Barriers to Entry and Regional Economic Growth in China

Loren Brandt
University of Toronto

Gueorgui Kambourov
University of Toronto

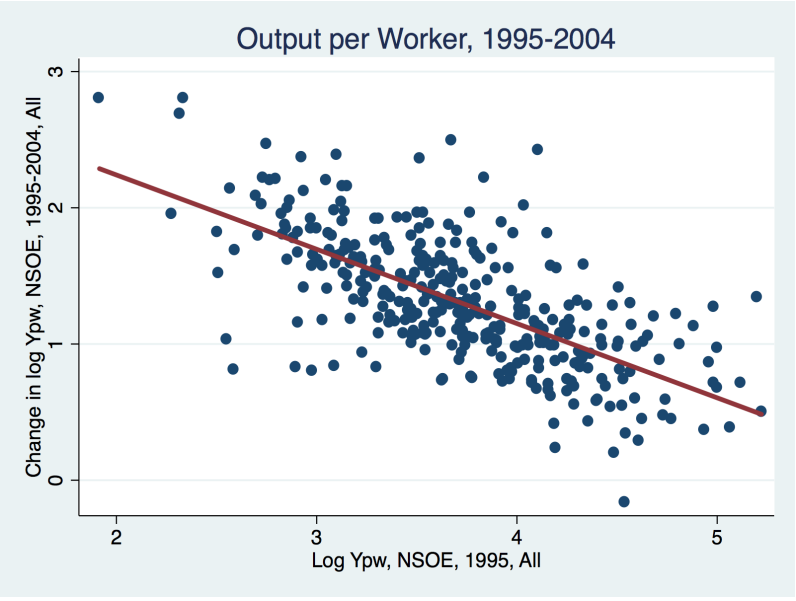
Kjetil Storesletten
University of Oslo

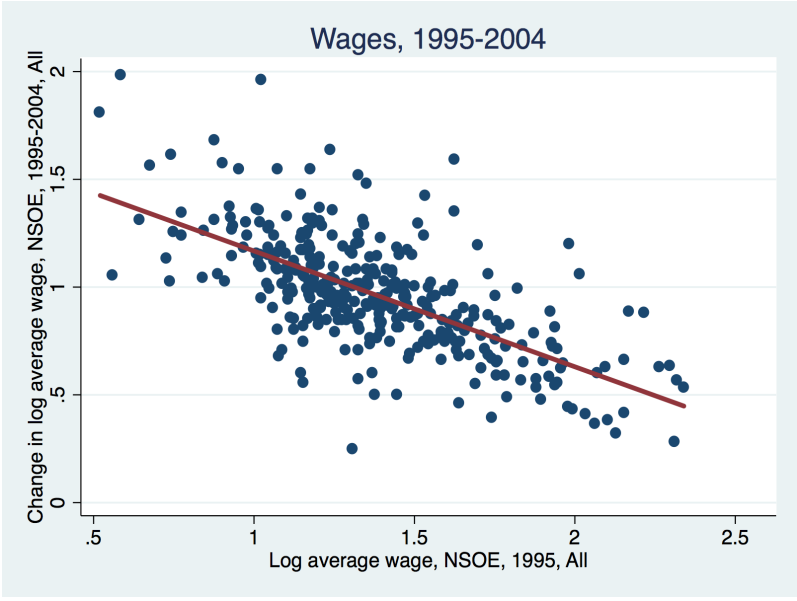
ABFER Singapore
May 21, 2018

Motivation

- Since the onset of economic reform in the late 1970s, China has gone from one of the poorest to a middle-income economy
- Expansion of non-state sector was main source of growth (Zhu, 2012)
- But growth was highly uneven across localities ($\approx$ 350 prefectures)
- We show that
  - : By mid-1990s, there were **sizable local differences** in productivity, wages, & size of non-state manufacturing sector
    - dispersion reflected divergence before 1995
  - : Reversal of fortune from mid-1990s: differences across localities in non-state manufacturing performance started disappearing
    - **strong convergence across prefectures** in non-state value added per worker, TFP, wages, and capital per worker

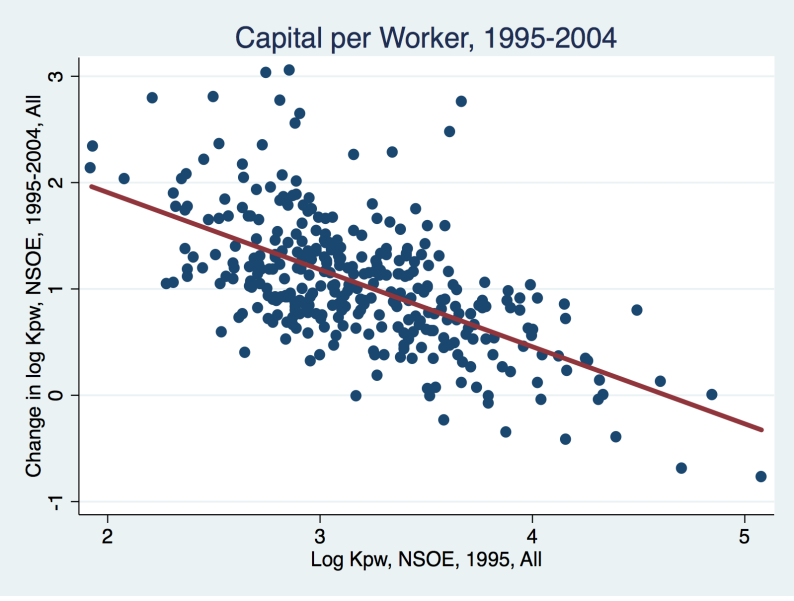
Non-State Dispersion & Convergence, 1995-2004

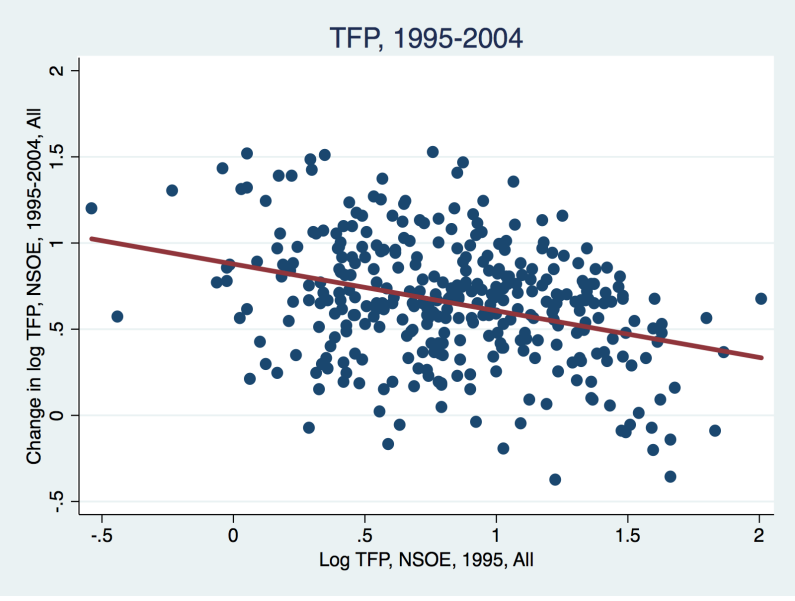




- **1995 dispersion**: avg 95% / avg 5% $=$ 9.5 for Y/N, 6.1 for wage
  (Restuccia et al.: ratio Y/N across countries is 5 for non-agricult.)
- **rate of convergence, output per worker; 8.5%** after 1995
  (Barro and Sala-i-Martin: regional convergence rate in USA: 2%)
- **rate of convergence, wages; 6.0%** after 1995

Non-State Dispersion & Convergence, 1995-2004





- **rate of convergence, capital per worker; 13.5%** after 1995
- **rate of convergence, TFP (calculated as Solow residual); 3.1%** after 1995

Overview

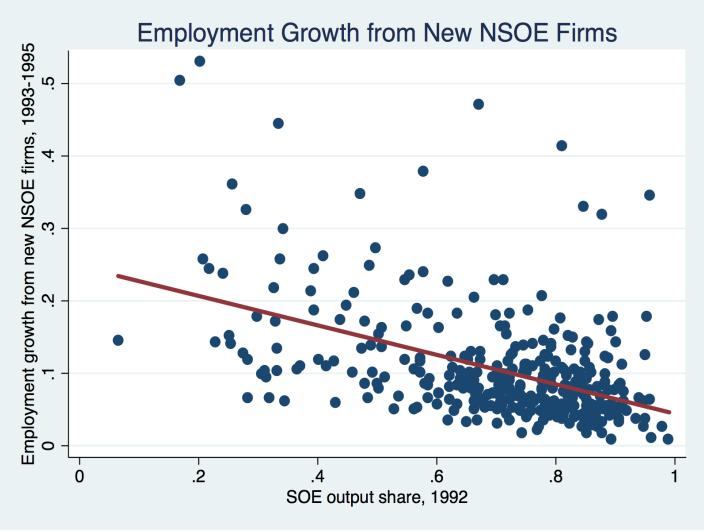
- Aim of paper: understand forces behind initial dispersion and 1995-2008 convergence
- Brandt et al, (2012) argue: creation and selection of new firms is most important source of non-state sector productivity and output growth
- We find: this process is very different across prefectures:

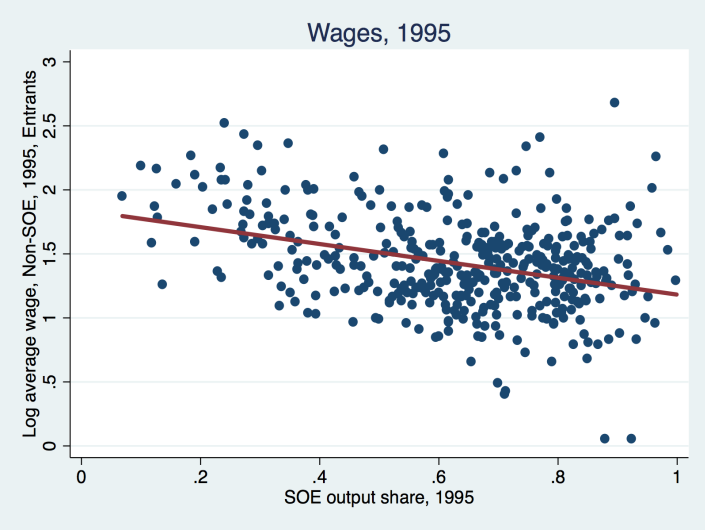
  ... in prefectures with a large presence of state firms,

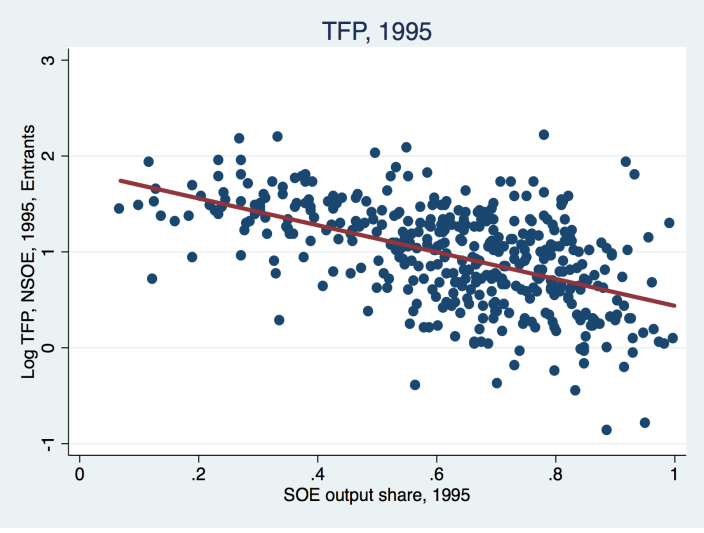
  : **less entry** of non-state firms

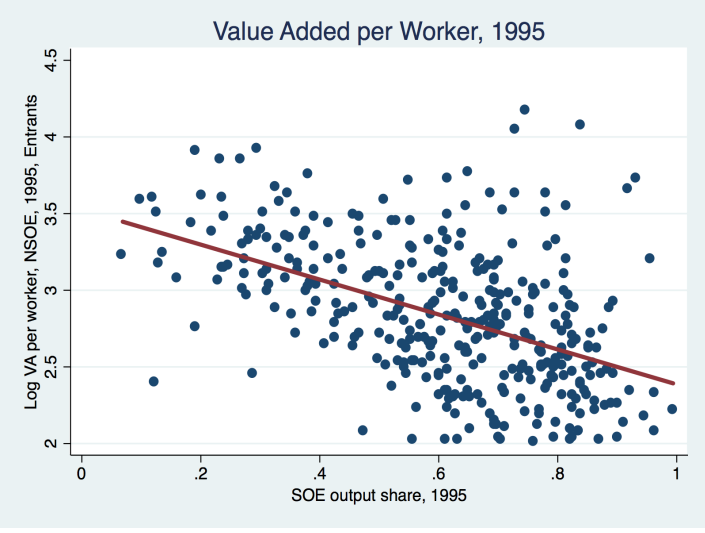
  : non-state entrants pay **lower wages**, have **lower TFP**, **lower value added per worker**, **lower capital per worker**

Non-State firms 1995: entry rates, wages, TFP, Y/N









Overview

- Build closed economy version of Hopenhayn (1992) model with 3 distortions to account for empirical patterns
  - : capital and output wedges,
  - : an entry wedge
- Interpretation of entry wedge: restriction on number of licences allowing potential entrants to operate.
- Solve model analytically
- Estimate model using firm-level data from the 1995, 2004, and 2008 Chinese Industrial Census

Findings: entry wedge is quantitatively most important

- Entry wedge:
  - main driver of initial 1995 dispersion
  - main driver of 1995-2008 convergence
- World Bank survey “Cost of Doing Business in China, 2008”:
  indices match well with our 2008 entry wedge estimates
- Study the empirical factors behind measured entry wedges:
  - : 1995 level systematically linked to size of SOE sector
  - : convergence after 1995 tied to downsizing of state sector
- Political economy model rationalizes entry wedge-SOE link
  - : Narrative: presence of SOEs makes local government less prone to promote private business

Model: Hopenhayn Meets Hsieh-Klenow

$$y_i = z_i^{1-\eta} \left(k_i^{1-\alpha_j} n_i^{\alpha_j} \right)^{\eta},$$

- firms in each industry have common production function
- $j = J(i)$ denotes industry for firm i
- $0 < \eta < 1$: decreasing returns to scale
- common rental rate of capital $(r + \delta)$
- closed labor market: prefecture-specific wage rate w
- distortions: output tax τ_i^y and capital tax τ_i^k
- Benchmark: focus on prefecture-specific wedges.
  Extension: allow within-prefecture firm heterogeneity

Firm's Problem: Output and Capital Wedges

- The firm's objective is

$$\max_{k,n} \left\{ (1-\tau^y)\, y - wn - \left(1+\tau^k\right)(r+\delta)\, k \right\}.$$

- Firms' FOCs for k and n imply linear allocations in z

$$\begin{aligned}
y &= z\left((1-\tau^y)\,\eta\right)^{\frac{\eta}{1-\eta}} \left(\frac{1-\alpha}{\left(1+\tau^k\right)(r+\delta)}\right)^{\frac{(1-\alpha)\eta}{1-\eta}} \left(\frac{\alpha}{w}\right)^{\frac{\alpha\eta}{1-\eta}} \\
&\equiv z\cdot\bar{y} \\
n^* &= n(z,\tau^y,\tau^k;w) = z\cdot\alpha\eta\left(\frac{1-\tau^y}{w}\right)\cdot\bar{y} \\
k^* &= k(z,\tau^y,\tau^k;w) = z\cdot(1-\alpha)\,\eta\,\frac{1-\tau^y}{\left(1+\tau^k\right)(r+\delta)}\cdot\bar{y} \\
\Pi &= z\cdot\left(1-\tau^y\right)(1-\eta)\cdot\bar{y}.
\end{aligned}$$

Entrepreneur's Problem, Entry Wedges

- Large (but finite) number M of potential entrepreneurs in each prefecture
- Potential entrepreneurs observe individual TFP z
- z is Pareto distributed $f(z) = \underline{z}\xi z^{-\xi-1}$ (with $z^{\xi} \geq \underline{z}$)
- Entrepreneur incurs fixed cost ν if firm is operated
- Entry wedge: only a share $(1-\psi)$ of potential entrants allowed to enter
  - random selection/lottery

Entry Decision and Clearing of Labor Market

- Only entrepreneurs with $z \geq z^*$ will operate, where

$$z^*(\tau^y, \tau^k; w) = \frac{\nu}{(1-\tau^y)(1-\eta)\cdot \bar{y}}$$

- Equilibrium wage w clears the (local) labor market

$$M(1-\psi)\int_{z^*}^{\infty} n\left(z, \tau^y, \tau^k; w\right) f(z)\, dz = N$$

Equilibrium Mechanism

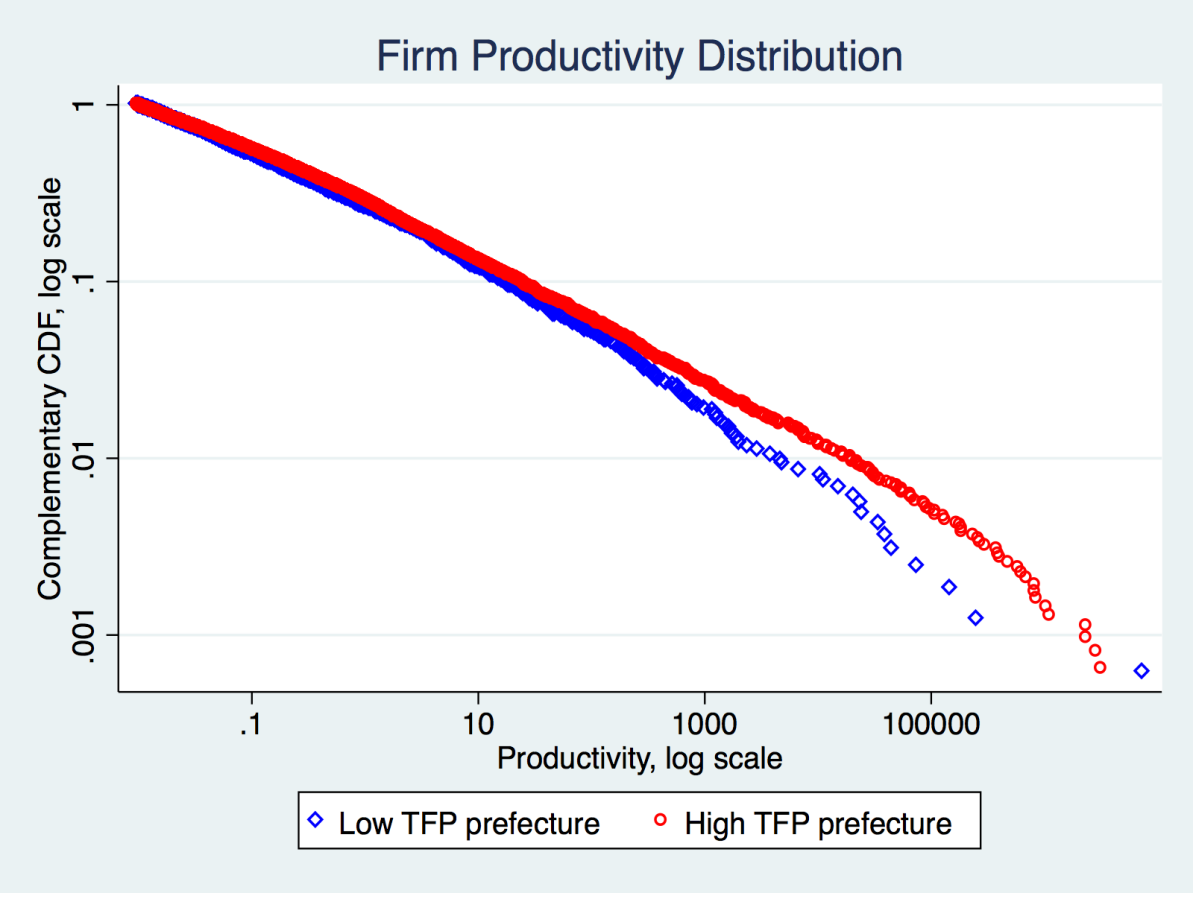
- Suppose $(1-\psi)$ is small
- Low $(1-\psi)$ implies that few firms enter
- Low entry implies low wages required to clear the labor market (since little competition for workers)
- Low wages implies low z^* (since labor is cheap)
- Low z^* implies negative selection
  ... hence low TFP and low Y/N

Equilibrium Mechanism

- The theory predicts that the upper tail of the TFP distribution should be the same in all prefectures
- Consistent with the data
  - pick z_0 as the 90th percentile of the overall TFP distrib.
  - separate all prefectures into two groups: low TFP and high TFP
  - the estimated ξ is the same in low and high TFP prefectures
  - for the 90th perc: $\xi_{TFP,low} = 1.051$, $\xi_{TFP,high} = 1.048$

Equilibrium Mechanism

- The distributions of $\ln z$, above the z_0 cutoff are very similar:



Equilibrium Wage: w

$$\begin{aligned}
\ln w \quad = \quad & \frac{1-\eta}{1-\eta+\xi\alpha\eta}\ln\left(\frac{(1-\psi)\underline{z}^{\xi}}{N}\right) - \frac{(1-\eta)(\xi-1)}{1-\eta+\xi\alpha\eta}\ln(v) \\
& + \frac{\xi}{1-\eta+\xi\alpha\eta}\ln(1-\tau^{y}) \\
& - \frac{(1-\alpha)\xi\eta}{1-\eta+\xi\alpha\eta}\ln\left(\left(1+\tau^{k}\right)(r+\delta)\right) \\
& + \Omega(\alpha,\eta,\xi)
\end{aligned}$$

$$\begin{aligned}
\frac{\partial \ln w}{\partial \ln\left(1+\tau^{k}\right)} \quad = \quad & \frac{\partial \ln w}{\partial \ln(r+\delta)} = -\frac{(1-\alpha)\xi\eta}{1-\eta+\xi\alpha\eta} < 0 \\
\frac{\partial \ln w}{\partial \ln(1-\tau^{y})} \quad = \quad & \frac{\xi}{1-\eta+\xi\alpha\eta} > 0 \\
\frac{\partial \ln w}{\partial \ln(1-\psi)} \quad = \quad & -\frac{\partial \ln w}{\partial \ln N} = \frac{1-\eta}{1-\eta+\xi\alpha\eta} > 0
\end{aligned}$$

Equilibrium: Output per Worker

$$\ln \frac{Y}{N} = \ln w - \ln\left(1-\tau^{y}\right) - \ln\left(\alpha\eta\right)$$

$$\begin{aligned}
\frac{\partial \ln \frac{Y}{N}}{\partial \ln\left(1+\tau^{k}\right)} &= \frac{\partial \ln w}{\partial \ln\left(r+\delta\right)} = -\frac{\left(1-\alpha\right)\xi\eta}{1-\eta+\xi\alpha\eta} < 0 \\
\frac{\partial \ln \frac{Y}{N}}{\partial \ln\left(1-\tau^{y}\right)} &= \frac{\xi\eta\left(1-\alpha\right)+\left(\xi-1\right)\left(1-\eta\right)}{1-\eta+\xi\alpha\eta} > 0 \\
\frac{\partial \ln \frac{Y}{N}}{\partial \ln(1-\psi)} &= -\frac{\partial \ln w}{\partial \ln N} = \frac{1-\eta}{1-\eta+\xi\alpha\eta} > 0
\end{aligned}$$

Equilibrium: Entrants

$$\Gamma\left(z \geq z^*\right) = (1-\psi)\underline{z}\left(\frac{\left(1-\tau^y\right)(1-\eta)\cdot\bar{y}}{\nu}\right)^{\xi}$$

$$\frac{\partial \ln \Gamma}{\partial \ln\left(1+\tau^k\right)} < 0$$

$$\frac{\partial \ln \Gamma}{\partial \ln\left(1-\tau^y\right)} > 0$$

$$\frac{\partial \ln \Gamma}{\partial \ln(1-\psi)} > 0$$

Equilibrium: TFP Z

$$\begin{aligned}
\ln Z \quad = \quad & \frac{\alpha\eta\,(1-\eta)}{1-\eta+\xi\alpha\eta}\ln\left(\frac{(1-\psi)\underline{z}^{\xi}}{N}\right)-\frac{\alpha\eta\,(1-\eta)\,(\xi-1)}{1-\eta+\xi\alpha\eta}\ln(v) \\
& -\frac{1-\eta}{1-\eta+\xi\alpha\eta}\ln\left(1-\tau^{y}\right) \\
& +\frac{(1-\eta)\,(1+(\xi-1)\,\alpha\eta)}{1-\eta+\xi\alpha\eta}\ln\left(\left(1+\tau^{k}\right)(r+\delta)\right) \\
& +\Omega(\alpha,\eta,\xi)
\end{aligned}$$

$$\begin{aligned}
\frac{\partial \ln Z}{\partial \ln\left(1+\tau^{k}\right)} \quad = \quad & \frac{\partial \ln Z}{\partial \ln(r+\delta)}=\frac{(1-\eta)\,(1+(\xi-1)\,\alpha\eta)}{1-\eta+\xi\alpha\eta}>0 \\
\frac{\partial \ln Z}{\partial \ln\left(1-\tau^{y}\right)} \quad = \quad & -\frac{1-\eta}{1-\eta+\xi\alpha\eta}<0 \\
\frac{\partial \ln Z}{\partial \ln(1-\psi)} \quad = \quad & -\frac{\partial \ln Z}{\partial \ln N}=\frac{\alpha\eta(1-\eta)}{1-\eta+\xi\alpha\eta}>0
\end{aligned}$$

Effects of Wedges on Allocations

	$(1-\tau^y)$	$(1+\tau^k)$	$(1-\psi)$
w	+	-	+
TFP_s	-	+	+
Entry	+	-	+
$\frac{Y}{N}$	+	-	+

[More]

A politico-economic motivation for wedges

- Central government dictates a prefecture-specific target level of state employment, $\bar{N}_{SOE}$
- Problem: SOEs compete with private sector for workers
- Instruments: Local government use wedges $\{\tau^y, \tau^k, \psi\}$ to deliver $N_{SOE} = \bar{N}_{SOE}$
- Objective: Local government maximize entrepreneur profits conditional on z (want to "help a friend")
- Optimal policy: set $\tau^y = \tau^k = 0$ and use ψ to constrain NSOE entry to ensure $N_{NSOE} = 1 - \bar{N}_{SOE}$

Chinese Industrial Census

- Chinese Industrial Census (CIC)
- CIC: (1992), 1995, 2004, 2008
- Large: covers most of the manufacturing sector
- Rich: firm-level observations on value added, employment, capital stock, wage bill, year of birth, ownership, sector
- Data work (issues)
  - make prefectures consistent across years
  - define the SOE sector (especially in 2004 and 2008)
  - construct measures of real capital

[Back]

Calibration

- Labor share for each industry $\alpha\eta$: Hsieh and Klenow (2009)
- Decreasing returns: $\eta = 0.85$ (Restuccia and Rogerson 2008)
- $\xi = 1.05$, Pareto parameter, use 30% of the most productive firms

$$\frac{E(z|z \geq z^*)}{z^*} = \frac{\xi}{\xi - 1}$$

- Set v such that $n^*(z^*) = 1$ in the lowest s prefectures
- Set $\underline{z}$ such that $\psi = 0$ in the lowest s prefectures
- From 1995, 204, 2008 Chinese Industrial Census
  - value added: y_i
  - wage bill: $w_i n_i$
  - estimated real capital: k_i

Accounting Exercise 1: Output and Capital Wedges

- τ_i^y and τ_i^k identified from firm's first-order conditions, for k and n

$$\begin{aligned}(1-\tau_i^y) &= \frac{1}{\alpha_j \eta}\frac{w_i n_i}{y_i} \\ (1+\tau_i^k) &= \frac{1-\alpha_j}{\alpha_j}\frac{w_i n_i}{(r+\delta)\,k_i}\end{aligned}$$

- Gross output wedge in the prefecture, Δ_p^y

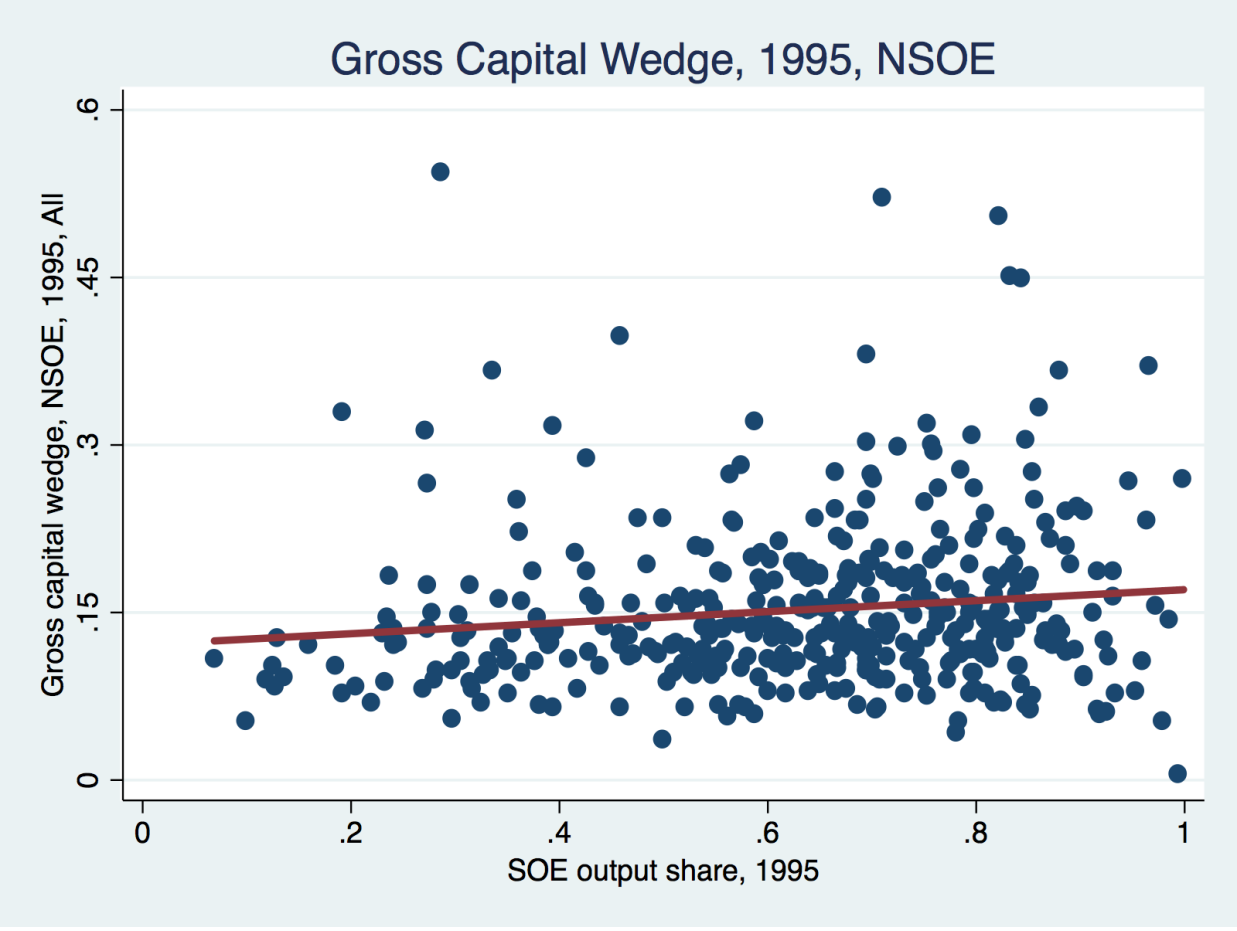
$$\Delta_p^y = \sum_{j=1}^{J}\left(\frac{1}{\alpha_j \eta}\sum_{i\in(j,p)}\frac{w_i n_i}{y_i}\frac{y_i}{Y_{j,p}}\right)\frac{Y_{j,p}}{Y_p},$$

- Gross capital wedge in the prefecture, Δ_p^k

$$\Delta_p^k = \sum_{j=1}^{J}\left(\frac{1-\alpha_j}{\alpha_j}\sum_{i\in(j,p)}\frac{w_i n_i}{k_i}\frac{k_i}{K_{j,p}}\right)\frac{K_{j,p}}{K_p}.$$

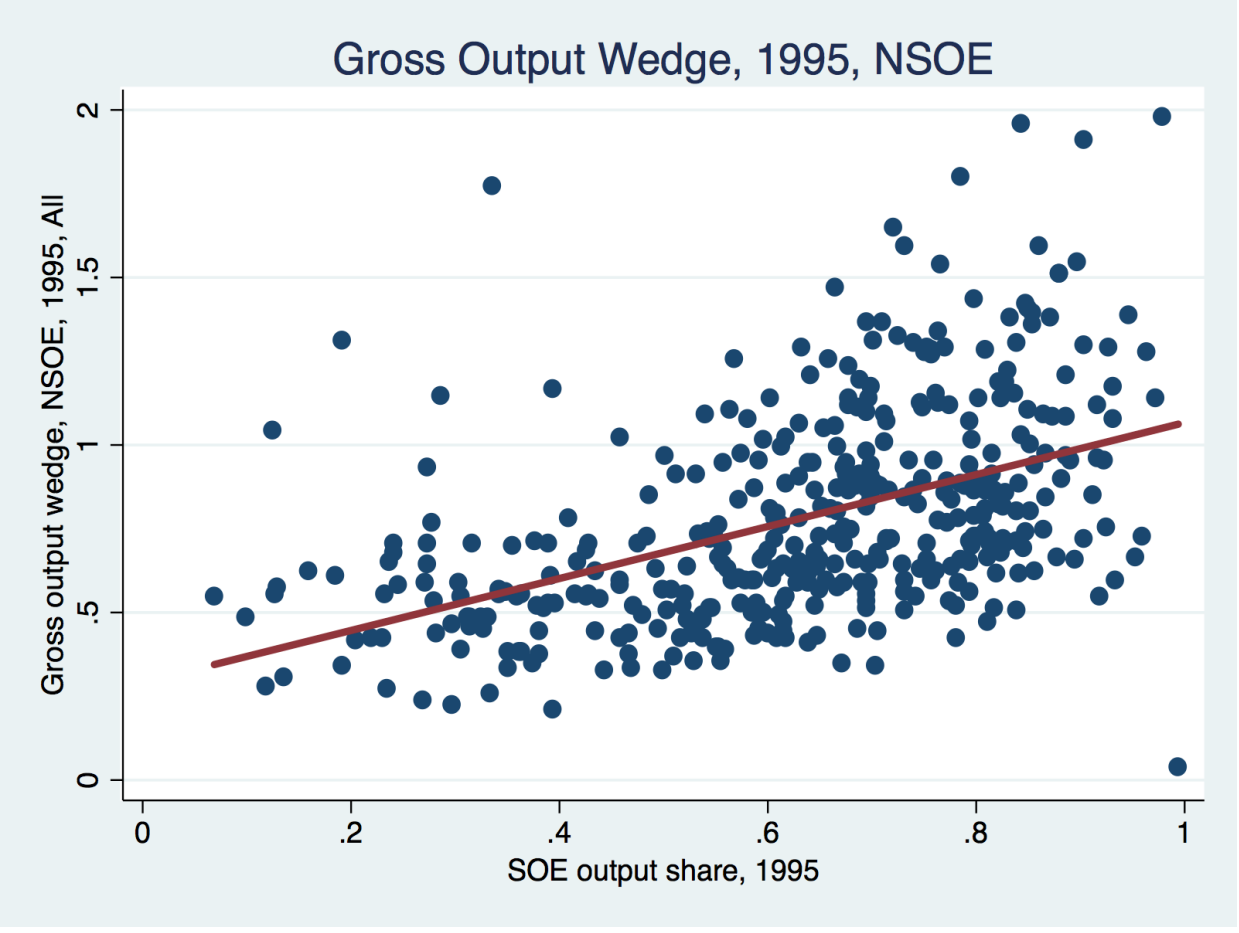
- Compute Δ_p^y and Δ_p^k for each prefecture in the dataset

Gross Capital Wedge: Δ_p^k



- Capital taxes slightly higher in high SOE-share prefectures

Gross Output Wedge: Δ_p^y



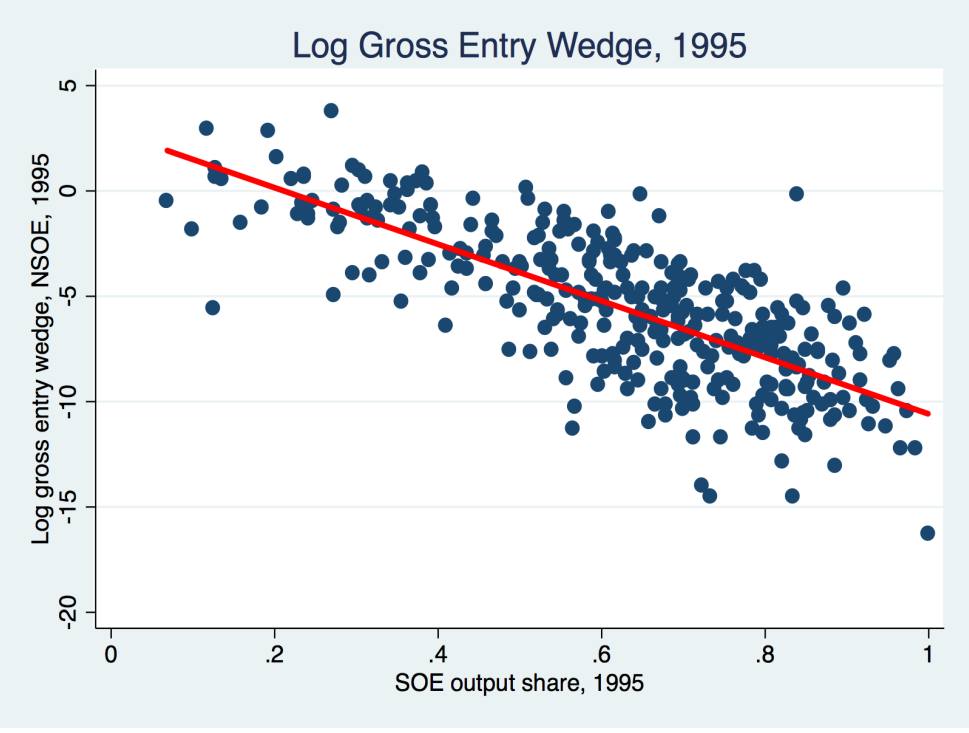
- Output taxes low in high SOE-share prefectures

Accounting Exercise 2: Entry Wedge $(1-\psi_p)$

- Estimate ψ_p in prefecture p from the equilibrium condition

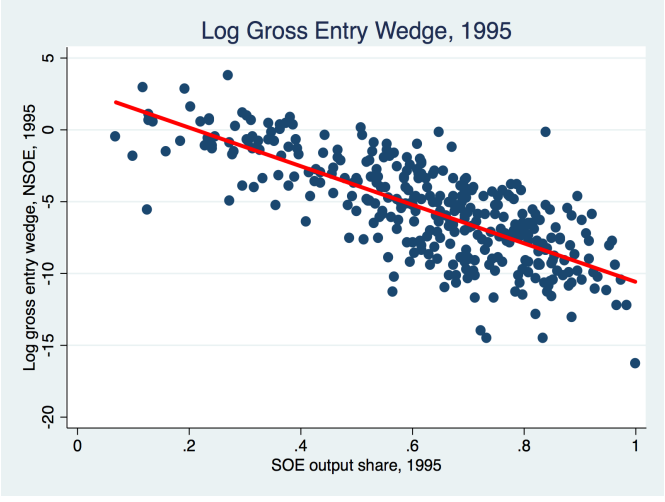
$$\begin{aligned}
\ln(1-\psi_p) &= \ln N_p + \frac{1-\eta+\xi\alpha\eta}{1-\eta}\ln w_p \\
&\quad - \frac{\xi}{1-\eta}\ln \Delta_p^y \\
&\quad + \frac{\xi\eta(1-\alpha)}{1-\eta}\ln \Delta_p^k \\
&\quad + (\xi-1)\ln v + \Omega(\alpha,\eta,\xi,\underline{z})
\end{aligned}$$

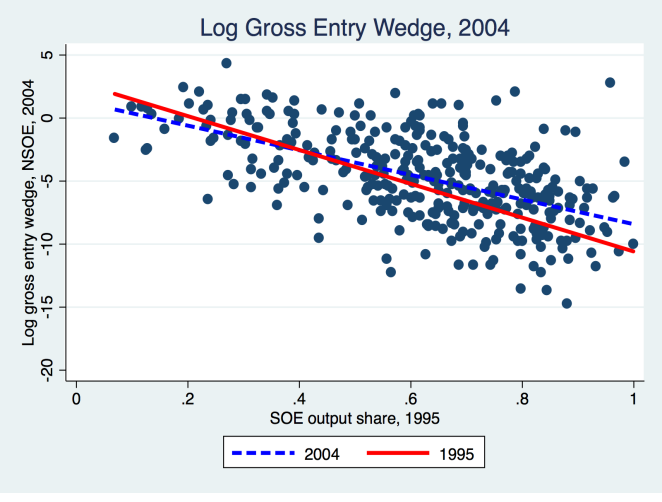
Estimated NSOE Entry Wedge $(1 - \psi_p)$ in 1995

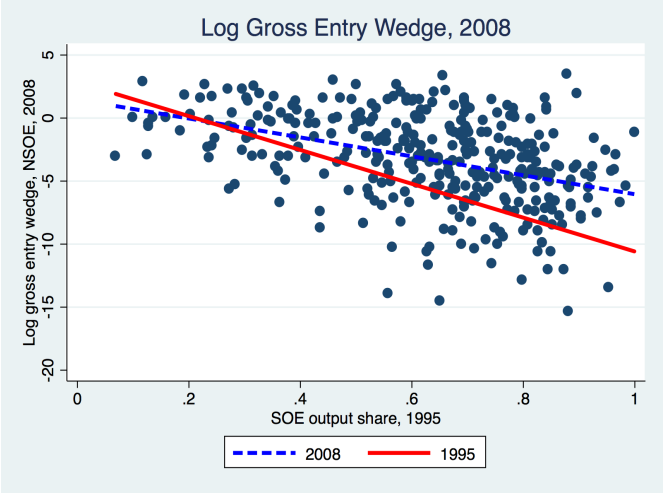


- Log gross entry wedge $\ln(1 - \hat{\psi}_p)$
- SOE share accounts for 52% of the variation in the entry wedge

Estimated NSOE Entry Wedge $(1 - \psi_p)$



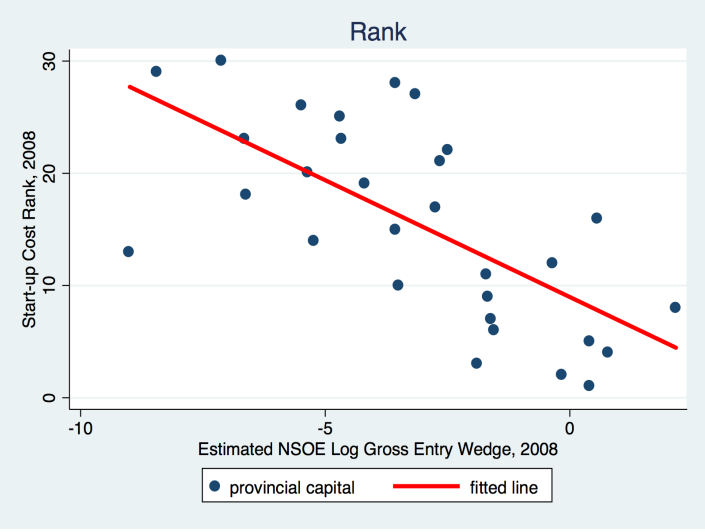


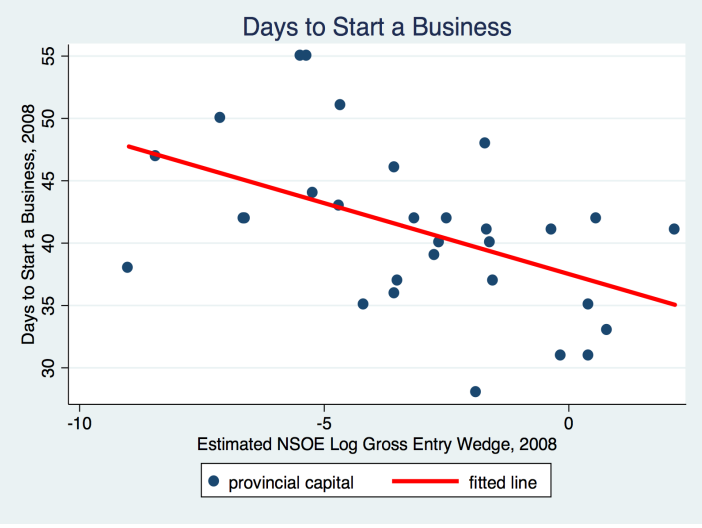


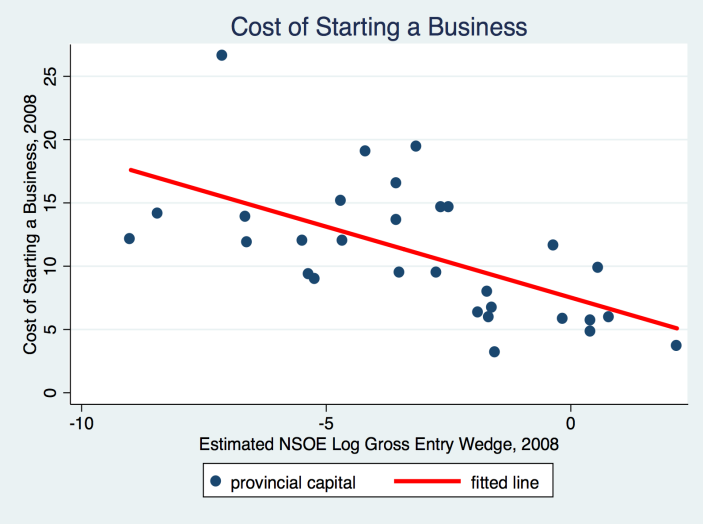
2008 Costs of Starting a Business in China

- "Doing Business in China 2008" Report
  - : The World Bank Group (2008)
  - : provides various measures of the cost of starting a business in main provincial cities
- Measures
  - : Rank: from easy (1) to hard (30) to start a business
  - : Days it takes to start a business
  - : Cost of starting a business: as a % of provincial GDP per capita

“Doing Business in China” and Entry Wedges, 2008







Entry Rates and Wedges

- Non-SOE entry rates were not targeted in the estimation of the model
- Entry rate measure $\Gamma^e_{p,t}$ for prefecture p in period $t = 1995, 2004, 2008$

$$\Gamma^e_{p,t} = \frac{N^e_{p,t}}{N_{p,t} - N^e_{p,t}}$$

  - : $N^e_{p,t}$ is employment in new non-SOE firms
  - : $N_{p,t}$ is total employment
  - : new firms are started in period $t-1$ or $t-2$
  - : firms started in period t are dropped

Entry Rates and Wedges

$$\ln \Gamma^{e}_{p,t} = \beta_0 + \underbrace{\beta_1}_{(+)} \underbrace{\ln(1-\tau^{y}_{p,t})}_{\text{log gross output wedge}} + \underbrace{\beta_2}_{(-)} \underbrace{\ln[(1+\tau^{k}_{p,t})(r+\delta)]}_{\text{log gross capital wedge}}$$

$$+ \underbrace{\beta_3}_{(+)} \underbrace{\ln(1-\psi_{p,t})}_{\text{log gross entry wedge}} + \varepsilon_{p,t}$$

	$\ln(1-\tau^{y})$		$\ln(1+\tau^{k})$		$\ln(1-\psi)$	
	β_1	$1sd$	β_2	$1sd$	β_3	$1sd$
1995	0.188*	9.5%	-0.161*	-9.3%	0.106**	36.9%
2004	0.086	3.8%	0.045	2.2%	0.042**	14.9%
2008	0.221**	12%	-0.065	-5.0%	0.037**	13.1%

Note: ** – statistically significant at 1%; * – statistically significant at 10%.

Entry Rates and Wedges

$$\Delta \ln \Gamma^{e}_{p,t} = \gamma_0 + \underbrace{\gamma_1}_{(+)} \Delta \underbrace{\ln(1-\tau^{y}_{p,t})}_{\text{log gross output wedge}} + \underbrace{\gamma_2}_{(-)} \Delta \underbrace{\ln[(1+\tau^{k}_{p,t})(r+\delta)]}_{\text{log gross capital wedge}}$$

$$+ \underbrace{\gamma_3}_{(+)} \Delta \underbrace{\ln(1-\psi_{p,t})}_{\text{log gross entry wedge}} + \varepsilon_{p,t}$$

	$\Delta \ln(1-\tau^{y})$		$\Delta \ln(1+\tau^{k})$		$\Delta \ln(1-\psi)$	
	γ_1	$1sd$	γ_2	$1sd$	γ_3	$1sd$
1995-2004	-0.083	-4.2%	-0.201*	-13.6%	0.035*	9.1%
2004-2008	0.160*	8.9%	-0.086*	-6.8%	0.044**	9.8%

Note: ** – statistically significant at 1%; * – statistically significant at 10%.

Convergence in TFP and Wages

	TFP		Wages	
Change in	1995-2004	2004-2008	1995-2004	2004-2008
all	**0.031**	**0.038**	**0.060**	**0.109**
$\alpha\eta$	-0.003	-0.007	**0.023**	0.006
n	0.001	-0.001	0.006	-0.009
$(1+\tau^k)$	-0.006	0.003	0.005	0.015
$(1-\tau^y)$	0.009	0.013	-0.001	**-0.028**
$(1-\psi)$	**0.029**	**0.029**	**0.024**	**0.081**

What Explains the Entry Wedges?

$$\ln(1-\psi)_{p,t} = \beta_0 + \beta\, e^{SOE}_{p,t} + X_{p,t}\gamma' + \varepsilon_{p,t}$$

$$\Delta \ln(1-\psi)_{it} = \beta_0 + \beta_1 \Delta e^{SOE}_{it} + \Delta X_{it}\gamma' + \Delta\varepsilon_{it}$$

Controls

- $\ln FREV_t$: 1995 (2004) log fiscal revenue per government worker
- $\ln PROF^{soe}_t$: 1995 ratio of profits to total assets for SOEs
- $e^{soe}_p = \frac{E^{soe}_p}{E_p}$: 1995 (2004, 2008) share of SOE employment in pref. p

Cross-Sectional IVs for SOE Share, e_p^{soe}

Cross-sectional instruments: **lagged variables**

- $IV_{lag} = e^{soe}_{p,t-1}$; lagged SOE employment share in pref. p
- IV_{1978}
  - : restrict 1995 sample to firms established 1978 or earlier
  - : measure SOE share in 1978 using this restricted sample
- IV_{prov}: use 1978 GDP provincial data and construct province SOE share in 1978

The Entry Wedge in 1995, 2004, and 2008

	$\ln(1-\psi)$	*OLS*	IV_{lag}	IV_{1978}	IV_{prov}
1995	e^{soe}	-11.64**	-14.13**	-12.96**	-11.72**
	$\ln FREV$	1.31**	0.93*	1.11**	1.69*
	$\ln PROF^{soe}$	0.31*	0.32*	0.32*	0.13
2004	e^{soe}	-9.61**	-13.39**	-16.06**	-17.47**
	$\ln FREV$	2.16**	1.89**	1.70**	0.40
2008	e^{soe}	-8.10**	-9.63**	-14.60**	-16.71**

Note: ** – statistically significant at 1%; * – statistically significant at 5%.

[First-Stage Results]

Time-Series IV for Change in SOE Share, Δe_p^{soe}

- **Bartik** instrument for 1995-2004 SOE empl. change
  - : 1998 SOE reform "Grab the Large, Release the Small"
- Aggregate 1995-2004 SOE empl. change in industry *j*
  - : $\mu_j^{soe} = \frac{E_{j,2004}^{soe} - E_{j,1995}^{soe}}{E_{j,1995}^{soe}}$
- 1995 ratio SOE empl. share in ind. *j* / pref. *p* empl.
  - : $e_{p,j}^{soe} = \frac{E_{p,j}^{soe}}{E_p}$
- Predicted increase in SOE employment (Bartik instrument)
  - : $IV_p^{ind} = \sum_j e_{p,j}^{soe} * \mu_j^{soe}$

Change in the Entry Wedge, 1995-2004

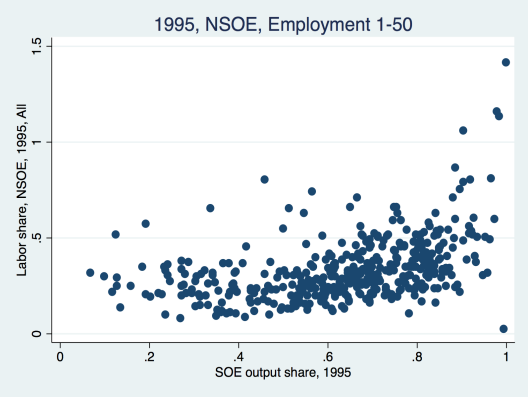
$\Delta \ln(1-\psi)$	*OLS*	*OLS*	IV_p^{ind}	IV_p^{ind}
Δe^{soe}	-3.13**	-2.54*	-5.38*	-6.14*
	(1.00)	(1.18)	(2.20)	(2.38)
$\Delta \ln FREV$		1.13**		0.84*
		(0.37)		(0.41)
First stage:				
IV coefficient			0.67**	0.71**
st. error			(0.07)	(0.07)
R^2			0.21	0.30

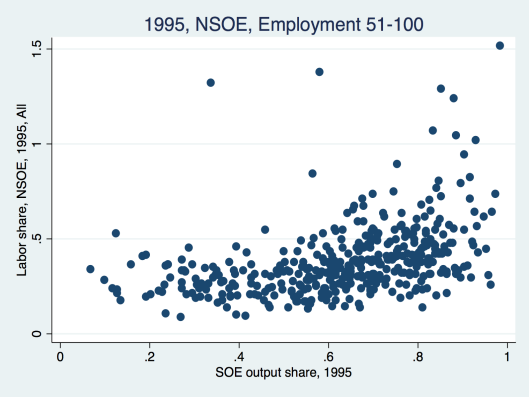
Note: ** – statistically significant at 1%; * – statistically significant at 5%.

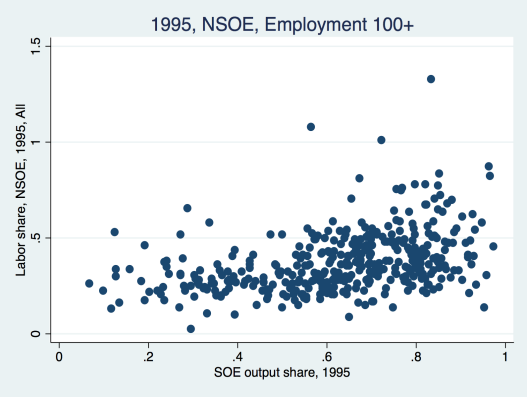
Alternative Theory I

- NSOE firms in a prefecture have access to two technologies:
  1. inefficient low z technology with a high labor share (labor intensive)
  2. efficient high z technology with a low labor share
- A larger fraction of the NSOE firms in the high s prefectures will use technology 1 $\Rightarrow$ higher labor share
- Predictions of the alternative theory
  - within prefectures: smaller firms have higher labor share
  - across prefectures: conditional on size, firms have the same labor share

Alternative Theory I







- Predictions of the alternative theory are not consistent with the data
- Within prefectures
  - : firms with different sizes have the same labor share
- Across prefectures
  - : conditional on size, firms have increasing in *s* labor share

Alternative Theory II

- The pool of potential entrants is worse in the high s prefectures:
  - lower TFP of entrants
  - less heavy right Pareto tail (larger Pareto coefficient)
- Predictions of the alternative theory
  - consider a productivity cutoff z_0
  - consider the right tail of the Pareto distribution for firms with $z > z_0$
  - ξ should be higher in high s prefectures
- Predictions of the alternative theory are not consistent with the data
  - pick z_0 as the 90th or 95th percentile of the overall TFP distrib.
  - in each case, ξ is the same in high and low s prefectures
  - for the 90th perc: $\xi_{s,low} = 1.051$, $\xi_{s,high} = 1.048$

Alternative Theory III

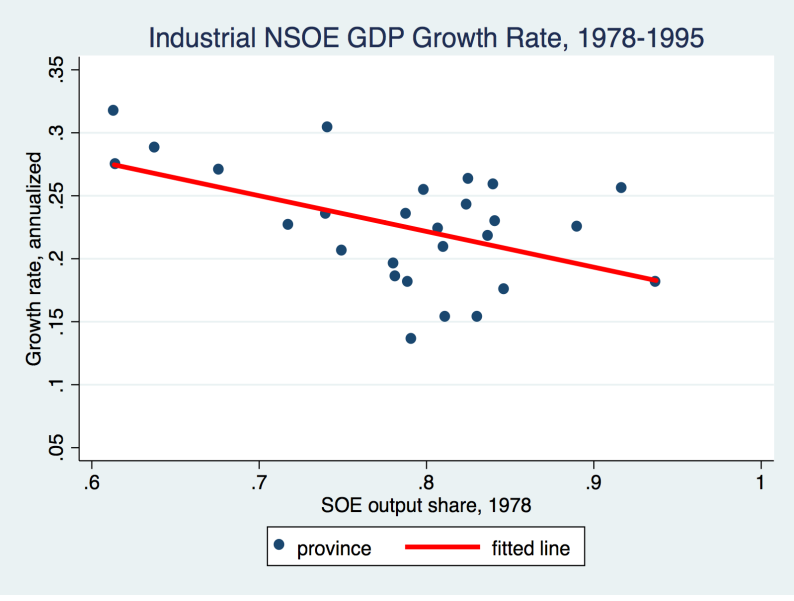
- The cost of operation, v, is higher in high s prefectures
- Predictions of the alternative theory
  - less entry
  - lower wages
- Predictions of the alternative theory that are not consistent with the data
  - entrants are positively selected on productivity
  - high TFP

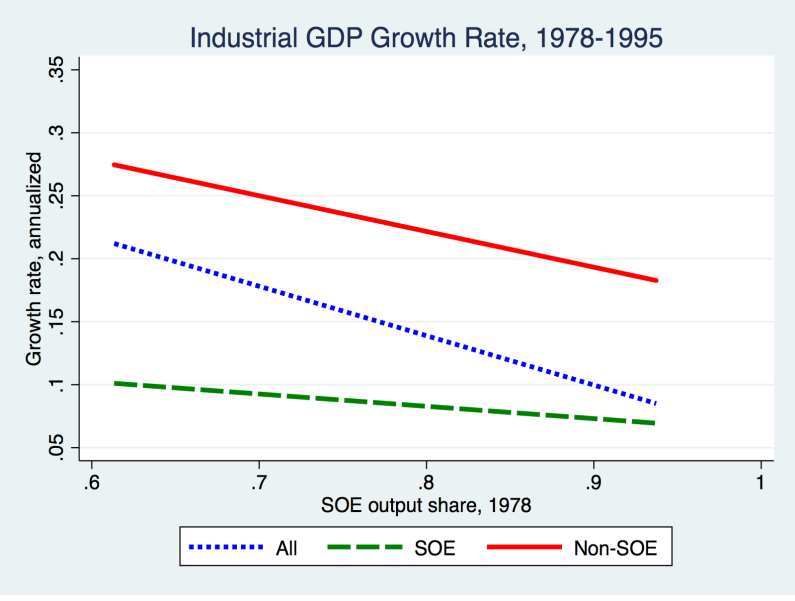
Conclusion

- Study growth patterns of non-state sector across localities in China
- Build Hopenhayn model of new firm entry with multiple distortions
- Identify novel entry wedge as key to explaining heterogeneity in new firm behavior across prefectures
  - Provide out-of-sample validation for these wedges
  - Link size and changes of entry costs to dynamics of state-sector
- Develop political-ec. model of local government behavior to motivate observed correlations between entry wedges and SOE presence
- Future directions
  - Allow wedges to differ by industry and location
  - Extend through Great Recession to capture possible reversal
  - Study role of wedges for impeding structural transformation

Additional Slides

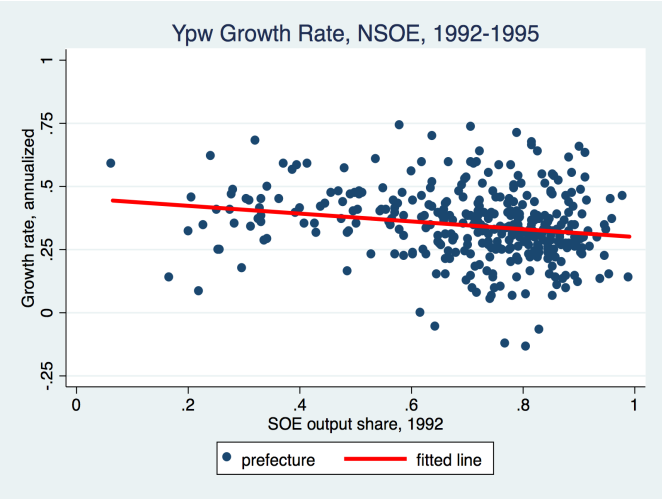
Growth in the Non-State Sector: 1978-1995

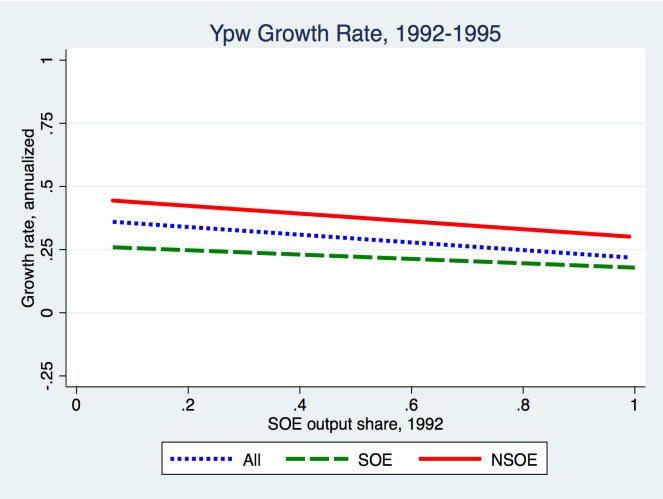


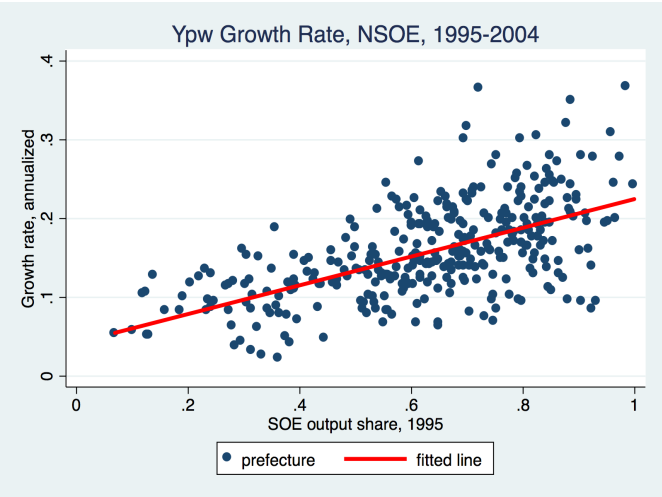


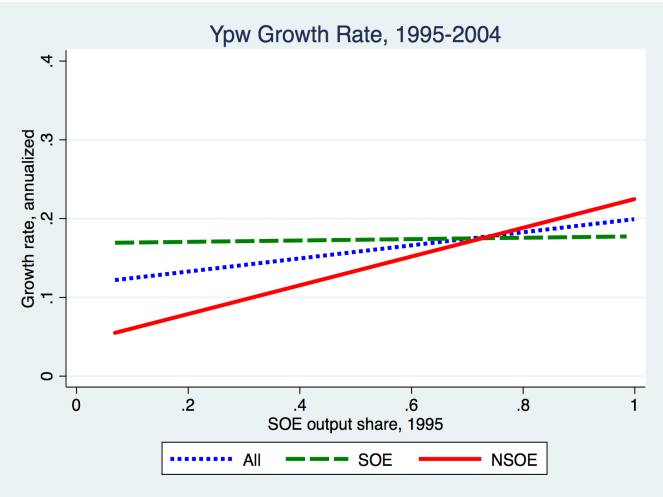
- Provincial level industrial output data
- The size of the state sector in 1978 is negatively correlated with the
  - 1978-1995 growth in provincial NSOE GDP (left panel); and
  - 1978-1995 growth in prov. overall, SOE, and NSOE GDP (right panel).

Growth in the Non-State Sector



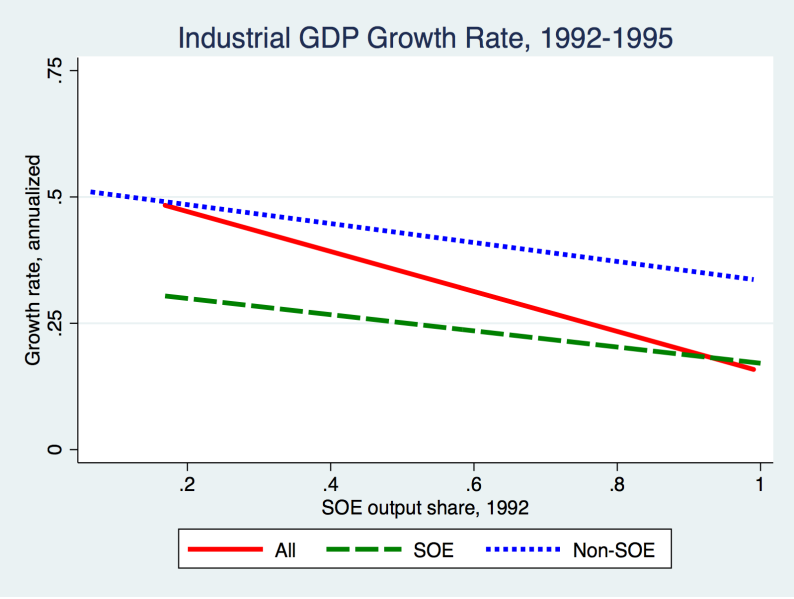


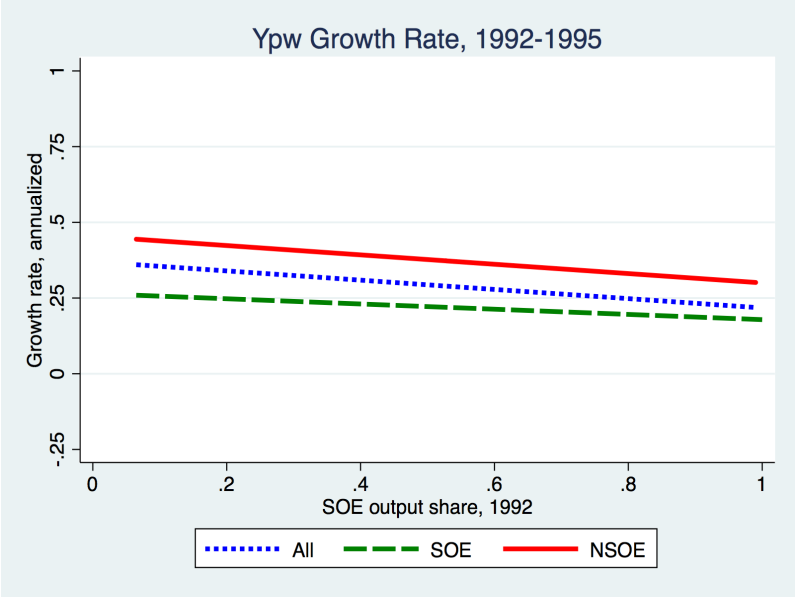




- 1992-1995: divergence
- 1995-2004: convergence (as well as in 2004-2008)

Growth in the Non-State Sector: 1992-1995

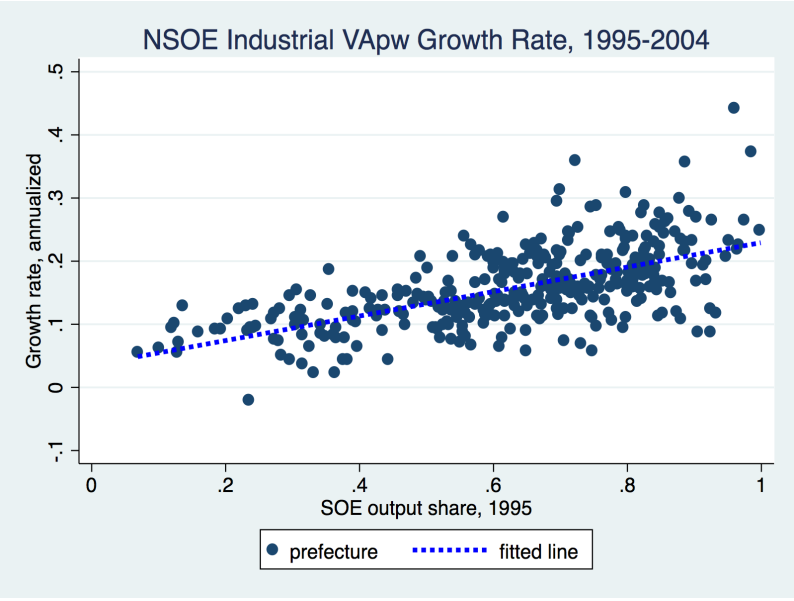


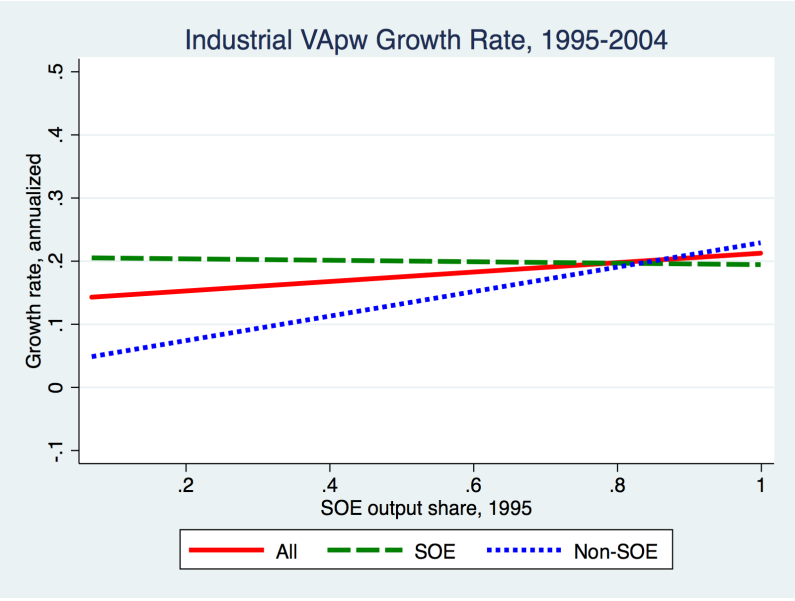


- At the prefecture level, industrial output (per worker)
- The size of the state sector in 1992 is negatively correlated with the
  - 1992-1995 growth in prefecture GDP (left panel); and
  - 1992-1995 growth in prefecture output per worker (right panel)

[Y/N]

Growth Rate in VApw, 1995-2004





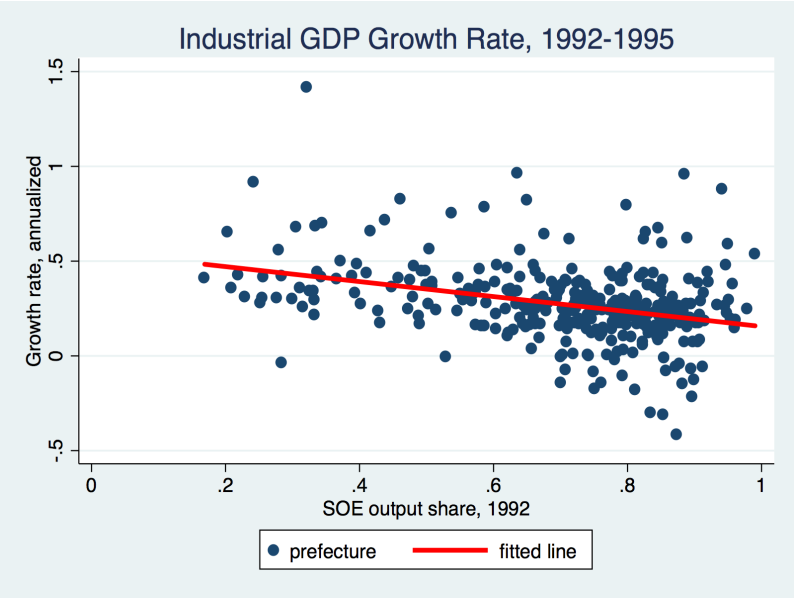
- The size of the state sector in 1995 is positively correlated with the
  - 1995-2004 growth in prefecture NSOE VApw (left panel); and
  - 1995-2004 growth in pref. overall and NSOE VApw (right panel).

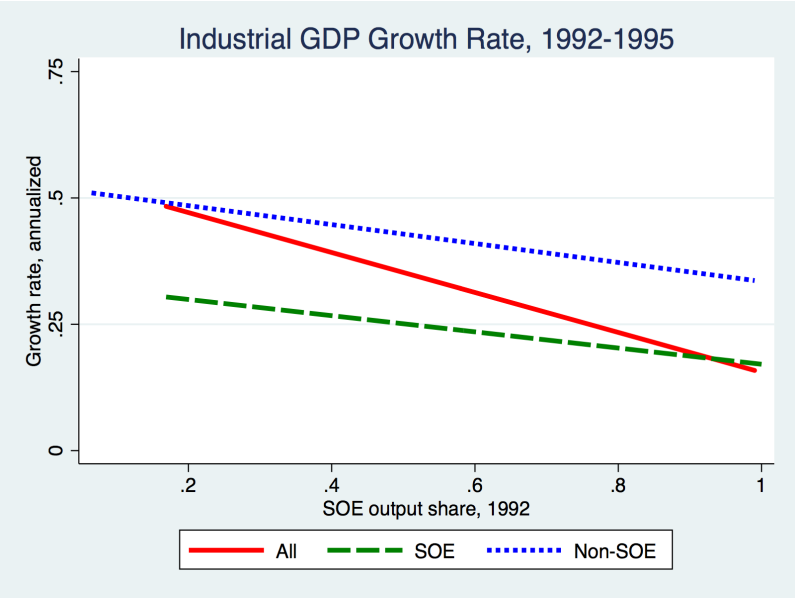
[Output per worker]

[Output]

[2004-2008]

The Effect of the State Sector: 1992-1995



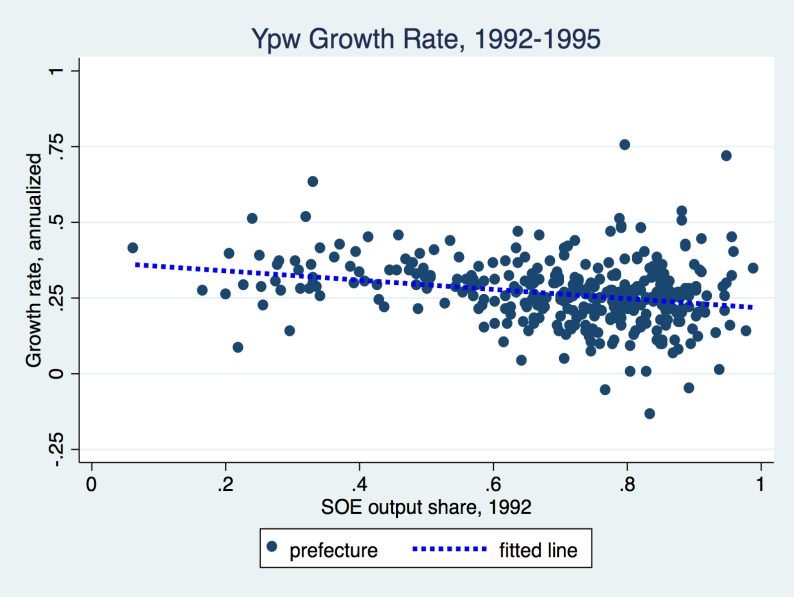


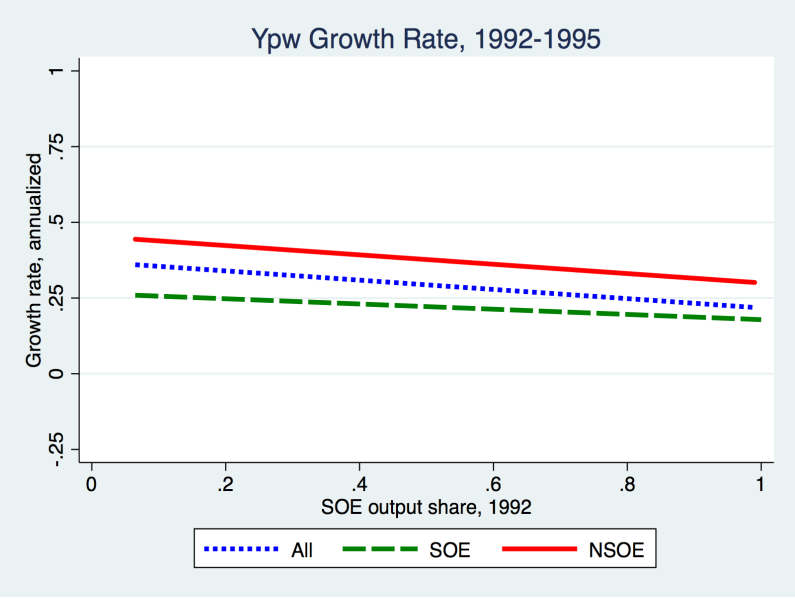
- At the prefecture level, industrial output
- The SOE share of output, *s*, in 1992 is negatively correlated with the
  - 1992-1995 growth in prefecture GDP (left panel); and
  - 1992-1995 growth in pref. overall, SOE, and NSOE GDP (right panel).

[Y/N]

[Back]

The Effect of the State Sector: 1992-1995, Y/N

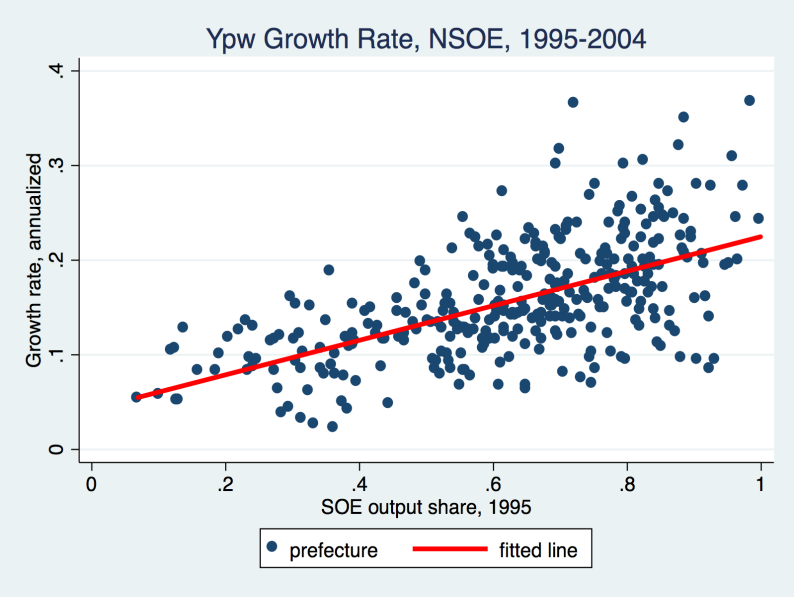


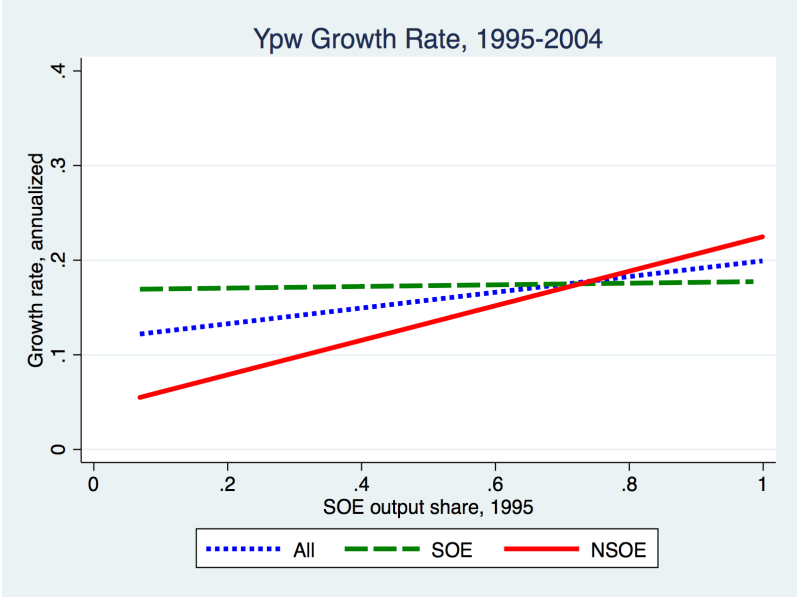


- At the prefecture level, industrial output
- The size of the state sector in 1992 is negatively correlated with the
  - 1992-1995 growth in prefecture Y/N (left panel); and
  - 1992-1995 growth in pref. overall, SOE, and NSOE Y/N (right panel).

[Back]

Growth Rate in Ypw, 1995-2004

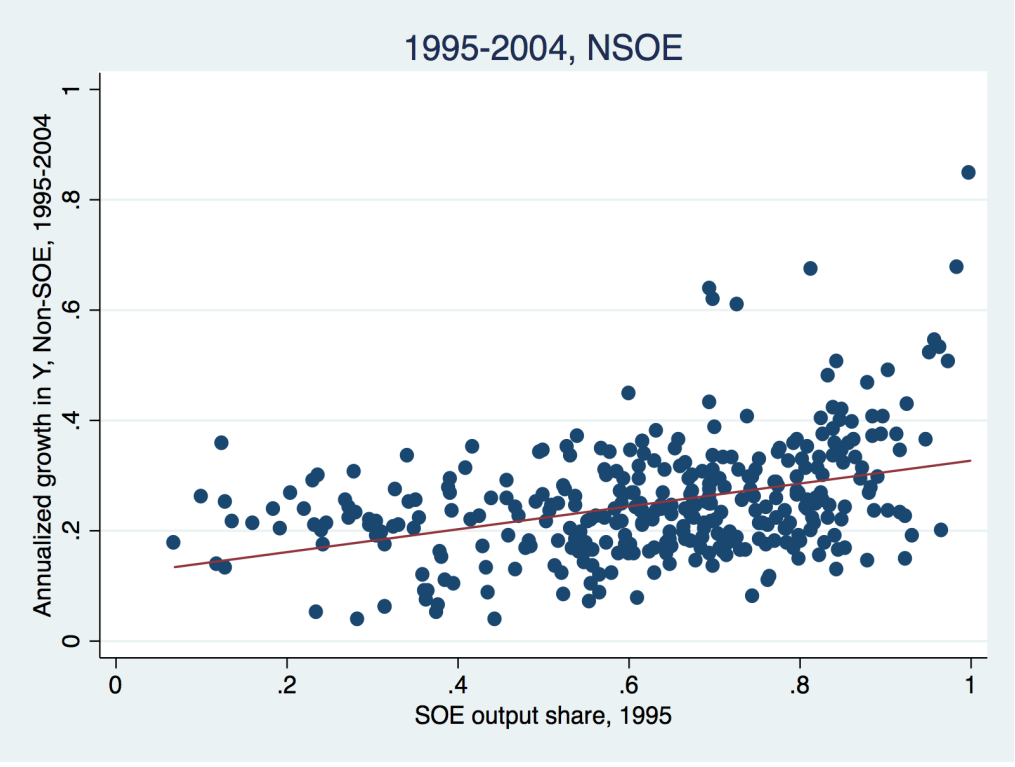




- The size of the state sector in 1995 is positively correlated with the
  - 1995-2004 growth in prefecture NSOE Ypw (left panel); and
  - 1995-2004 growth in pref. overall and NSOE Ypw (right panel).

[Back]

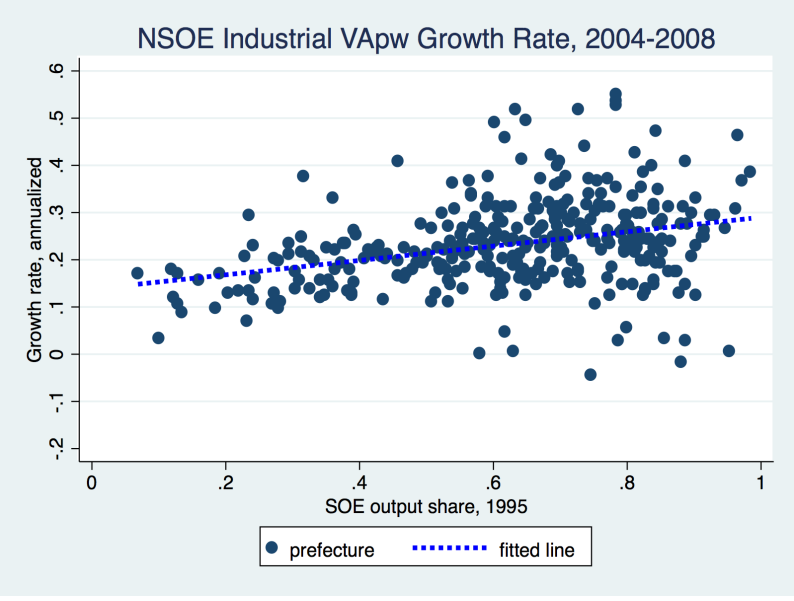
Growth Rate in Y, 1995-2004

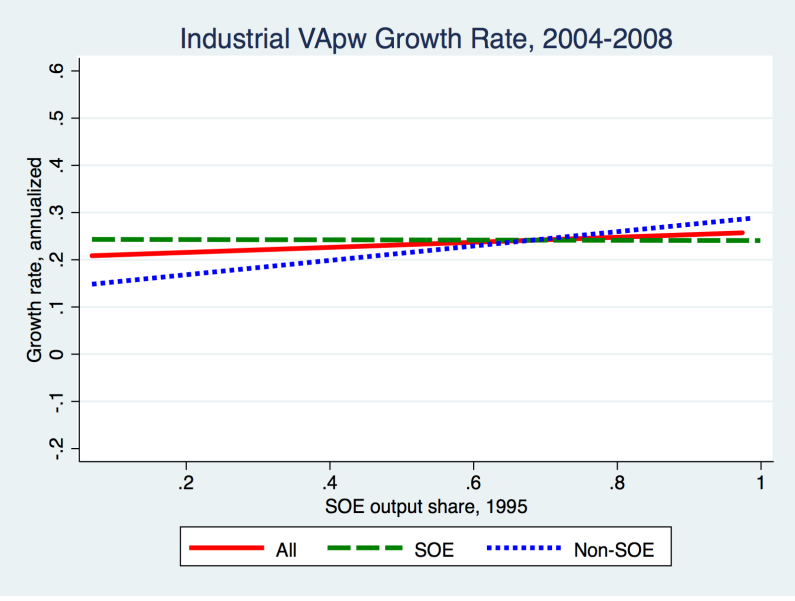


- The size of the state sector in 1995 is positively correlated with the
  - 1995-2004 growth in prefecture NSOE Y

[Back]

Growth Rate in VApw, 2004-2008

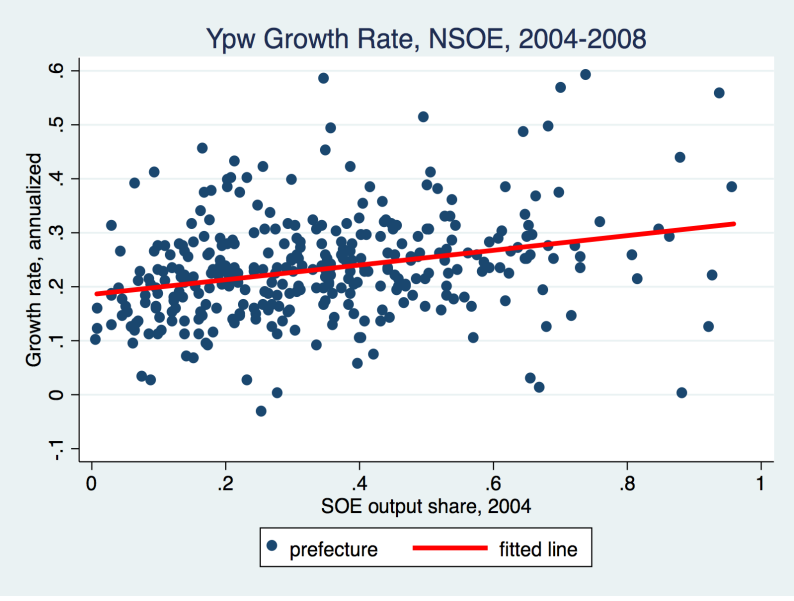


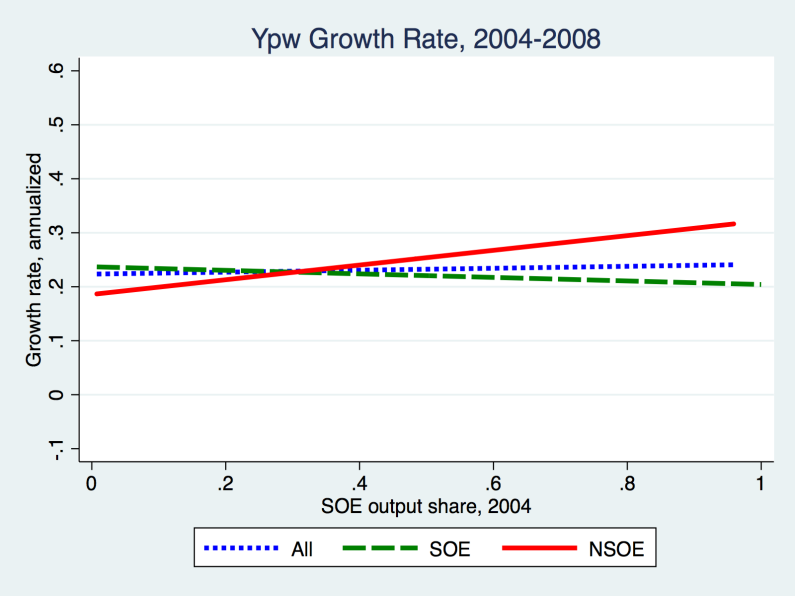


- The size of the state sector in 1995 is positively correlated with the
  - 2004-2008 growth in prefecture NSOE VApw (left panel)

[Back]

Growth Rate in Ypw, 2004-2008

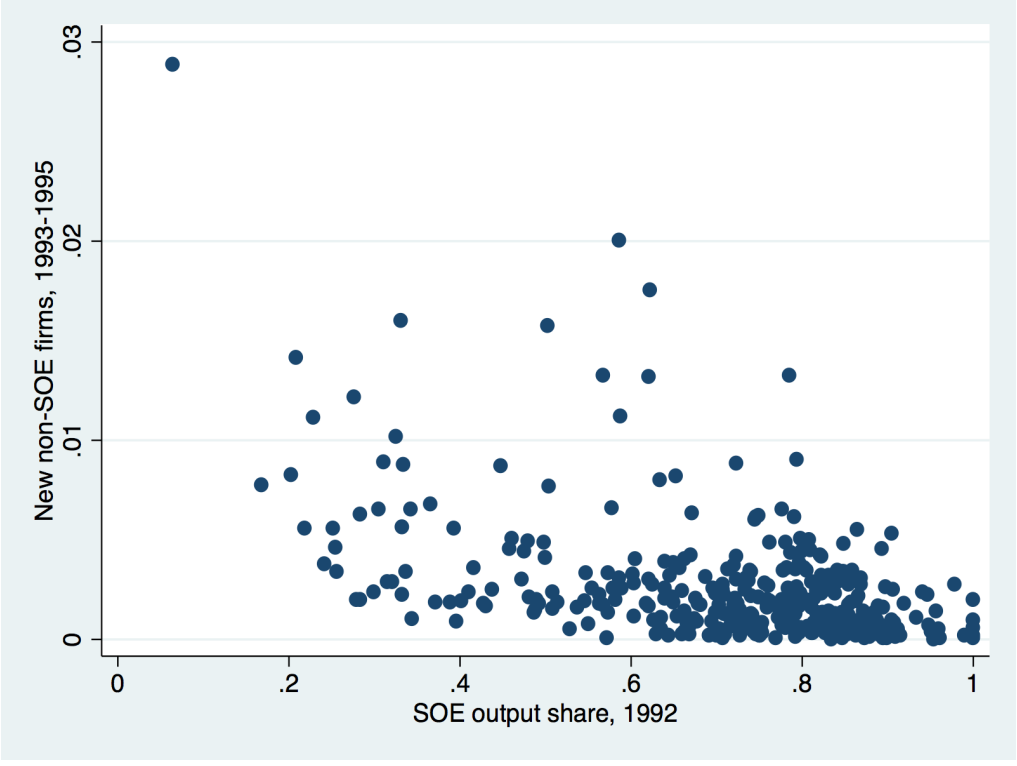




- The size of the state sector in 2004 is positively correlated with the
  - 2004-2008 growth in prefecture NSOE Ypw (left panel).

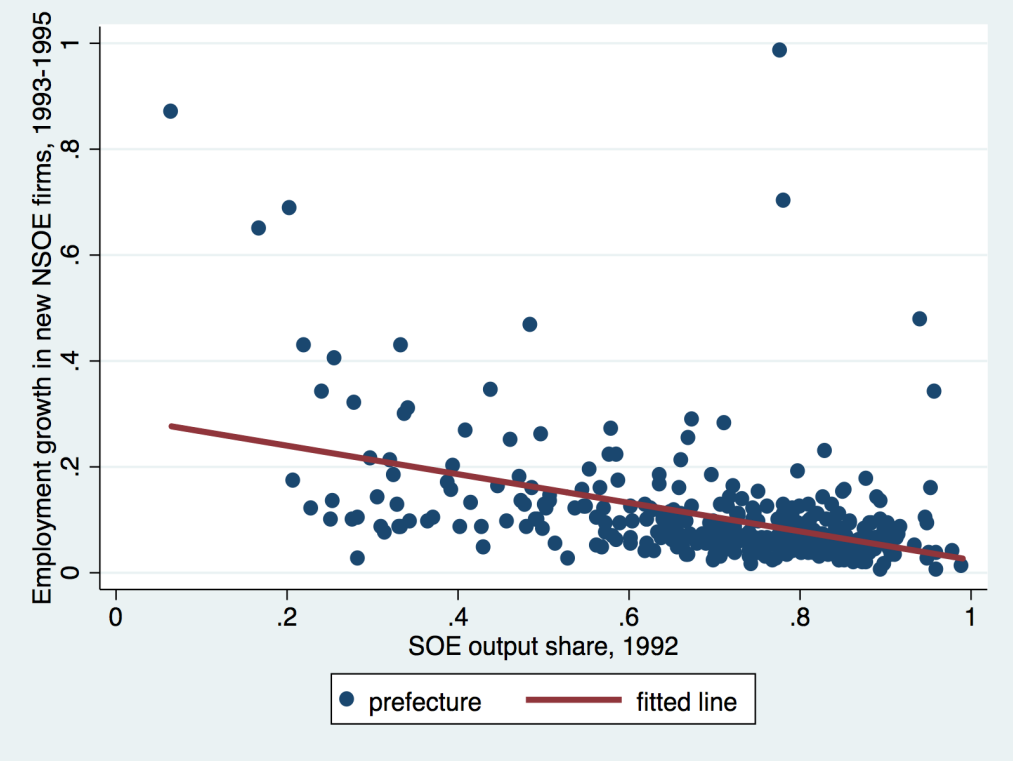
[Back]

Firm Entry in the Non-state Sector, 1995



- Distribution of new non-state firms (1993-1995 entrants)
- Most are in the low *s* prefectures

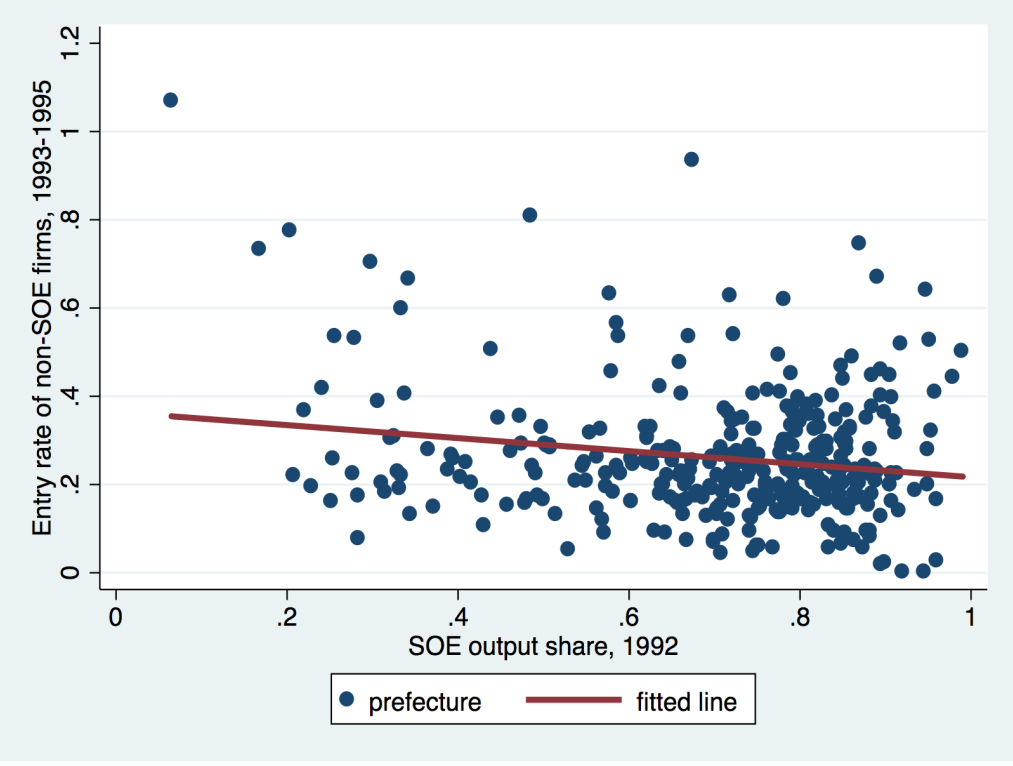
Firm Entry in the Non-state Sector, 1995



- Employment in new non-state entrants (1993-1995) relative to the employment in all firms in 1992
- Lower in high *s* prefectures

[Number of firms]

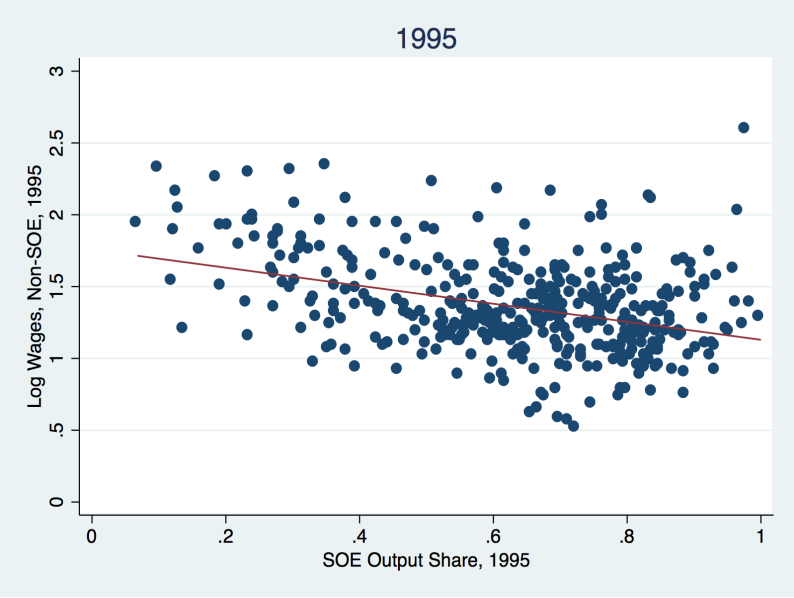
Firm Entry in the Non-state Sector, 1995

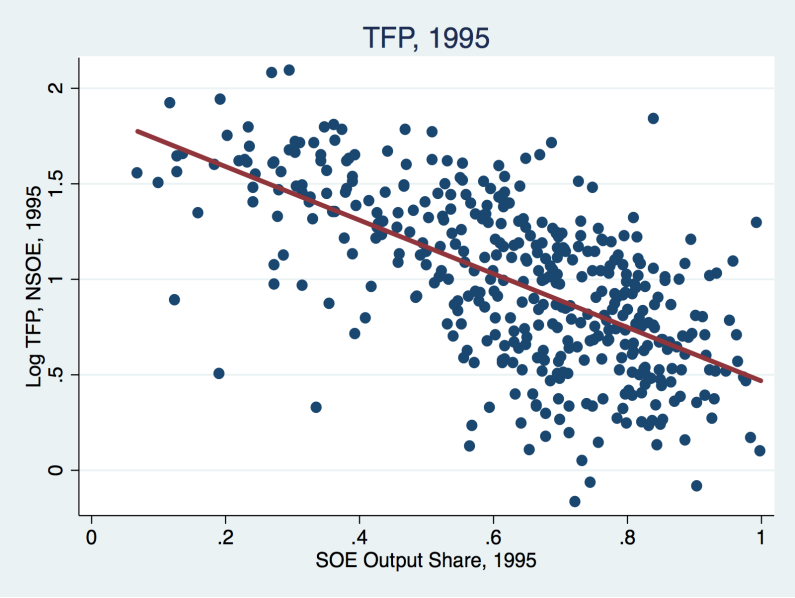


- New non-state entrants (1993-1995) relative to the stock of all firms in 1992
- Lower in high *s* prefectures

[Back]

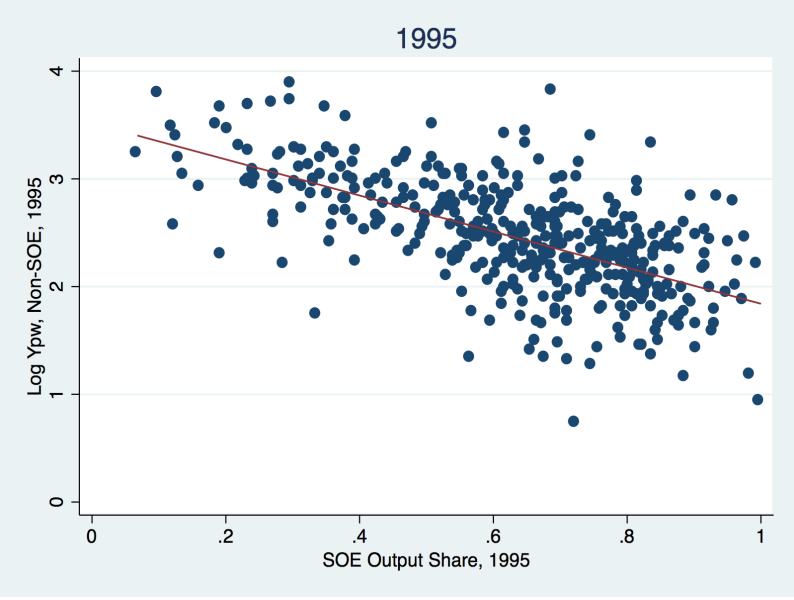
Non-State Sector, 1995

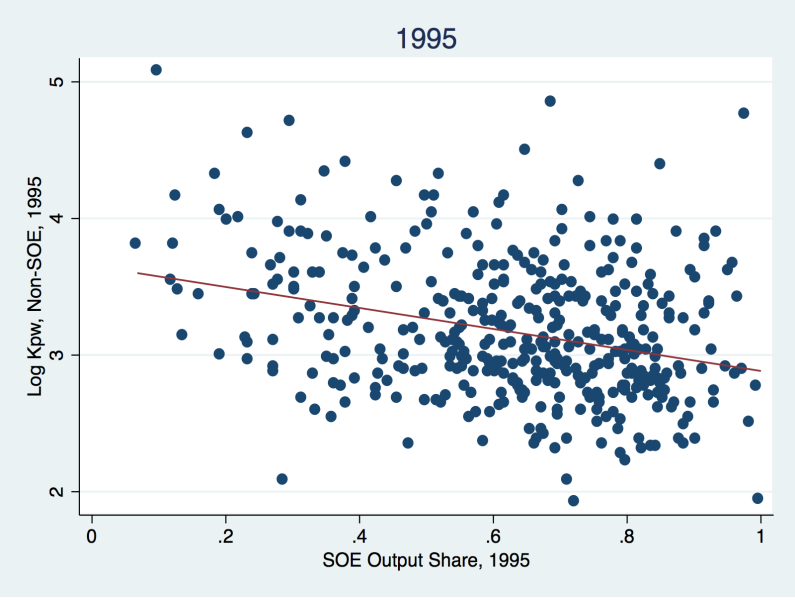




- Size of state sector negatively correlated with NSOE
  - wages;
  - TFP (defined as Solow residual);

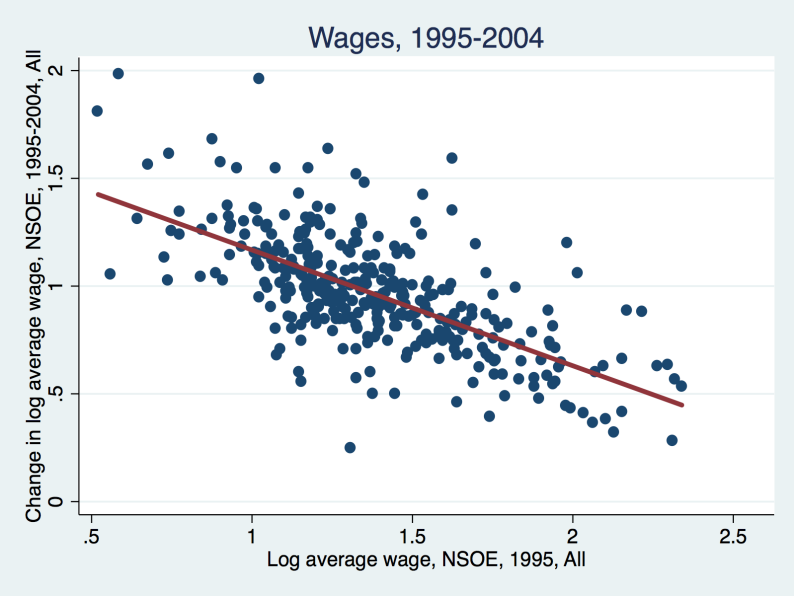
Non-State Sector, 1995

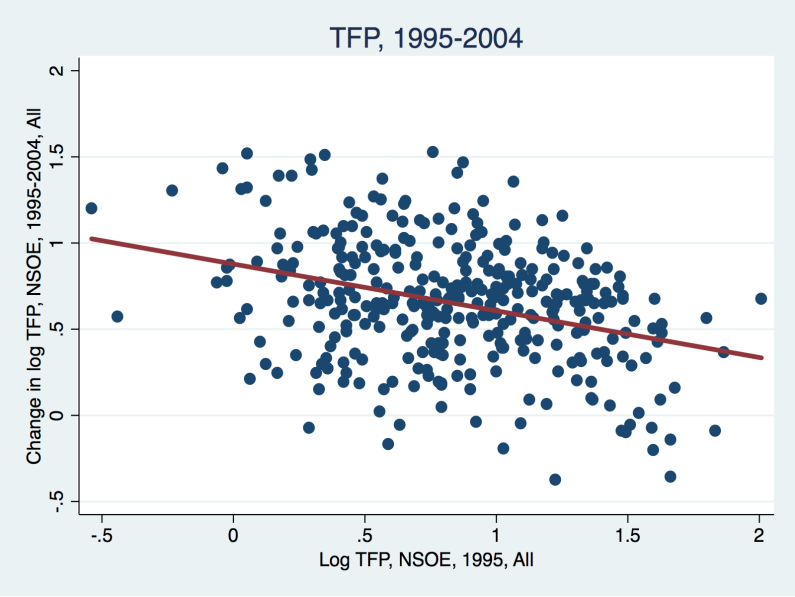




- The size of the state sector is negatively correlated with NSOE
  - output per worker;
  - capital per worker;

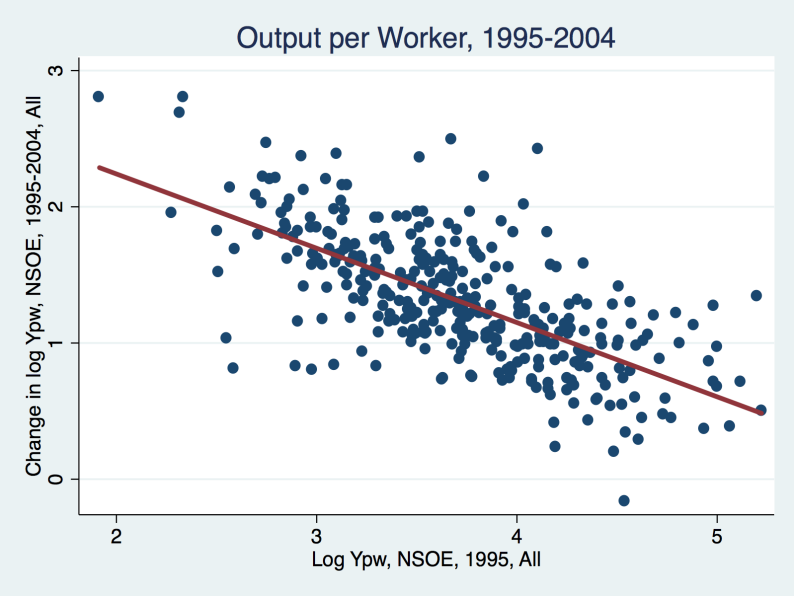
Non-State Sector Convergence, 1995-2004

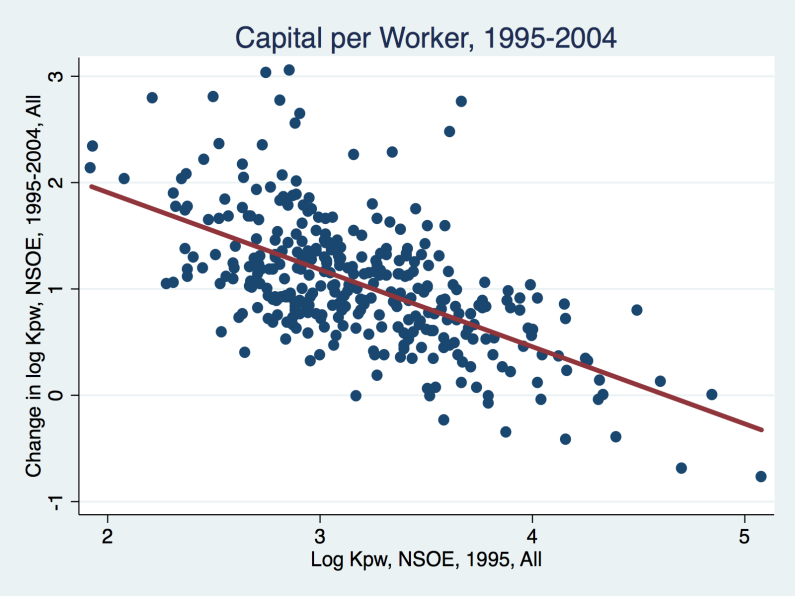




- There is a 1995-2004 convergence in the NSOE sector in
  - wages; rate of convergence is 6.0%
  - TFP (calculated as Solow resid.); rate of convergence is 3.1%

Non-State Sector Convergence, 1995-2004





- There is a 1995-2004 convergence in the NSOE sector in
  - output per worker; rate of convergence is 8.5%
  - capital per worker; rate of convergence is 13.5%

Framework for Wedges: The Labor Wedge

- Incorporating the gross labor wedge: $(1+\tau^w)$
- Gross output wedge, Δ_i^y

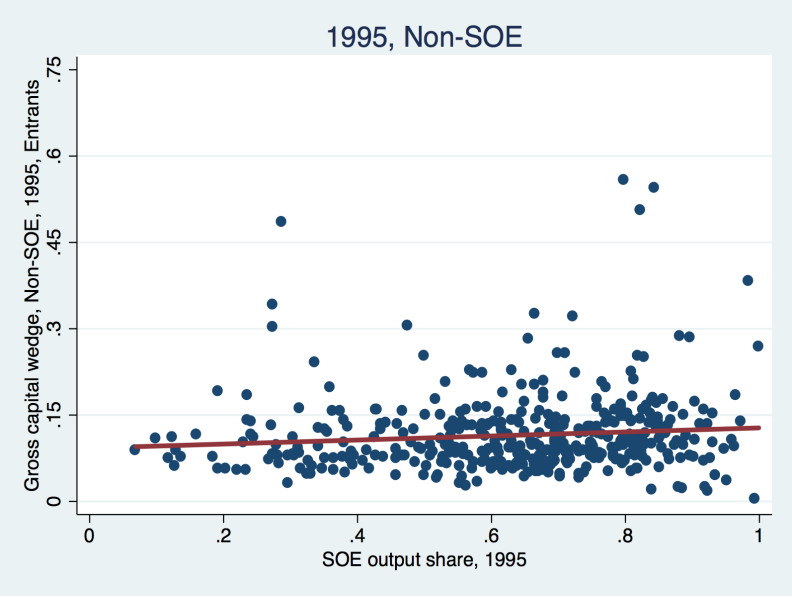
$$\Delta_i^y = \frac{(1-\tau_i^y)}{(1+\tau^w)} = \frac{1}{\alpha\eta}\frac{w_i n_i}{y_i}$$

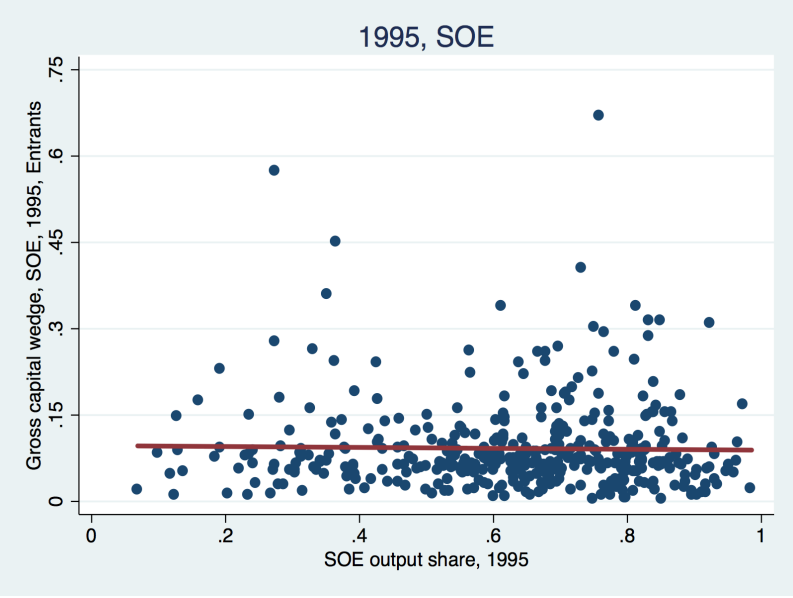
- Gross capital wedge, Δ_i^k

$$\Delta_i^k = \frac{(1+\tau_i^k)(r+\delta)}{(1+\tau^w)} \quad = \quad \frac{1-\alpha}{\alpha}\cdot\frac{w_i n_i}{k_i}$$

- If the labor wedge increases with s, then in the NSOE sectors
  - : the output subsidies have to be even higher in the high s prefectures, and
  - : the capital tax wedges have to be higher in the high s prefectures

Gross Capital Wedge, Entrants: Δ^k

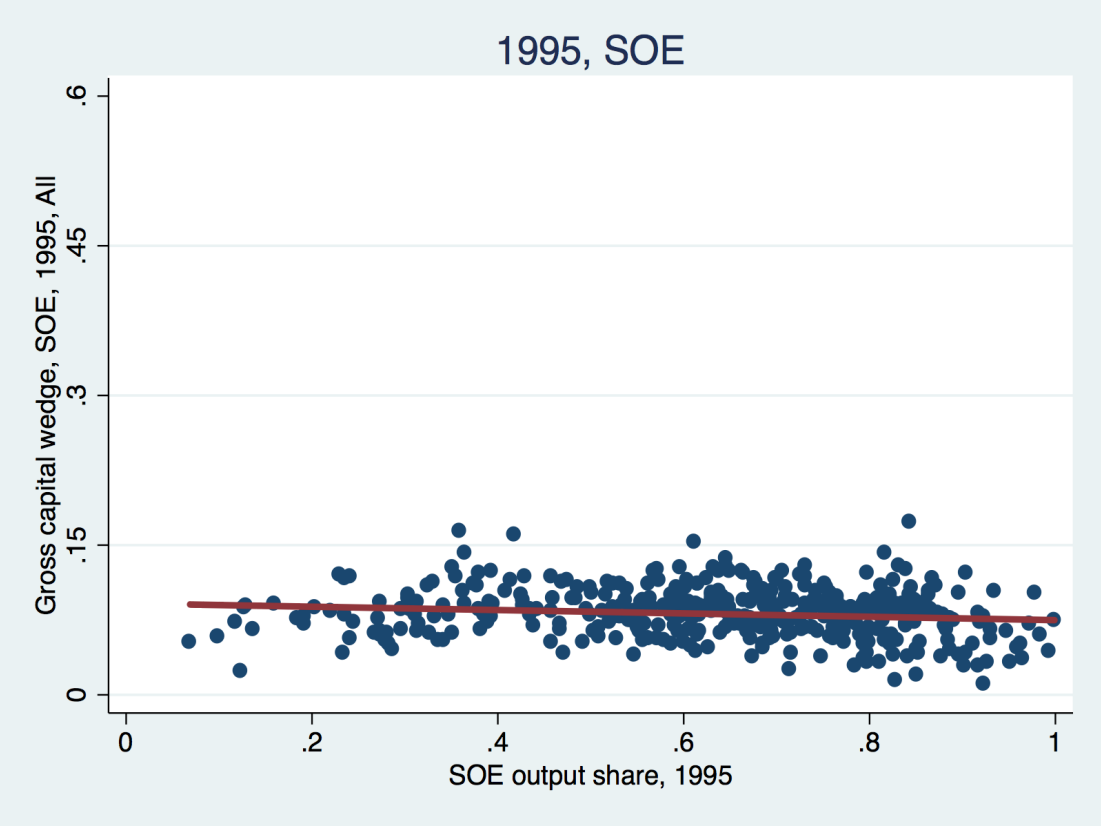




- Higher capital taxes in high *s* prefectures for non-SOE firms
- No relationship between capital taxes and *s* for SOE firms

[Back]

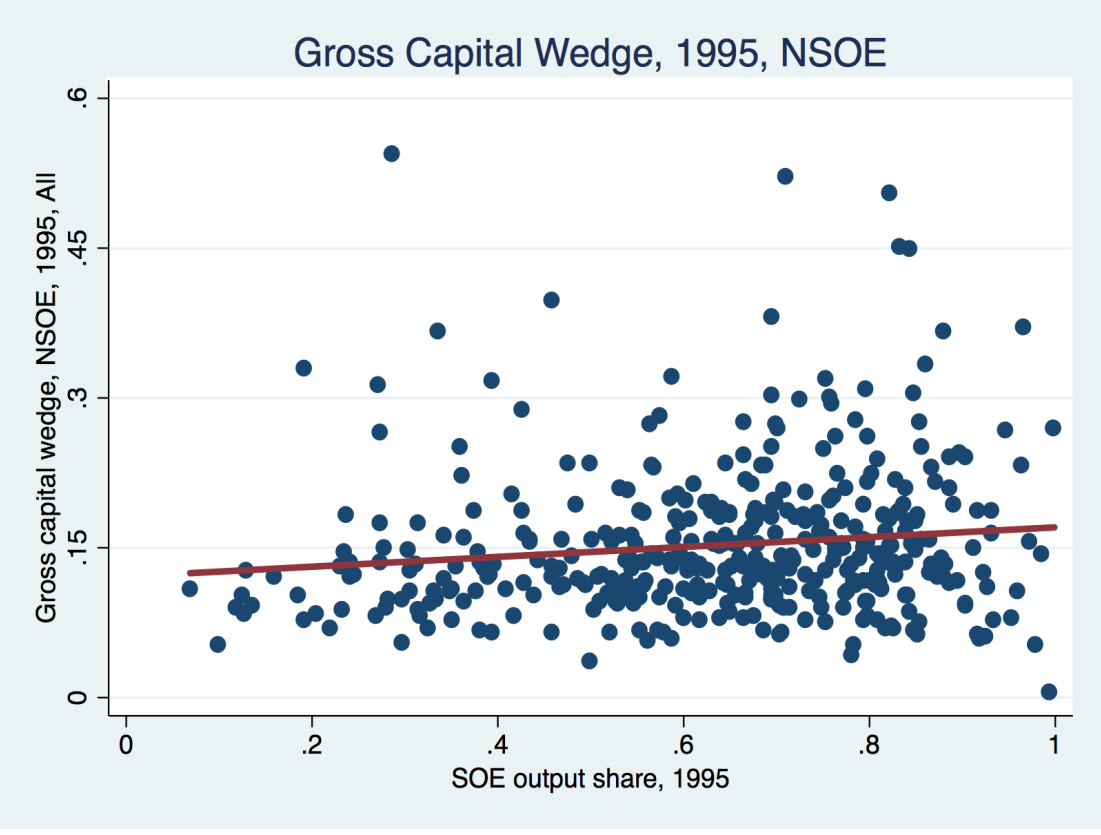
Gross Capital Wedge: Δ^k



- No relationship between capital taxes and *s* for SOE firms

[Back]

Gross Capital Wedge: Δ^k

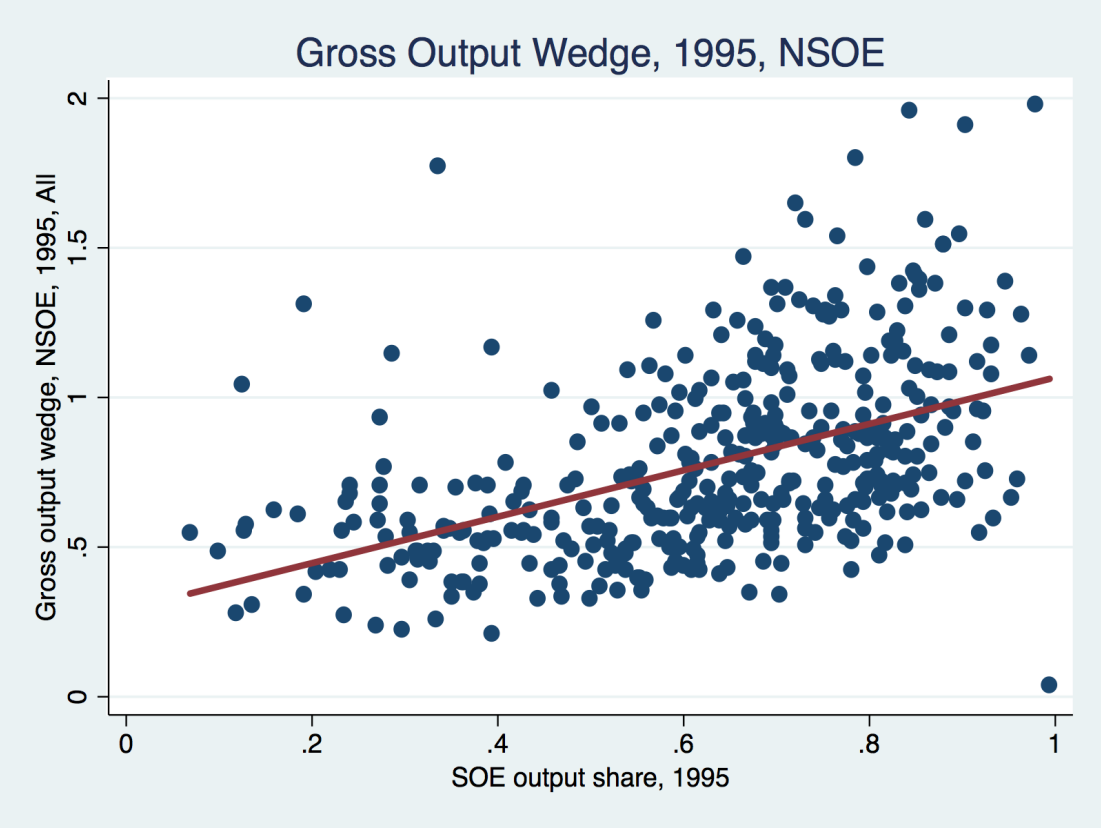


- Higher capital taxes in high *s* pref. for non-SOE firms

[Entrants]

[SOEs]

Gross Output Wedge: Δ^y

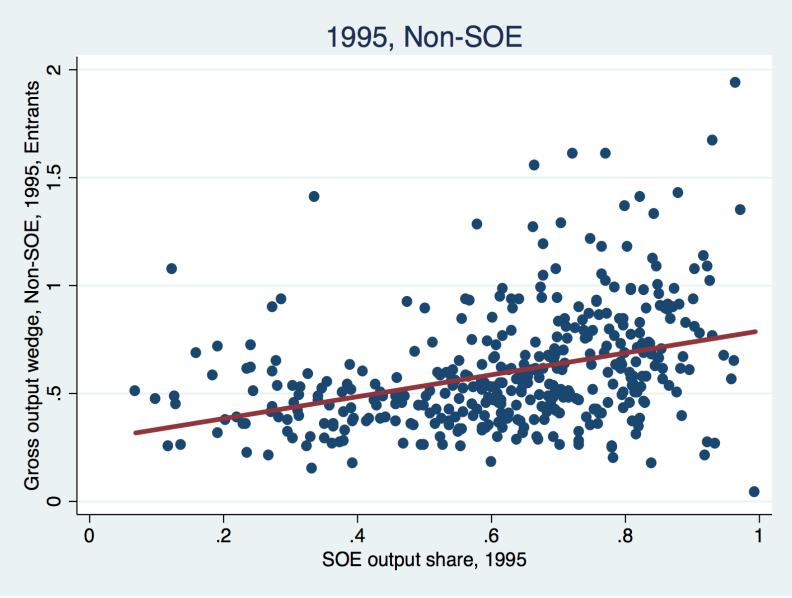


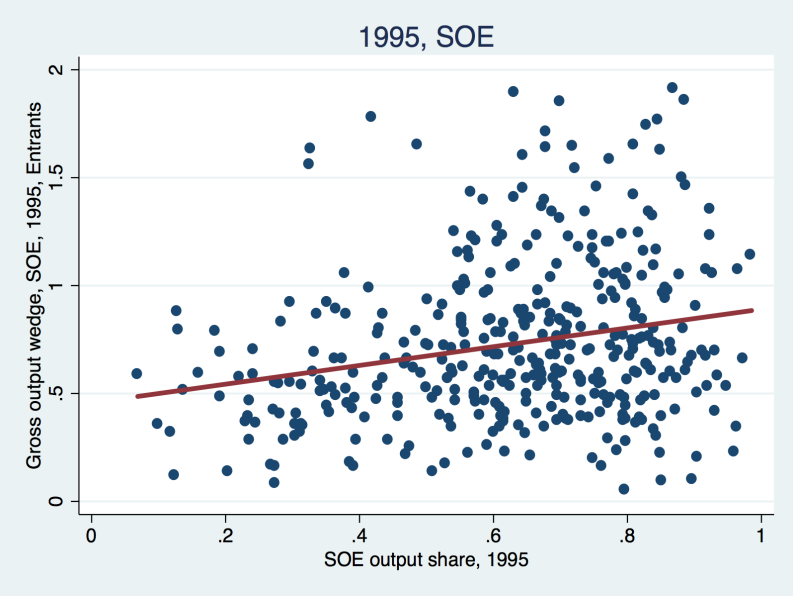
- Lower output taxes (higher subsidies) in high *s* pref. for non-SOE firms

  [Entrants]

  [SOEs]

Gross Output Wedge, Entrants: Δ^y

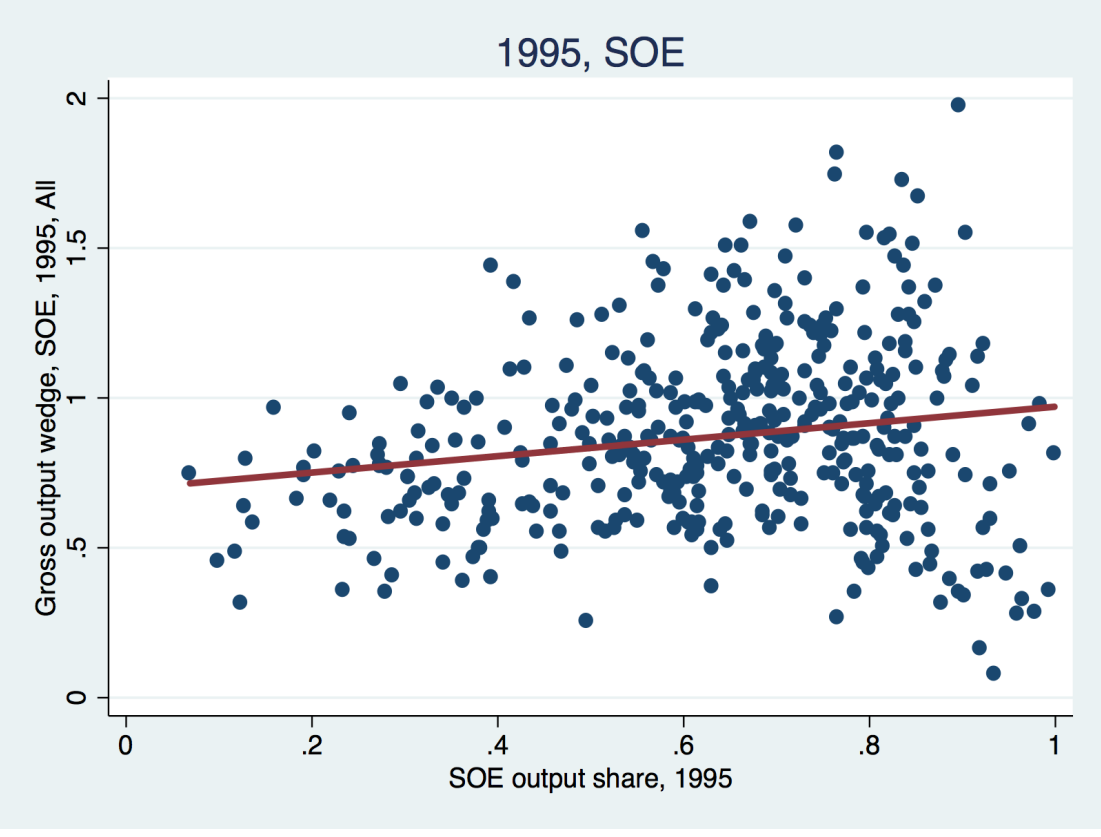




- Lower output taxes (higher subsidies) in high *s* prefectures
- For both non-SOE and SOE firms

[Back]

Gross Output Wedge: Δ^y



- Lower output taxes (higher subsidies) in high *s* pref. for SOE firms

[Back]

Entry Decision

- $f(z)$ is Pareto distributed

$$f(z) = \underline{z}^{\xi}\,\xi\, z^{-\xi-1},$$

: $\xi > 1$
: $\underline{z} \geq 1$, $z \in [\underline{z}, \infty)$

- The firm problem implies:

$$\begin{aligned}
y &= z\left(\left(1-\tau^{y}\right)\eta\right)^{\frac{\eta}{1-\eta}}\left(\frac{1-\alpha}{\left(1+\tau^{k}\right)(r+\delta)}\right)^{\frac{(1-\alpha)\eta}{1-\eta}}\left(\frac{\alpha}{w}\right)^{\frac{\alpha\eta}{1-\eta}} \\
&\equiv z\cdot\bar{y} \\
n &= z\cdot\alpha\eta\left(\frac{1-\tau^{y}}{w}\right)\cdot\bar{y} \\
k &= z\cdot(1-\alpha)\,\eta\,\frac{1-\tau^{y}}{\left(1+\tau^{k}\right)(r+\delta)}\cdot\bar{y} \\
\Pi &= z\cdot\left(1-\tau^{y}\right)(1-\eta)\cdot\bar{y}.
\end{aligned}$$

Entry Decision

- Only entrepreneurs with $z \geq z^*$ will operate, where

$$z^* = \frac{\nu}{(1-\tau^y)(1-\eta)\cdot\bar{y}}$$

- The measure Γ of all operating entrepreneurs is

$$\Gamma(z \geq z^*) = M(1-\psi)\int_{z^*}^{\infty} \underline{z}^{\xi}\,\xi\, z^{-\xi-1}\,dz = M(1-\psi)\underline{z}^{\xi}\,(z^*)^{-\xi}$$

- The equilibrium wage w clears the labor market

$$M(1-\psi)\int_{z^*}^{\infty} n(z)\,f(z)\,dz = N$$

- Normalize by the size of the labor force in the prefecture

The Effect of the Wedges

	$(1-\tau^y)$	$(1+\tau^k)$	$(1-\psi)$
w	$\mu\xi > 0$	$-\mu(1-\alpha)\xi\eta < 0$	$\mu(1-\eta) > 0$
TFP_s	$-\mu(1-\eta) < 0$	$\mu(1-\eta)[1+(\xi-1)\alpha\eta] > 0$	$\mu\alpha\eta(1-\eta) > 0$
Entry	$\mu\xi > 0$	$-\mu\xi(1-\alpha) < 0$	$\mu(1-\eta) > 0$
$\frac{Y}{N}$	$\mu\xi\eta(1-\alpha)+$ $\mu(\xi-1)(1-\eta) > 0$	$-\mu(1-\alpha)\xi\eta < 0$	$\mu(1-\eta) > 0$

- $\mu = \frac{1}{1-\eta+\xi\alpha\eta} > 0$

[Back]

Estimating the Gross Entry Wedge: $(1-\psi)$

- Calibrate some key parameters
  - : labor share, $\alpha\eta$: Hsieh and Klenow (2009)
  - : $\eta = 0.85$, Restuccia and Rogerson (2008):
  - : $\xi = 1.05$, Pareto parameter, use 30% of the most productive firms

$$\frac{E(z|z \geq z^*)}{z^*} = \frac{\xi}{\xi - 1}$$

- calibrate v such that $n^*(z^*) = 1$ in the lowest s prefectures
- calibrate $\underline{z}$ such that $\psi = 0$ in the lowest s prefectures

Variance in TFP and Wedges

$$\begin{aligned} Var[\ln Z] \quad \approx \quad & a_1^2 Var[\ln(1-\psi)] + a_1^2 Var[\ln N] \\ & + a_3^2 Var[\ln\left(1-\tau^y\right)] + a_4^2 Var[\ln(1+\tau^k)(r+\delta)] \end{aligned}$$

- covariance terms do not play a role
- variation of a_i across prefectures ignored: does not play a role
- compute the contribution of each term in $Var[\ln Z]$

Variance in TFP and Wedges

	Var_{ψ}	Var_{N}	Var_{τ^y}	Var_{τ^k}
1995	0.76	0.02	0.06	0.07
2004	0.68	0.03	0.03	0.05
2008	0.62	0.02	0.05	0.09
1995-2004	0.63	0.03	0.05	0.10
2004-2008	0.60	0.01	0.10	0.15

Variance in Wages and Wedges

$$
\begin{aligned}
Var[\ln w] \quad \approx \quad & a_1^2\, Var[\ln(1-\psi)] + a_1^2\, Var[\ln N] \\
& + a_3^2\, Var[\ln\left(1-\tau^y\right)] + a_4^2\, Var[\ln(1+\tau^k)(r+\delta)] \\
& + 2a_1 a_3\, Cov[\ln(1-\psi), \ln(1-\tau^y)] \\
& - 2a_3 a_4\, Cov[\ln(1-\tau^y), \ln(1-\tau^k)]
\end{aligned}
$$

- the other covariance terms do not play a role
- variation of a_i across prefectures ignored: does not play a role
- compute the contribution of each term in $Var[\ln w]$

Variance in Wages and Wedges

	Var_{ψ}	Var_{N}	Var_{τ^y}	Var_{τ^k}	Cov_{ψ,τ^y}	Cov_{τ^y,τ^k}
1995	5.34	0.13	4.36	0.71	-7.57	-2.13
2004	10.45	0.43	5.54	1.07	-11.88	-2.26
2008	6.15	0.24	5.27	1.28	-6.56	-3.46
1995-2004	5.14	0.28	4.46	1.23	-6.73	-2.62
2004-2008	2.39	0.03	4.24	0.90	-3.74	-2.62

Variance in K/Y and Wedges

$$Var\left[\ln\frac{K}{Y}\right] = Var[\ln\left(1-\tau^{y}\right)] + Var[\ln(1+\tau^{k})(r+\delta)]$$
$$-2Cov[\ln(1-\tau^{y}),\ln(1-\tau^{k})]$$

- compute the contribution of each term in $Var\left[\ln\frac{K}{Y}\right]$

	Var_{τ^y}	Var_{τ^k}	Cov_{τ^y,τ^k}
1995	1.14	1.28	-1.42
2004	0.81	1.08	-0.89
2008	1.05	1.75	-1.80
1995-2004	0.72	1.38	-1.10
2004-2008	1.18	1.72	-1.90

Understanding the Entry Wedge

- 1995, the entry wedge is higher in prefectures where
  - : the share of employment (or output) in the SOE sector is higher
  - : fiscal revenues per government worker are lower
  - : the profitability of SOEs is lower
- 1995-2004, the decline in the entry wedge is larger in pref. where
  - : the decline in the SOE share of employment is larger
  - : the increase in fiscal revenues per government worker are larger

Note that data on

- : fiscal revenue per government worker available for 1995 and 2004
- : profitability of SOEs available for 1995

Fiscal and SOE Reforms

- SOE reforms after 1995
  - : smaller SOEs sold off or shutdown
  - : massive layoffs of workers in the SOE sector including in those firms not privatized
  - : concentration of SOEs in strategic and pillar sectors
- Fiscal reform after 1995
  - : recentralization of the fiscal system that increased the % of revenue going to the center
  - : new system of fiscal transfers and sharing rules between provinces and the center, and localities and provinces
  - : localities allowed to retain land conveyance fees; i.e., basically profits from the sale of farm land for non-agricultural uses

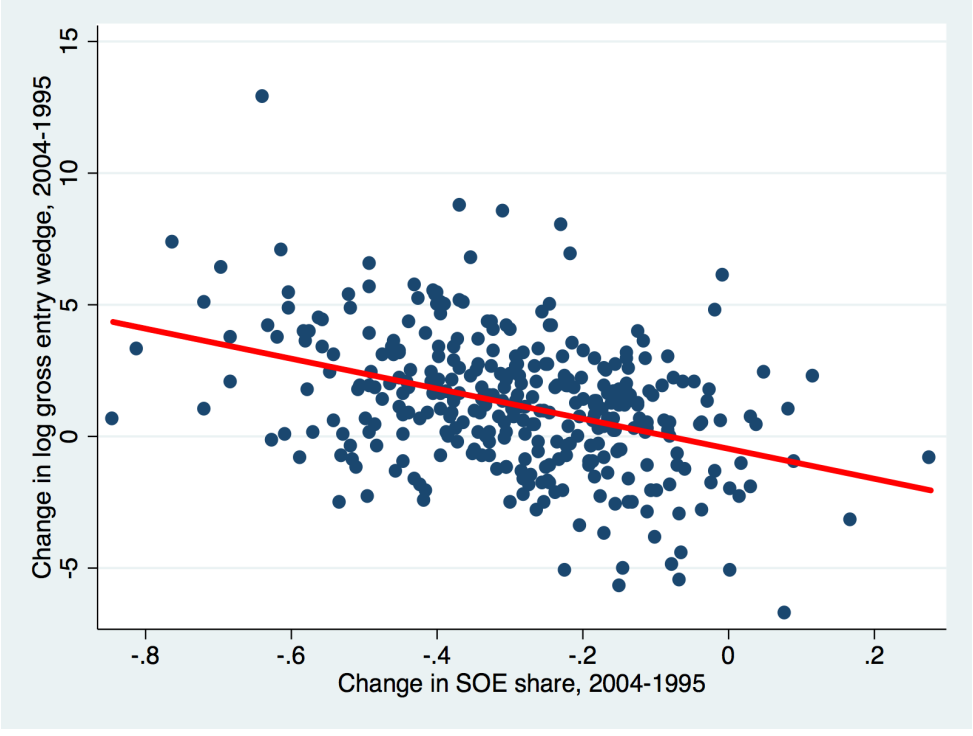
The Entry Wedge in 1995, 2004, and 2008

	$\ln(1-\psi)$	*OLS*	IV_{lag}	IV_{1978}	IV_{prov}
1995	e^{soe}	-11.64**	-14.13**	-12.96**	-11.72**
	ln *FREV*	1.31**	0.93*	1.11**	1.69*
	ln $PROF^{soe}$	0.31*	0.32*	0.32*	0.13
First stage:	*IV coefficient*		0.73**	0.97**	0.97**
	R^2		0.74	0.73	0.64
2004	e^{soe}	-9.61**	-13.39**	-16.06**	-17.47**
	ln *FREV*	2.16**	1.89**	1.70**	0.40
First stage:	*IV coefficient*		0.62**	0.68**	0.79**
	R^2		0.45	0.38	0.60
2008	e^{soe}	-8.10**	-9.63**	-14.60**	-16.71**
		(1.04)	(1.20)	(1.82)	(6.02)
First stage:	*IV coefficient*		0.88**	0.78**	1.05**
	R^2		0.76	0.36	0.30

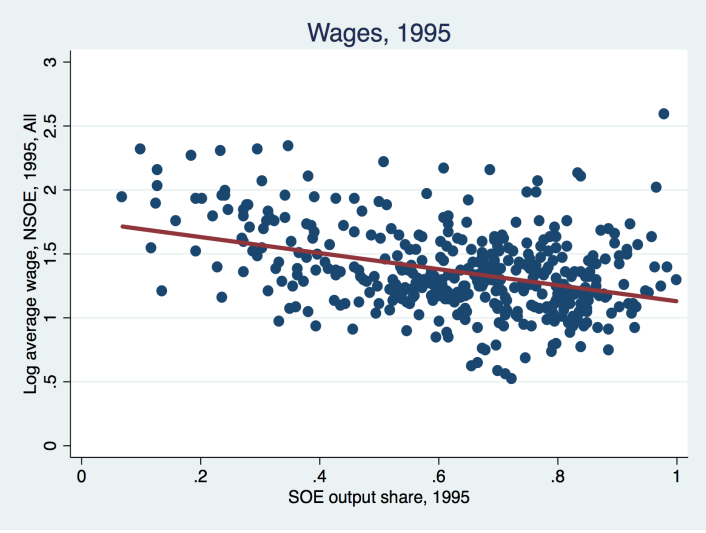
Note: ** – statistically significant at 1%; * – statistically significant at 5%.

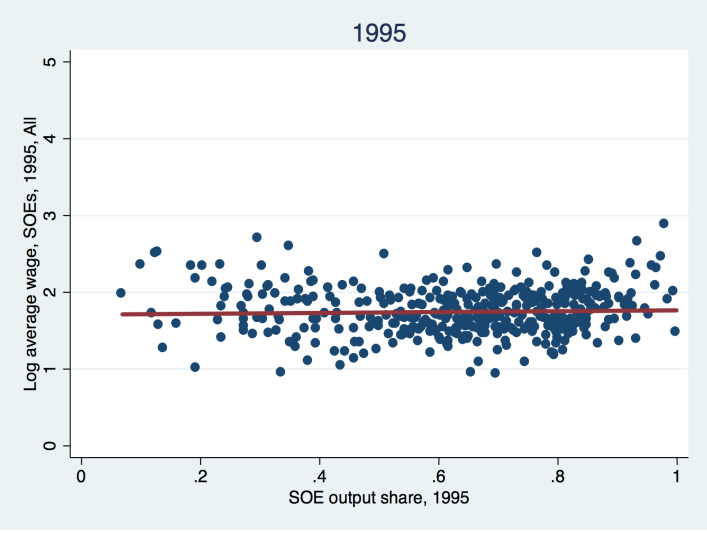
[Back]

Entry Wedge and SOE Share, 1995-2004



SOE and NSOE Wages in *s* Prefectures





- SOEs pay the same wage in all *s* prefectures
- SOE and NSOE wages are similar in low *s* prefectures
- SOE wages are higher than NSOE wages in high *s* prefectures

Introduce State-owned firms (SOE)

- Assume unit measure of potential SOE (and unit measure of potential NSOE)
- SOEs have same production function and same productivity distribution as NSOE
- SOEs compete with NSOEs for workers
- Key friction: central government decides what local state employment must be: $N_{SOE} = \bar{N}$
  - Local government must impose frictions on NSOE to satisfy employment constraint
- For simplicity: assume $\tau_y^{SOE} = \tau_k^{SOE} = 0$

Equilibrium in model with SOE and NSOE

- Labor market equilibrium requires $N_{NSOE} = 1 - \bar{N}$, implying

$$\frac{1-\bar{N}}{\bar{N}} = (1-\psi)\left(1-\tau_y\right)^{\frac{\xi}{1-\eta}} \left(\frac{1}{1+\tau_k}\right)^{\xi\frac{(1-\alpha)\eta}{1-\eta}}$$

- Note: target employment $\bar{N}$ is increasing in each of the wedges, $\left(\psi, \tau_k, \tau_y\right)$
  - an increase in $\bar{N}$ must be offset by an increase in ψ, τ_y, or τ_k (since ψ, τ_y, and τ_k are increasing in $\bar{N}$)

Equilibrium (cont.)

- Calculate profits – net of wedges – conditional on z and obtaining a licence;

$$\frac{\Pi(z)}{z}$$

$$= \frac{1-\bar{N}}{1-\psi}\cdot(1-\eta)\left(\frac{\xi \underline{z}}{\xi-1}\left(\frac{1-\eta}{\nu}\right)^{\xi-1}\left(\frac{(1-\alpha)\eta}{r+\delta}\right)^{\xi\frac{(1-\alpha)\eta}{1-\eta}}\frac{1}{\bar{N}}\right)^{\frac{1}{\xi}}$$

Politico-economic problem

- Local official choose wedges $\left(\psi, \tau_y, \tau_k\right)$
- Assume: official maximizes profits entrepreneur profits conditional on z, subject to
  1. a hiring constraint $N_{SOE} = \bar{N} \geq 1/2$
  2. wedges are non-negative, $\psi \geq 0$, $\tau_y \geq 0$, and $\tau_k \geq 0$

  Motivation: give advantage to friends
- **REMARK**: The constrained optimal choice of wedges $\left(\psi, \tau_y, \tau_k\right)$ imply $\tau_k = \tau_y = 0$ and $\psi > 0$.
- Expect to see a high correlation between SOE employment N_{SOE} and entry barrier ψ

Equilibrium Mechanism

- The distributions of $\ln z$, above the z_0 cutoff are very similar: