Privatization and Productivity in China

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Overview

Abstract

- Research topic:
  - The privatization of China's state-owned enterprises (SOEs).
  - **'Grasp the large, let go of the small '**and **'Layout wave'**
- Data:
  - Annual Survey of Industrial Enterprises (ASIE) from 1998 to 2007
  - Match with patents from China's State Intellectual Property Office.
- Methodology:
  - Gandhi et al.. (2020). On the Identification of Gross Output.*JPE.*
  - **Endogenous** production, privatization, and liquidation decision.
- Key Findings:
  - Privatization in 1998 brought 53% productivity increase productivity, and it usually took 8 to 14 months for the increase to fulfill.
  - Heterogeneity across industries, areas, and time.

History of China's SOEs

- **1950s to mid-1970s: Central planning**
  - 1953 to 1956: Three Great Remolding
  - 1958 Decentralization: Delegated the control to local government
- **Mid-1970s to 1990s: Private firm in 'Gray zone'**
  - 'Red-cap Businessmen' while SOEs is fiscal-revenue generator:
  - SOEs profit and tax accounted for 91.7% of the fiscal income in 1975.
- **1990s: Privatization and collectivization**
  - Deng's south tour
  - SOEs no longer made profit and generated fiscal revenue
  - Late 1990s layoff wave
  - The number of SOEs 238,000 in 1998 to 116,000 in 2007 (Jin, 2013)

Layoff wave: late-1990s to mid-2000s

傍晚6点下班换掉药厂的衣裳
妻子在熬粥我去喝几瓶啤酒
如此生活30年直到大厦崩塌
云层深处的黑暗啊淹没心底的景观
在八角柜台疯狂的人民商场
用一张假钞买一把假枪
保卫她的生活直到大厦崩塌
夜幕覆盖华北平原忧伤浸透她的脸
河北师大附中乒乓少年背向我
沉默的注视无法离开的教室
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一万匹脱缰的马在他脑海中奔跑

如此生活30年直到大厦崩塌
云层深处的黑暗啊淹没心底的景观

How Privatization was Carried out?

- **Management Buy-Out (MBO):**
  - According to a survey of 3,012 small and medium-size private enterprises in 2004 commissioned by the Party, most of the new owners of the privatized firms were **the managers of the same** SOEs before privatization (Bei 2014, Marukawa 2013).

- **The Process of Privatization:**
  - Negotiation $\longrightarrow$ Approval $\longrightarrow$ Registration
  - Time of the process: 14 months on average, with median of 8 months.
    $\Rightarrow$ **Research gap: it takes time to fulfill full productivity increase**

- **Selection Effect of Privatization:**
  - Government maintain the most *'important'* SOEs
    $\Rightarrow$ **Research gap: privatization is endogenous**

Data

- Data:
  - Annual Survey of Industrial Enterprises (ASIE) from 1998 to 2007
  - Match with patents from China's State Intellectual Property Office.

Table 10: Summary Statistics (1998 Cohort)

Variable	Number of observations	Mean	Standard deviation	Minimum	Maximum
Log output	195,972	9.9290	1.6662	−0.6082	18.4706
Log capital	195,972	8.6845	1.8173	−4.8423	17.7498
Log labor	195,972	5.2591	1.2285	2.0794	12.0249
Log materials	195,972	9.6916	1.6611	−0.2748	17.7955
Ownership type $\in \{1, 2, 3\}$	195,972	1.9557	0.6754	1	3
Collectivization (type $1 \longrightarrow 2$)	195,972	0.0167	0.1282	0	1
Privatization (types $1, 2 \longrightarrow 3$)	195,972	0.0389	0.1935	0	1
New products (frac. of revenue)	180,819	0.0365	0.1391	0	1
Invention patent application	195,972	0.1150	17.4009	0	4,940
Invention patent granted	195,972	0.0807	12.6756	0	3,474
Design patent application	195,972	0.0614	1.1775	0	210
Utility patent application	195,972	0.0644	2.4740	0	485
Indicator {invention patents > 0}	195,972	0.0113	0.1056	0	1
Indicator {invention granted > 0}	195,972	0.0074	0.08543	0	1
Indicator {design patents > 0}	195,972	0.0179	0.13265	0	1
Indicator {utility patents > 0}	195,972	0.0105	0.10216	0	1

Note: Ownership types are coded as follows: SOE (1), collective (2), and private (3).

Preliminary Finding

Table 2: Number of Firms, Privatization, and Labor Productivity (Full Sample)

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
(A) Number of firms										
SOE	17,313	13,931	11,826	9,235	7,866	11,185	9,136	7,449	6,204	4,440
Collective	30,988	28,971	28,003	27,541	27,398	49,040	53,719	55,656	56,827	60,571
Private	4,856	6,460	9,659	15,849	21,719	56,618	92,729	104,631	125,881	147,946
(B) Privatization										
Privatized	–	927	1,087	1,800	1,548	2,551	8,072	4,240	5,042	3,042
Collectivized	–	742	747	682	418	468	884	448	384	204
(C) Exit										
SOE	–	3,080	3,196	3,352	1,941	1,988	3,592	1,929	1,486	2,075
Collective	–	6,383	6,471	7,871	5,057	5,416	13,604	5,410	6,922	6,391
Private	–	906	1,341	3,067	2,732	3,573	15,382	7,487	11,659	11,568
(D) Entry										
SOE	–	1,221	769	1,294	965	5,768	2,048	503	493	391
Collective	–	4,595	5,601	8,054	5,601	28,299	20,463	8,160	10,180	10,718
Private	–	1,827	3,773	8,163	7,614	36,854	49,425	18,328	30,541	33,434
(E) Output/worker										
SOE	63.5	72.8	91.2	99.1	118.9	142.7	163.0	205.4	256.2	373.4
Collective	158.0	165.0	217.5	200.3	223.8	257.5	298.6	349.5	415.8	460.3
Private	178.9	186.4	229.3	204.6	223.7	261.4	276.9	323.9	383.5	430.2
(F) Value-added/worker										
SOE	9.2	10.2	18.5	18.8	23.1	30.0	39.6	58.5	71.1	114.7
Collective	17.6	20.9	34.1	32.6	39.1	52.5	65.6	85.8	104.4	116.6
Private	21.6	22.7	37.0	32.4	37.8	50.4	60.1	79.4	101.4	115.3

Note: Full sample including new entrants during the sample period. Panels (E) and (F) are in 1998 constant RMB in thousands.

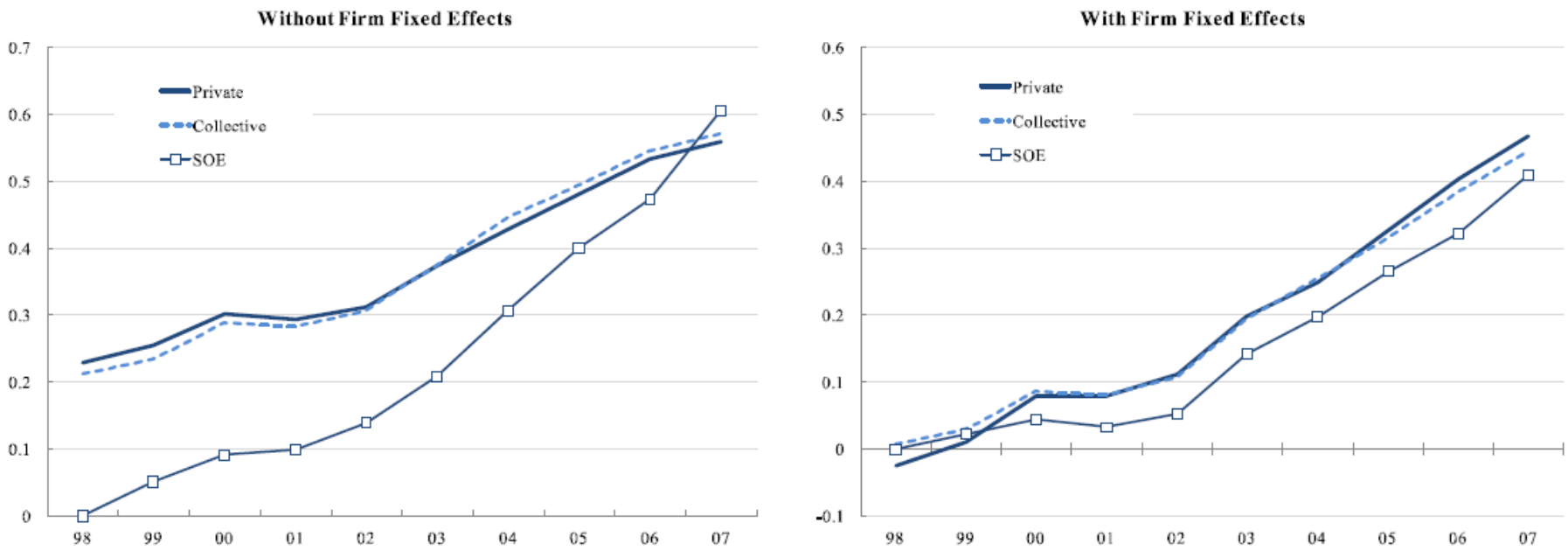
OLS Estimation of Production Function: No.1

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + \sum_{\tau=1998}^{2007} \left(\beta_{soe,\tau} d_{i\tau}^{soe} + \beta_{col,\tau} d_{i\tau}^{col} + \beta_{pri,\tau} d_{i\tau}^{pri} \right) + \epsilon_{it}$$

- Production function estimation with firm types:
  - $y_{it}, k_{it}, l_{it}, m_{it}$ are natural logarithms of output, capital, labor, and material at firm i in year t.
  - $d_{i\tau}^{soe}, d_{i\tau}^{col}, d_{i\tau}^{pri}$ are ownership-type dummies for each year.
  - ϵ_{it} is firm-year error term.
  - βs are coefficents to estimate ($\beta_{soe,1998}$ is normalized to zero)
    $\Rightarrow \beta$ **before dummies measures the effect of ownership types.**

Estimation Result No.1

Figure 1: OLS Estimates of Productivity by Ownership Type (Full Sample)



- Adding firm fixed effect $\Rightarrow$ muting cross-firm variation
  - Without fixed effect: SOEs were catching up.
  - With fixed effect: SOEs never catched up.
  - **How to interpret the result?**

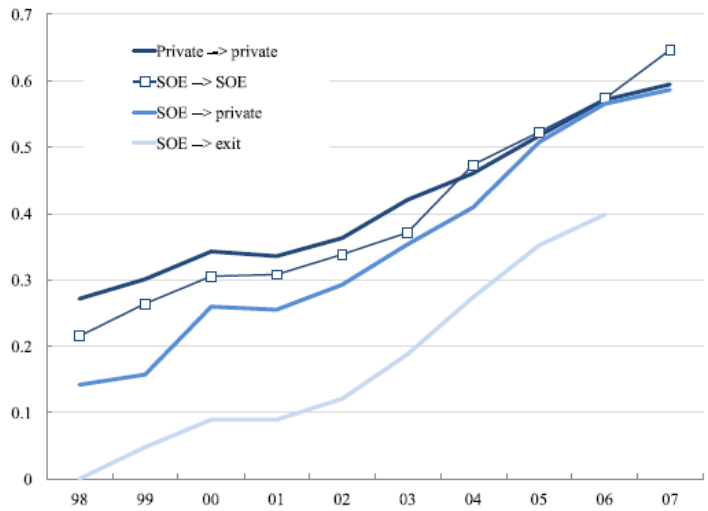
OLS Estimation of Production Function: No.2

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + \sum_{\tau=1998}^{2007} \left(\beta_{1\to 0,\tau} d_{i\tau}^{1\to 0} + \beta_{1\to 1,\tau} d_{i\tau}^{1\to 1} + \cdots + \beta_{3\to 3,\tau} d_{i\tau}^{3\to 3} \right) + \epsilon_{it}$$

- Production function estimation with firm type transition:
  - **Firm type coding:**
  - 1: State owned; 2: Collective; 3: Private; 0: Liquidated
  - Dummies are constant over time.
  - e.g.: For a SOE enters the market at 2000 and liquidated at 2005, $d_{i\tau}^{1\to 0}$ are 1 for $\tau = 2000 \cdots 2005$, all other dummies are 0.

Estimation Result No.2

Figure 2: OLS Estimates of Productivity by Transition Type (Full Sample)



Note: The graph plots the coefficient estimates of type-year interaction dummies, where "SOE → exit" in 1998 is the reference category, based on the *full* sample (i.e., unbalanced panel data including new entrants during the sample period). See Appendix Figure 8 for the *1998-cohort-only* version of the same graphs.

- **Result: 'Grasp the large, let go of the small':**
  - Privatization, collectivization, liquidation are endogenous
  - Most productive: retain state-owned; middle: privatize and collectivize; Least: liquidation

Problems of OLS Production Function Estimation

- Linear form assume same technology across ownership types:
  - In reality: **managerial heterogeneity**
  - We need different production function across firm type
- OLS assume error term ϵ_{it} is exogenous and unknown:
  - In reality: manager (government) know more than y, k, l, m, d
- Linear model assume privatization/liquidation are exogenous:
  - In reality: 'Grasp the large, let go of the small'
  - We need a discrete choice model: privatization/liquidation endogenous
- βs represent only persistent TFP changes:
  - In reality: TFP increases fulfill in 8 to 14 months
  - we need a model to discriminate long-tern and short-term TFP increase

Methodology

- **How to solve the above problems?**
  - 'by standing on the shoulders of giants'——
  - Gandhi, A., Navarro, S., Rivers, D. A. (2020). On the identification of gross output production functions. *Journal of Political Economy, 128*(8), 2973-3016.

  - A new nonparametric identification strategy
  - Two stage estimation

Methodology: Production Function

- A more general production function:

$$y_{it} = f(k_{it}, l_{it}, m_{it}, d_{it}) + \omega_{it} + \varepsilon_{it} \tag{1}$$

- $f(\cdot)$ is heterogeneous across $d_{it} \in \{1, 2, 3\}$
  - Second-order polynomial, interact with all d
- ω_{it} **time-varying firm-specific productivity term**:
  - It describe persistent heterogeneity:
  - Unobserved to researchers (Not measurable)
  - Known to firm managers (government fir SOEs):
  - e.g. Lazy labor, corporate governance, corruption
- Firm make three decisions **based on ω_{it} but not on ϵ_{it}:**
  - Input/output choices: $m_{it}, k_{i,t+1}, l_{i,t+1}$ (instant m, lag in k, l)
  - Ownership Choice: $d_{i,t+1} \in \{1, 2, 3\}$ (lag in d)
  - Liquidation Choice $d_{i,t+1} \in \{0\}$ (lag in d)

Time-varying Firm-specific Productivity Term

- ω_{it} **time-varying firm-specific productivity term**:

$$\begin{aligned}\omega_{it} &= E\left[\omega_{it} \mid \omega_{i,t-1}, \text{collectivized}_{it}, \text{privatized}_{it}; \text{year}_t, cic_i\right] + \xi_{it} \\ &\equiv \tilde{h}\left(\omega_{i,t-1}, \text{collectivized}_{it}, \text{privatized}_{it}; \text{year}_t, cic_i\right) + \xi_{it} \\ &= h\left(\omega_{i,t-1}, \text{collectivized}_{it}, \text{privatized}_{it}\right) + \text{year}_t + cic_i + \xi_{it}\end{aligned} \tag{2}$$

- ω_{it} follows a first order Markov process
  - $\tilde{h}$ are predictable by firms, and $h(\cdot)$ is specified as second-order polynomial
  - ξ_{it} are unpredictable and exogenous by firms
  - $year_t, cic_i$ represent additive dummies to control for the time trend and industry heterogeneity

Time-varying Firm-specific Productivity Term

$$\text{collectivized}_{it} = \begin{cases} 1 & \text{if } d_{i,t-1} = 1 \text{ and } d_{it} = 2, \text{ and} \\ 0 & \text{otherwise} \end{cases}$$

$$\text{privatized}_{it} = \begin{cases} 1 & \text{if } d_{i,t-1} \neq 3 \text{ and } d_{it} = 3, \text{ and} \\ 0 & \text{otherwise.} \end{cases}$$

- Hence, ω_{it} depends on:
  - Its past level $\omega_{i,t-1}$
  - Whether it has just been privatized or collectivized

- **Interpretation of parameters:**
  - Different $f(\cdot)$ capture long-term productivity differences
  - w_{it}, especially $h(\cdot)$ capture short-term shock of privatization or collectivization

Parameters of Interest

- **Long-run or Eventual Effect:**

$$\beta_{pri}(k, l, m) \equiv f(k, l, m, d = 3) - f(k, l, m, d = 1) \tag{3}$$

$$\beta_{col}(k, l, m) \equiv f(k, l, m, d = 2) - f(k, l, m, d = 1) \tag{4}$$

  - E.g.: better management of products and processes, reduced instances of political interventions
  - Correspond to $(\beta_{soe}, \beta_{col}, \beta_{pri})$ in OLS estimation

Parameters of Interest

- Initial gap between already-private firms and just-privatized firms:

$$\gamma_{pri} \equiv h(\omega, 0, 1) - h(\omega, 0, 0) \tag{5}$$

$$\gamma_{col} \equiv h(\omega, 1, 0) - h(\omega, 0, 0) \tag{6}$$

  - $h(\cdot)$ is deterministic, state-dependent component of next ω

- **Short-run Effect:**

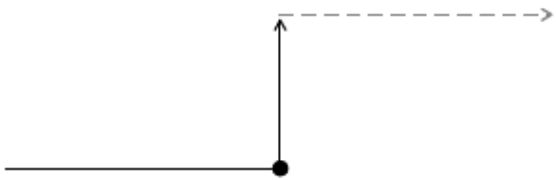
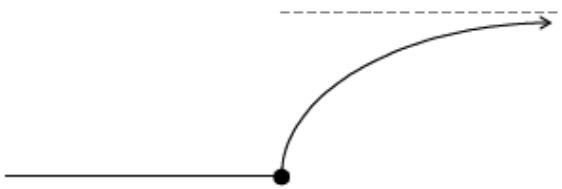
$$\beta_{pri}(k, l, m) + \gamma_{pri}(\omega) \tag{7}$$

$$\beta_{col}(k, l, m) + \gamma_{col}(\omega) \tag{8}$$

  - Short-run effect are eventual gains discounted by the initial gaps

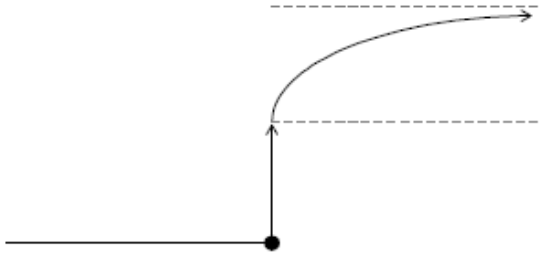
Scenarios

Figure 9: Possible Time Paths of Productivity after Privatization

Transition dynamics	Initial gap between private and privatized	Description
Case 1: Immediate gain only		
	$\gamma = 0$	All eventual gain materializes immediately after privatization. No initial gap exists between private and privatized firms.
Case 2: Eventual gain only		
	$\beta + \gamma = 0$	No immediate gain. In the short run, initial gap completely offsets eventual gain.

Scenarios

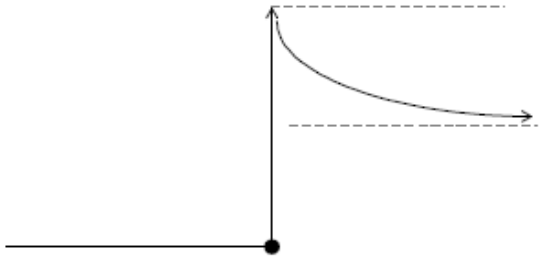
Case 3: Immediate & eventual gains



$\beta + \gamma > 0$

Both immediate and eventual gains.
Initial gap exists but does not offset eventual gain completely.

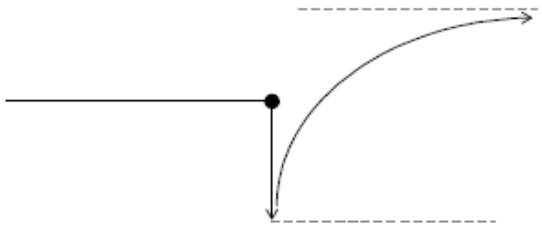
Case 4: Over-shooting



$\gamma > 0$

Short-run gain is larger than long-run gain.
(Initial "gap" is negative.)

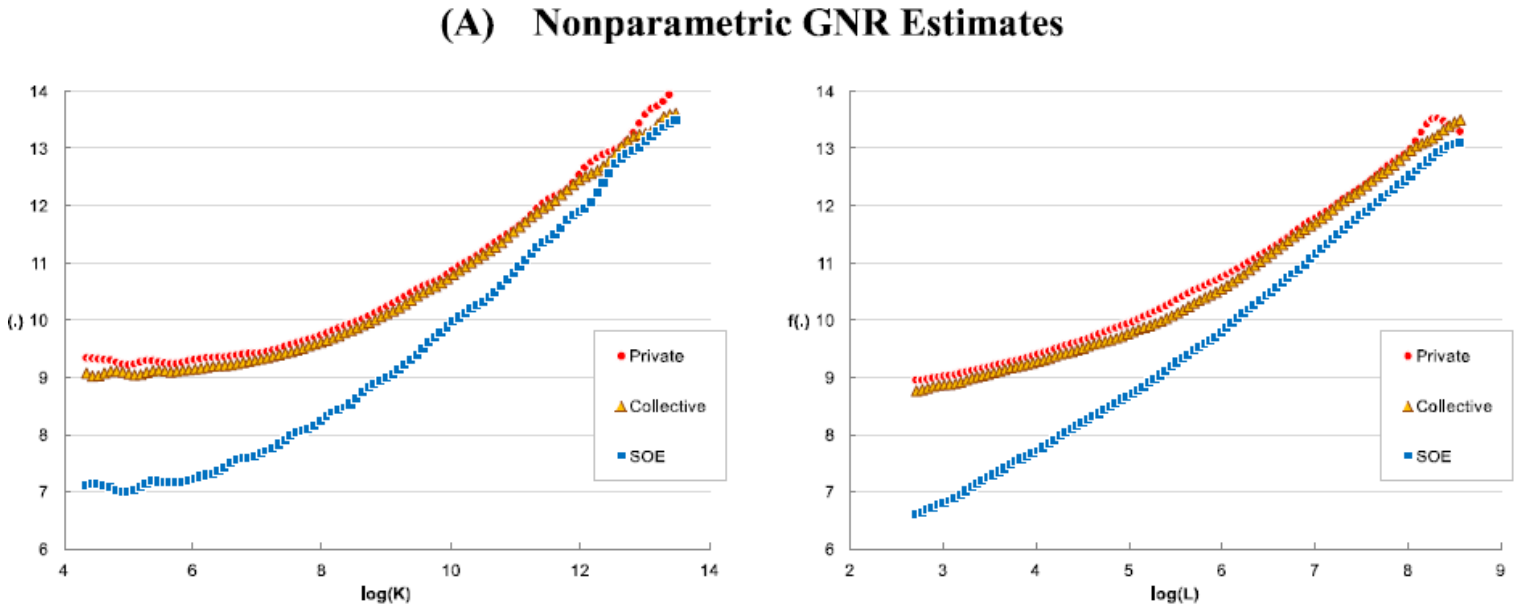
Case 5: Switch-over disruption



$\beta + \gamma < 0$

Negative change in short run.
Initial gap more than offsets (long-run) private TFP premium.

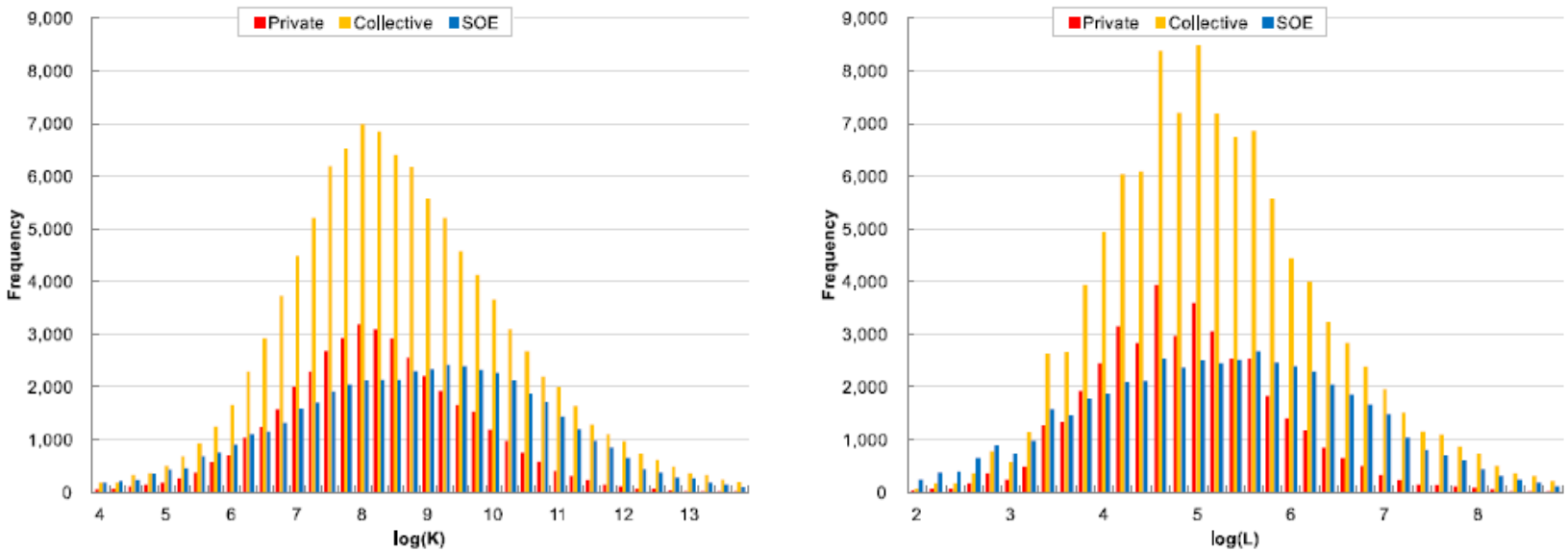
Results 1: βs of 1998 Cohort of Firms:



- The Author Focus on 1998 Cohort of Firms
- βs or Long-run productivity:
  - SOEs are less productivity in nearly all sizes
  - The gap is larger in small firms

Results 1: βs of 1998 Cohort of Firms:

(B) Histograms of Firm (Input) Size



- Why do opposing views coexist?
  - largest SOEs in the top 5-10 percentile are comparable to the largest private firms
    $\Rightarrow$ **Anecdotal evidences** about *superstar SOEs.*

Results 2: A Linear Approximation with OLS estimation

- Easier approach: Approximate $f(\cdot)$ and $h(\cdot)$ by linear function:

$$\hat{E}\left[f \mid k_{it}, l_{it}, m_{it}, d_{it}\right] \approx \hat{\beta}_0 + \hat{\beta}_k k_{it} + \hat{\beta}_l l_{it} + \hat{\beta}_m m_{it} + \hat{\beta}_{soe} d_{it}^{soe} + \hat{\beta}_{col} d_{it}^{col} + \hat{\beta}_{pri} d_{it}^{pri}$$

$$\hat{E}\left[h \mid \hat{\omega}_{i,t-1},\ \text{collectivized}_{it}, \text{privatized}_{it}; \text{year}_t, cic_i\right] \approx \hat{\gamma}_0 + \rho\hat{\omega}_{i,t-1}$$

$$+\hat{\gamma}_{col}\,\text{collectivized}_{it} + \hat{\gamma}_{\text{pri}}\,p\ \text{rivatized}_{\ it} + \text{year}_t + cic_i$$

- Take SOEs as reference group ($\hat{\beta}_{SOE} = 0$), productivity difference are:

$$\begin{aligned} TFP_{it} &\equiv \beta_{col} c_{it}^{col} + \beta_{pri} d_{it}^{pri} + \hat{\omega}_{it} \\ &= \beta_{col} c_{it}^{col} + \beta_{pri} d_{it}^{pri} + \hat{\gamma}_0 + \rho\hat{\omega}_{i,t-1} \\ &\quad + \hat{\gamma}_{col} collectivized_{it} + \hat{\gamma}_{pri} privatized_{it} + year_t + cic_i + \hat{\xi}_{it} \end{aligned}$$

- Following is a table summarize the OLS and GNR estimation:

Results 2: OLS vs GNR

Table 3: Production-Function Estimates (1998 Cohort)

Method:	OLS	GNR	GNR	GNR
	(1)	(2)	(3)	(4)
Capital ($\hat{\beta}_k$)	0.027	0.136	0.113	0.100
	(0.002)	(0.007)	(0.007)	(0.006)
Labor ($\hat{\beta}_l$)	0.092	0.234	0.240	0.255
	(0.003)	(0.013)	(0.012)	(0.014)
Materials ($\hat{\beta}_m$)	0.876	0.609	0.610	0.606
	(0.003)	(0.022)	(0.022)	(0.021)
Collective ($\hat{\beta}_{col}$)	0.140	0.459	0.395	0.397
	(0.006)	(0.028)	(0.026)	(0.027)
Collectivization initial gap ($\hat{\gamma}_{col}$)	−0.053	−0.440	−0.388	−0.389
	(0.008)	(0.028)	(0.019)	(0.022)
Private ($\hat{\beta}_{pri}$)	0.147	0.624	0.417	0.427
	(0.006)	(0.036)	(0.032)	(0.031)
Privatization initial gap ($\hat{\gamma}_{pri}$)	−0.005	−0.198	−0.056	−0.063
	(0.004)	(0.013)	(0.011)	(0.012)
Autocorrelation ($\hat{\rho}$)	–	0.606	0.610	0.611
	(–)	(0.008)	(0.012)	(0.017)
Year dummy	Yes	No	Yes	Yes
2-digit CIC dummy	Yes	No	No	Yes
Number of observations	195,972	195,972	195,972	195,972
Number of privatization/collectivization	10,908	10,908	10,908	10,908
GNR's goodness-of-fit test (p-value)	–	0.051	0.121	0.131

Results 2: OLS vs GNR

Table 3: Production-Function Estimates (1998 Cohort)

Method:	OLS (1)	GNR (2)	GNR (3)	GNR (4)
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- Coefficient of input:
  - OLS: Materials and other intermediate inputs account for the most
  - GNR(2020): Capital and labor account more

Results 2: OLS vs GNR

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	(0.002)	(0.007)	(0.007)	(0.006)
Labor ($\hat{\beta}_l$)	0.092	0.234	0.240	0.255
	(0.003)	(0.013)	(0.012)	(0.014)
Materials ($\hat{\beta}_m$)	0.876	0.609	0.610	0.606
	(0.003)	(0.022)	(0.022)	(0.021)
Collective ($\hat{\beta}_{col}$)	0.140	0.459	0.395	0.397
	(0.006)	(0.028)	(0.026)	(0.027)
Collectivization initial gap ($\hat{\gamma}_{col}$)	−0.053	−0.440	−0.388	−0.389
	(0.008)	(0.028)	(0.019)	(0.022)
Private ($\hat{\beta}_{pri}$)	0.147	0.624	0.417	0.427
	(0.006)	(0.036)	(0.032)	(0.031)
Privatization initial gap ($\hat{\gamma}_{pri}$)	−0.005	−0.198	−0.056	−0.063
	(0.004)	(0.013)	(0.011)	(0.012)
Autocorrelation ($\hat{\rho}$)	–	0.606	0.610	0.611
	(–)	(0.008)	(0.012)	(0.017)
Year dummy	Yes	No	Yes	Yes
2-digit CIC dummy	Yes	No	No	Yes
Number of observations	195,972	195,972	195,972	195,972
Number of privatization/collectivization	10,908	10,908	10,908	10,908
GNR's goodness-of-fit test (p-value)	–	0.051	0.121	0.131

- Long-run Productivity Difference
  - OLS: $e^{0.147} - 1 = 15.8\%$ much less than the gap table 2 suggest
  - GNR(2020): $e^{0.427} - 1 = 53.3\%$ very large

Results 2: OLS vs GNR

Table 3: Production-Function Estimates (1998 Cohort)

Method:	OLS (1)	GNR (2)	GNR (3)	GNR (4)
Capital ($\hat{\beta}_k$)	0.027	0.136	0.113	0.100
	(0.002)	(0.007)	(0.007)	(0.006)
Labor ($\hat{\beta}_l$)	0.092	0.234	0.240	0.255
	(0.003)	(0.013)	(0.012)	(0.014)
Materials ($\hat{\beta}_m$)	0.876	0.609	0.610	0.606
	(0.003)	(0.022)	(0.022)	(0.021)
Collective ($\hat{\beta}_{col}$)	0.140	0.459	0.395	0.397
	(0.006)	(0.028)	(0.026)	(0.027)
Collectivization initial gap ($\hat{\gamma}_{col}$)	−0.053	−0.440	−0.388	−0.389
	(0.008)	(0.028)	(0.019)	(0.022)
Private ($\hat{\beta}_{pri}$)	0.147	0.624	0.417	0.427
	(0.006)	(0.036)	(0.032)	(0.031)
Privatization initial gap ($\hat{\gamma}_{pri}$)	−0.005	−0.198	−0.056	−0.063
	(0.004)	(0.013)	(0.011)	(0.012)
Autocorrelation ($\hat{\rho}$)	–	0.606	0.610	0.611
	(–)	(0.008)	(0.012)	(0.017)
Year dummy	Yes	No	Yes	Yes
2-digit CIC dummy	Yes	No	No	Yes
Number of observations	195,972	195,972	195,972	195,972
Number of privatization/collectivization	10,908	10,908	10,908	10,908
GNR's goodness-of-fit test (p-value)	–	0.051	0.121	0.131

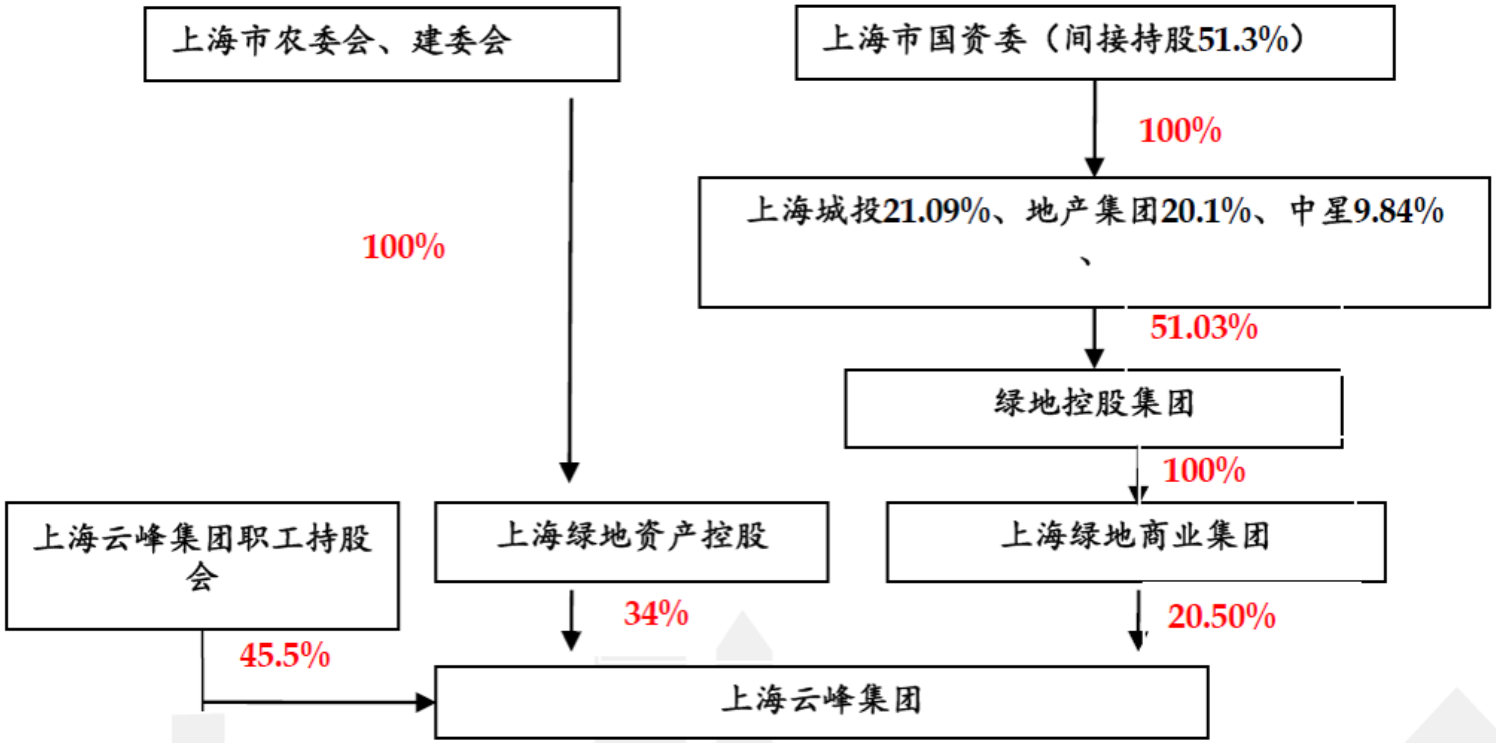
- $\beta - \gamma$ measures the short-run gain:
  - $e^{0.397-0.389} - 1 = 0.8\%$ for collectivization
  - $e^{0.427-0.063} - 1 = 43.9\%$ for privatization (why larger?)
- ρ measures the persistence of initial gap:
  - 90% of initial gap decay in 4.67 years ($0.611^{4.67} = 10\%$).

Alternative Definition of SOEs

- What does it means by saying firm A is state-owned?
  - Result above: **registration type** (broader)
  - BVZ(2012): **50% shareholding threshold** (narrower)
  - Only a proportion of SOEs are directly owned by the government
- E.g. Government A owns 51% of Firm B, and B owns 51% of C:
  - Only 26% of Firm C's share is owned by Government
  - But Firm C is **controlled by government**

Alternative Definition of SOEs: An Example

- A more complex structure in real world:
  - Is Shanghai Yunfeng Group state-owned?



Alternative Definition of SOEs: Result

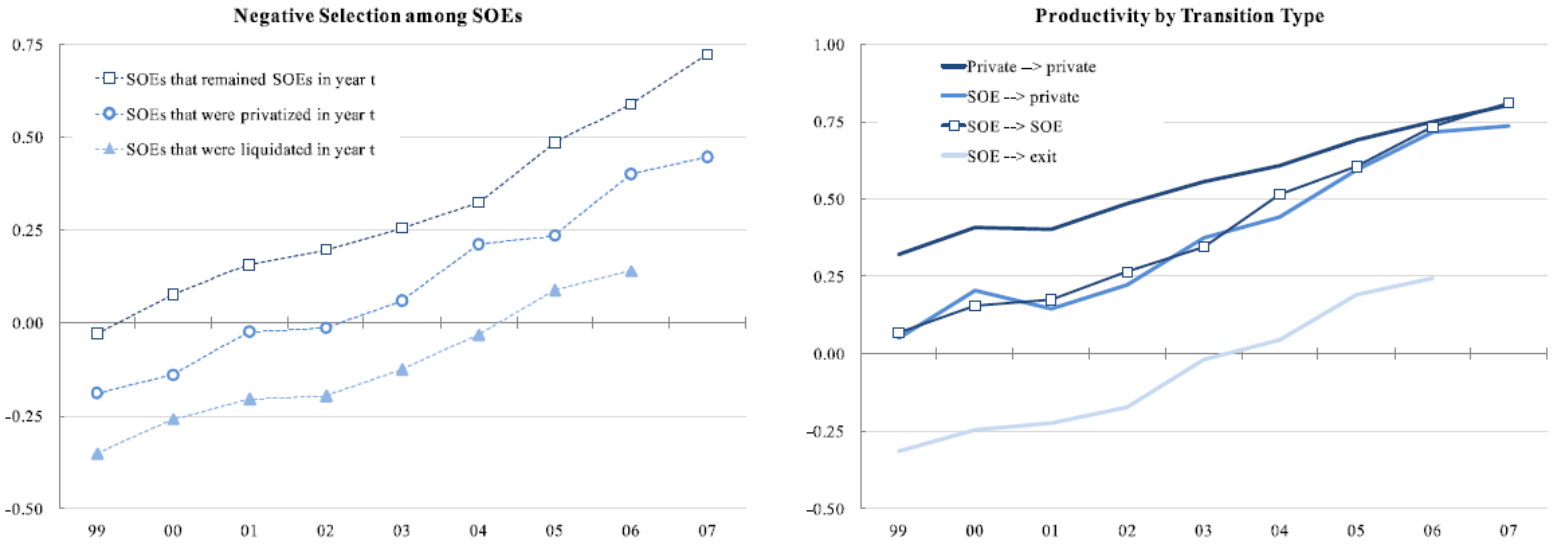
Table 6: Estimates by Shareholding-based Definition of Ownership Types (1998 Cohort)

Definition:	50% shareholding threshold		20% shareholding threshold	
Method:	OLS	GNR	OLS	GNR
	(1)	(2)	(3)	(4)
Collective ($\hat{\beta}_{col}$)	0.079	0.135	0.072	0.165
	(0.086)	(0.014)	(0.010)	(0.019)
Collectivization initial gap ($\hat{\gamma}_{col}$)	0.011	−0.079	0.014	−0.115
	(0.127)	(0.029)	(0.016)	(0.031)
Private ($\hat{\beta}_{pri}$)	0.090	0.275	0.063	0.247
	(0.006)	(0.015)	(0.006)	(0.014)
Privatization initial gap ($\hat{\gamma}_{pri}$)	−0.071	−0.355	−0.074	−0.331
	(0.007)	(0.018)	(0.007)	(0.019)
Number of observations	195, 174	195, 174	195, 174	195, 174
Number of privatization/collectivization	10, 230	10, 230	10, 014	10, 014

- Gains from privatization (collectivization) are much smaller.
- Short-run gain can even be negative.
- Why?
  - Small-sized, low-productive SOE are excluded
  - Corporate governance issue?

Government Decision

Figure 4: GNR Estimates of Productivity by Transition Type (1998 Cohort)



- Left graph illustrates means ω_{t-1} of SOEs in each year.
- Right graph illustrates means $\beta_{pri} + \omega_t$ for firms with eventual transition types

  $\Rightarrow$ Result: 'Grasp the large, let go of the small'

Time Heterogeneity

Table 7: GNR Estimates by Sub-period and Cohort

Entry cohort:	1998 cohort		1999	2000	2001	2002	2003	2004	2005
Data:	'98–'02	'03–'07	'99–'07	'00–'07	'01–'07	'02–'07	'03–'07	'04–'07	'05–'07
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Collective ($\hat{\beta}_{col}$)	0.447	0.290	0.419	0.279	0.252	0.086	0.220	0.084	0.004
	(0.029)	(0.029)	(0.098)	(0.065)	(0.030)	(0.046)	(0.020)	(0.032)	(0.063)
Initial gap ($\hat{\gamma}_{col}$)	−0.429	−0.250	−0.628	−0.400	−0.296	−0.051	−0.226	−0.166	0.151
	(0.036)	(0.027)	(0.084)	(0.091)	(0.054)	(0.092)	(0.032)	(0.066)	(0.218)
Private ($\hat{\beta}_{pri}$)	0.546	0.341	0.429	0.304	0.275	0.069	0.220	0.057	−0.039
	(0.043)	(0.035)	(0.102)	(0.072)	(0.033)	(0.049)	(0.022)	(0.032)	(0.061)
Initial gap ($\hat{\gamma}_{pri}$)	−0.125	−0.090	−0.114	−0.049	−0.043	0.008	−0.018	0.010	0.060
	(0.018)	(0.020)	(0.032)	(0.091)	(0.013)	(0.014)	(0.010)	(0.014)	(0.025)
Num. observations	123,707	72,265	21,943	28,018	53,127	35,984	164,119	157,524	38,344
Num. priv'n/collect'n	6,113	4,795	1,236	1,634	2,533	1,827	8,864	4,120	1,140

- Result:
  - Gain from privatization (collectivization) fades away from 1998 to 2007

Regional Heterogeneity

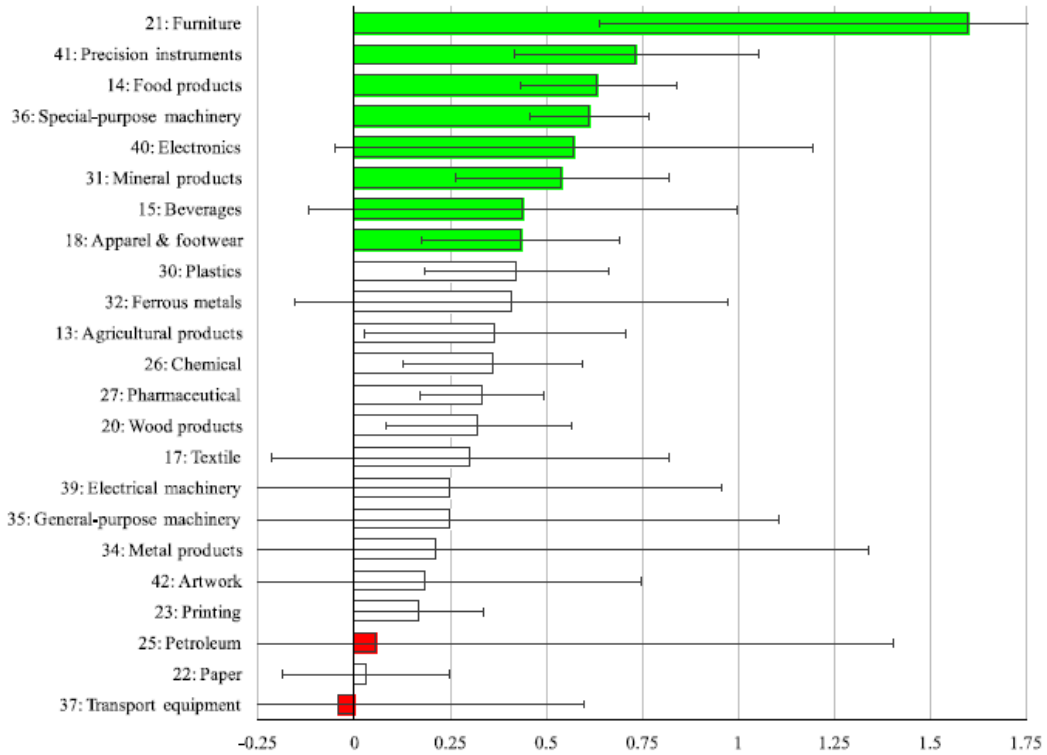
Table 8: GNR Estimates by Region (1998 Cohort)

Geographical split:	North vs. South		Inland vs. Coast	
Region:	North	South	Inland	East Coast
	(1)	(2)	(3)	(4)
Collective ($\hat{\beta}_{col}$)	0.516	0.285	0.519	0.166
	(0.049)	(0.033)	(0.029)	(0.055)
Collectivization ($\hat{\gamma}_{col}$)	−0.499	−0.297	−0.500	−0.195
	(0.042)	(0.028)	(0.032)	(0.037)
Private ($\hat{\beta}_{pri}$)	0.663	0.262	0.674	0.131
	(0.054)	(0.041)	(0.045)	(0.099)
Privatization ($\hat{\gamma}_{pri}$)	−0.167	−0.018	−0.215	0.008
	(0.026)	(0.012)	(0.037)	(0.013)
Number of observations	81,334	114,461	90,674	105,121
Number of privatization/collectivization	3,926	6,975	4,458	6,443

- Result:
  - SOEs from **inland and North regions** gain more
  - why? economic liberalization?

Industrial Heterogeneity

Figure 5: GNR Estimates of TFP Gaps by Industry (1998 Cohort)



- Result:
  - SOEs from **high-tech and consumer facing** industries gain more

Why SOEs are less productive?

- **Multiple reporting lines** caused confusion and inefficiency:
  - Party's Organization Department appoints managers
  - Central Planning Committee determines production plan
  - Department of Finance is in charge of funds for operations and investments
  - E.g. Huajing's Semiconductor Plant
- Other factors:
  - Product choice, technology choice, marketing, investment, and the design of incentive schemes
- Evidence on innovation-related activities is mixed.
- Downsizing was not the main channel

The End! Thanks for listening!