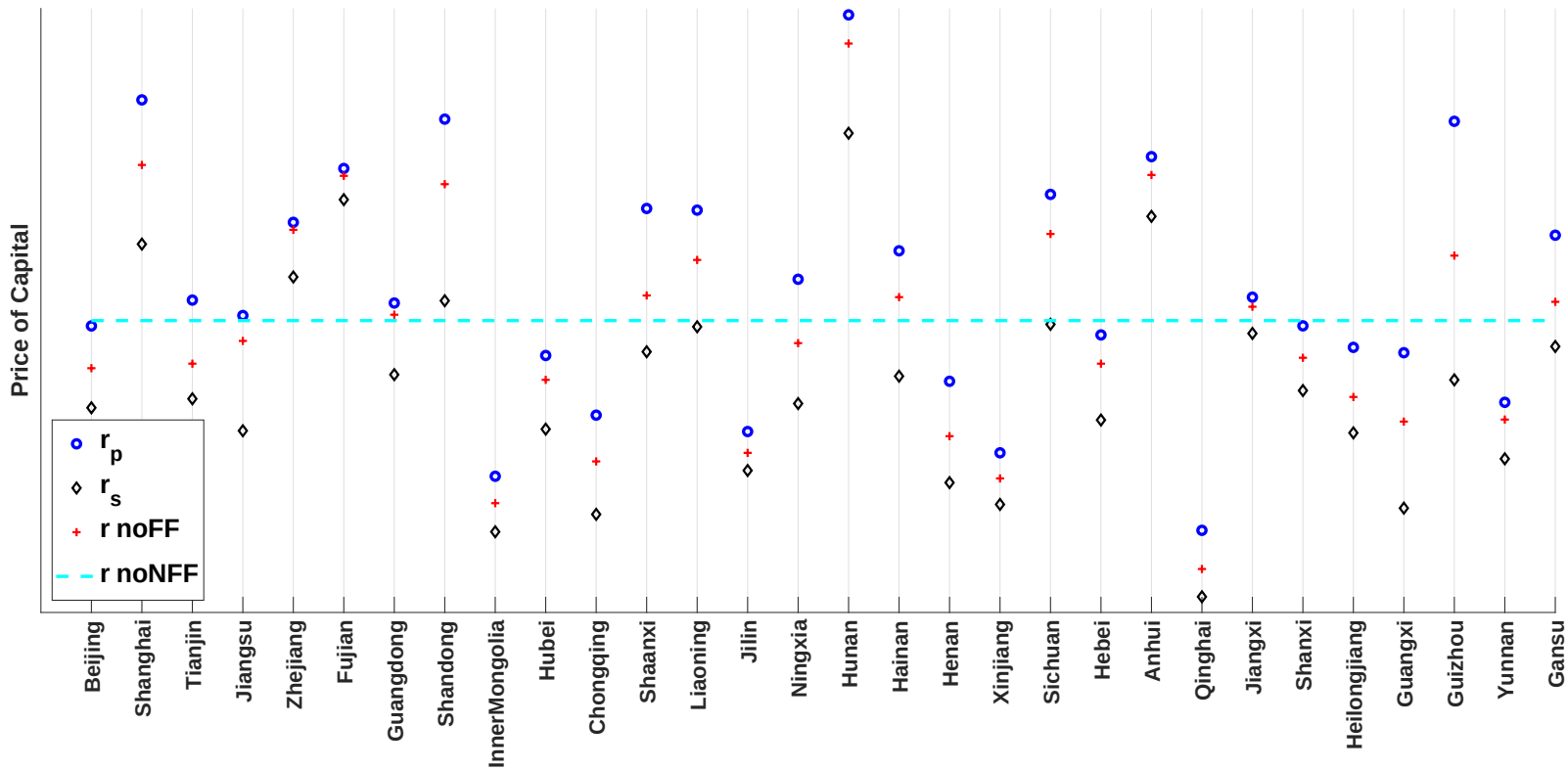
Counterfactual Results

- Illustration of NoFF Counterfactual



Counterfactual Results

- Illustration of NoNFF Counterfactual



Percentage Change Relative To Benchmark

	Real Income (Consumption)		Real Wage		Labor		Real Income per capita	
	noFF	noNFF	noFF	noNFF	noFF	noNFF	noFF	noNFF
National	1.08	3.88	1.04	3.11				
Beijing	0.98	-3.38	1.12	-3.36	-0.18	-5.19	1.16	1.91
Shanghai	1.01	13.41	0.91	19.88	-0.09	10.35	1.10	2.77
Tianjin	0.61	1.91	1.12	-3.49	-0.08	-1.93	0.70	3.92
Jiangsu	1.57	-1.04	0.97	-2.86	-0.02	-2.18	1.60	1.17
Zhejiang	0.51	1.71	0.26	10.53	-0.35	1.95	0.87	-0.24
Fujian	-0.63	8.91	0.29	21.17	-0.21	3.75	-0.42	4.97
Guangdong	0.34	-0.82	0.32	0.49	-0.28	-0.79	0.63	-0.03
Shandong	2.46	8.25	2.00	21.75	0.14	3.48	2.32	4.62
InnerMongolia	-0.44	10.00	0.95	-22.32	-0.08	-6.45	-0.36	17.58
Hubei	0.78	-0.92	0.91	-6.51	-0.03	-2.05	0.81	1.15
Chongqing	3.86	1.00	2.90	-18.27	0.46	-6.52	3.39	8.05
Shaanxi	1.71	7.16	2.54	7.92	0.26	1.72	1.45	5.35
Liaoning	1.15	4.86	1.35	10.18	0.03	2.72	1.12	2.09
Jilin	0.58	1.10	1.10	-18.28	-0.03	-4.34	0.61	5.69
Ningxia	1.75	2.13	1.43	-0.53	0.01	-0.06	1.74	2.19
Hunan	0.17	18.83	0.64	40.56	-0.07	6.00	0.24	12.10
Hainan	0.76	6.39	0.75	6.38	-0.10	1.04	0.86	5.29
Henan	2.51	1.88	2.01	-15.21	0.17	-3.33	2.34	5.40
Xinjiang	0.88	3.44	0.59	-20.79	-0.21	-5.81	1.09	9.82
Sichuan	1.37	4.22	1.25	10.83	0.01	2.44	1.35	1.74
Hebei	0.03	2.55	0.98	-3.21	-0.05	-0.19	0.09	2.74
Anhui	0.75	7.81	0.46	22.77	-0.15	4.60	0.90	3.07
Qinghai	3.15	24.84	3.14	-31.01	0.45	-9.06	2.69	37.28
Jiangxi	0.10	0.11	0.37	2.18	-0.10	-0.93	0.20	1.05
Shanxi	-0.46	4.50	0.72	-1.89	-0.08	0.12	-0.38	4.38
Heilongjiang	0.00	4.57	1.04	-6.91	-0.07	-2.20	0.06	6.91
Guangxi	4.73	4.72	4.03	-9.57	0.54	-2.31	4.17	7.19
Guizhou	4.17	9.84	3.99	15.12	0.65	2.04	3.49	7.64
Yunnan	0.47	0.35	0.45	-11.40	-0.09	-2.17	0.57	2.58
Gansu	1.23	3.86	1.50	5.34	0.03	1.38	1.19	2.45

Complementarity Between Labor and Capital Movement

- Change in real income

	Migration Cost		
	Full	**Half**	**Zero**
noFF:Benchmark	1.08	1.05	1.00
noNFF:Benchmark	3.88	4.51	6.01

Outline

Conclusion

- We build a model of financial friction that explains regional capital flow and migration flow.
- Estimated model around year 2010 shows up to 4% real income game from removing financial friction.
- The impact is enhanced with reduced migration cost.