Misallocation and Manufacturing TFP in China and India

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Why do poor countries have low TFP?

Barriers to technology diffusion? (Howitt, Parente/Prescott)

Alternatively, resource misallocation across firms:

- Rogerson and Restuccia

- Banerjee and Duflo

- McKinsey Global Institute

What we do:

Standard Monopolistic Competition Model
(Melitz, Hopenhayn).

Manufacturing plants in China and India

- China (1995, 1998 through 2003)

- India (1989-1990 and 1994-1995)

What we find:

- TFP could double if capital and labor were allocated efficiently within 4-digit industries.

- Small plants would shrink, big plants would expand.

- Little evidence efficiency improved in India.

- Some evidence that efficiency improved in China.

Model Setup: One-Sector

Aggregate Output: $Y = \left[\displaystyle\sum_{i=1}^{M} Y_i^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}$

Production: $Y_i = A_i L_i$

Profit: $\pi_i = (1 - \tau_{Yi}) P_i Y_i$

Equilibrium

Marginal Cost: $MC_i \propto \dfrac{1}{(1-\tau_{Yi}) \cdot A_i}$

Firm Employment: $L_i \propto A_i^{\sigma-1}(1-\tau_{Yi})^{\sigma}$

Firm Output: $Y_i \propto A_i^{\sigma}(1-\tau_{Yi})^{\sigma}$

Value of MPL $\equiv \dfrac{P_i Y_i}{L_i} \propto \dfrac{1}{1-\tau_{Yi}}$

Model Setup

- Aggregate Output: $Y = \prod_s Y_s^{\theta_s}$

- Sectoral Output: $Y_s = \left[\sum_{i=1}^{M_s} Y_{si}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}$

- Production: $Y_{si} = A_{si} K_{si}^{\alpha_s} L_{si}^{1-\alpha_s}$

- Profit: $\pi_i = (1 - \tau_{Ysi}) P_i Y_i - w L_i - (1 + \tau_{Ksi}) R K_i$

Equilibrium

Marginal Cost: $MC_i \propto \dfrac{(1 + \tau_{Ksi})^{\alpha_{si}}}{(1 - \tau_{Ysi}) \cdot A_i}$

Capital-Labor Ratio: $\dfrac{K_{si}}{L_{si}} = \dfrac{\alpha_{si}}{1 - \alpha_{si}} \cdot \dfrac{w}{R} \cdot \dfrac{1}{(1 + \tau_{Ksi})}$

Firm Employment: $L_{si} \propto \dfrac{A_{si}^{\sigma-1} (1 - \tau_{Ysi})^{\sigma}}{(1 + \tau_{Ksi})^{\alpha_s(\sigma-1)}}$

Firm Output: $Y_{si} \propto \dfrac{A_{si}^{\sigma} (1 - \tau_{Ysi})^{\sigma}}{(1 + \tau_{Ksi})^{\alpha_s \sigma}}$

Dispersion in Marginal Products

$$\text{Value of MPL} \equiv \frac{P_{si}Y_{si}}{L_{si}} \propto \frac{1}{1-\tau_{Ysi}}$$

$$\text{Value of MPK} \equiv \frac{P_{si}Y_{si}}{K_{si}} \propto \frac{1+\tau_{Ksi}}{1-\tau_{Ysi}}$$

$$\text{TFPQ} \equiv A_{si} \equiv \frac{Y_{si}}{K_{si}^{\alpha_s} L_{si}^{1-\alpha_s}}$$

$$\text{TFPR} \equiv P_{si}A_{si} \propto \frac{(1+\tau_{Ksi})^{\alpha_s}}{1-\tau_{Ysi}}$$

Hypothetical Liberalization

Remove dispersion of distortions around industry average.

Gains from liberalization (fixed K):

$$\frac{Y}{\tilde{Y}} = \prod_{s=1}^{S}\left[\frac{1}{M_s}\sum_{i=1}^{M_s}\left\{\frac{A_{si}}{\bar{A}_s}\left(\frac{1-\tau_{Ysi}}{1-\bar{\tau}_{Ys}}\right)\left(\frac{1+\tau_{Ksi}}{1+\bar{\tau}_{Ks}}\right)^{-\alpha_s}\right\}^{\sigma-1}\right]^{\frac{\theta_s}{\sigma-1}}$$

Gains with endogenous K:

$$\frac{\tilde{Y}_{endogenous\ K}}{Y} = \left(\frac{\tilde{Y}}{Y}\right)^{\frac{1}{1-\sum_{s=1}^{S}\alpha_s\theta_s}}$$

What we need to know

Output Distortion: $1 - \tau_{Ysi} \propto \dfrac{wL_{si}}{P_{si}Y_{si}}$

Capital Distortion: $1 + \tau_{Ksi} \propto \dfrac{wL_{si}}{K_{si}}$

TFPQ $\equiv A_{si} \propto \dfrac{\left(P_{si}Y_{si}\right)^{\frac{\sigma}{\sigma-1}}}{K_{si}^{\alpha_s}\left(wL_{si}\right)^{1-\alpha_s}}$

TFPR: $P_{si}A_{si} \propto \dfrac{\left(1 + \tau_{Ksi}\right)^{\alpha_s}}{\left(1 - \tau_{Ysi}\right)}$

Annual Survey of Industries (India)

1989-1990 and 1994-1995

Census of large plants (>100) and 1/3 sample of small plants

~ 40,000 plants.

~ 400 industries (100 plants per industry)

Largely private (95% of plants, 76% of value added)

China Manufacturing Census (1995)

Census of mfg. plants

~ 340,000 plants

Annual Survey of Industrial Production (1998-2003)

Census of state-owned plants and census of private plants > 5 million RMB ($600,000)

~ 120,000 plants

Ownership of Chinese Plants

% of value added

	State	Collective	Private
1995	56.4	20.9	22.7
1998	40.7	20.2	39.1
1999	38.8	17.6	43.6
2000	32.8	15.8	51.4
2001	27.1	12.4	60.5
2002	24.1	10.5	65.4
2003	20.4	8.0	71.6

Distribution of Plant TFP,
Output Distortion, and Capital Distortion

TFP

India

China

Output Distortion

India

China

Capital Distortion
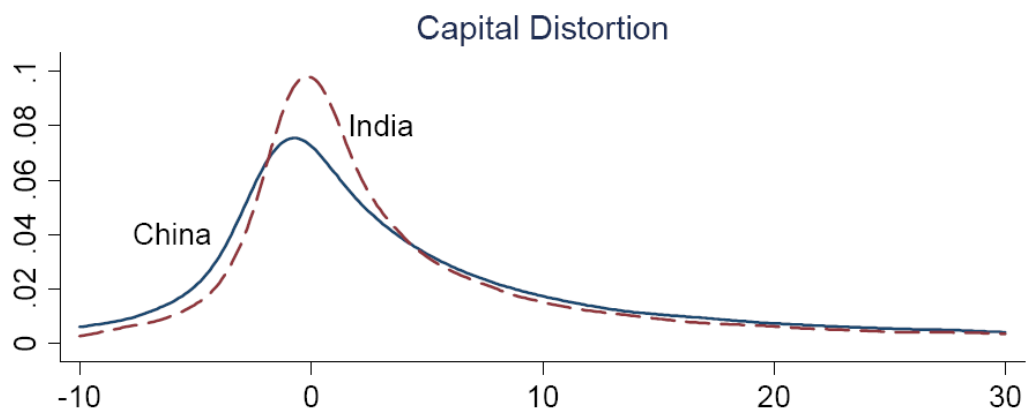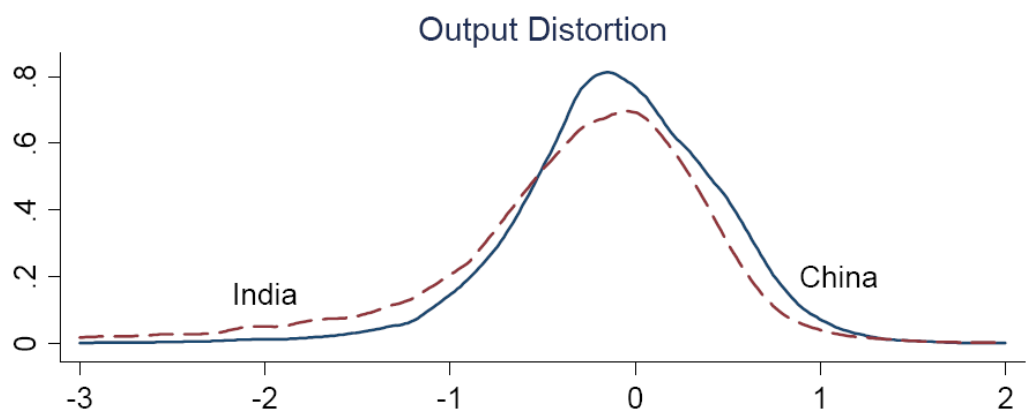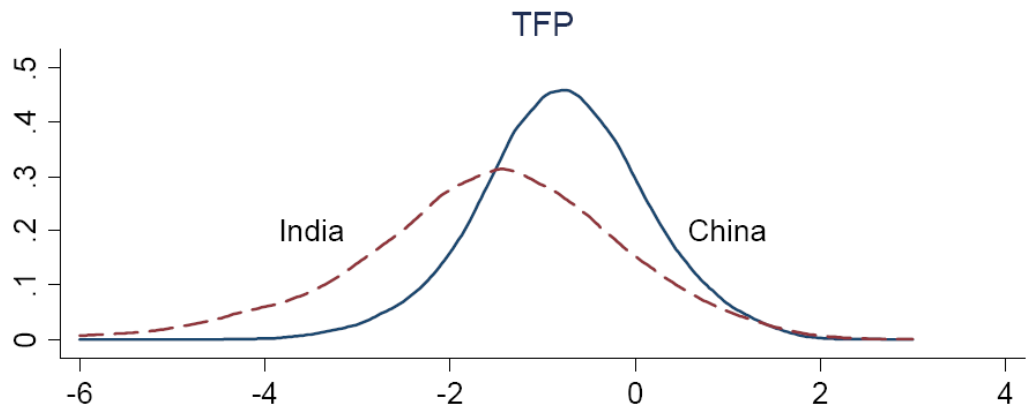
India

China

TFPR dispersion within 4-digit industries

	U.S.	China	India
$90^{th}/10^{th}$	1.9	5.6	5.7
$75^{th}/25^{th}$	1.3	2.5	2.4

Correlations in India

	A	$1+\tau_K$	$1-\tau_Y$
$1+\tau_K$	0.063		
$1-\tau_Y$	-0.470	0.524	
wL	0.560	0.135	0.257

Correlations in China

	A	$1+\tau_K$	$1-\tau_Y$
$1+\tau_K$	0.064		
$1-\tau_Y$	-0.464	0.380	
wL	0.590	-0.082	0.251

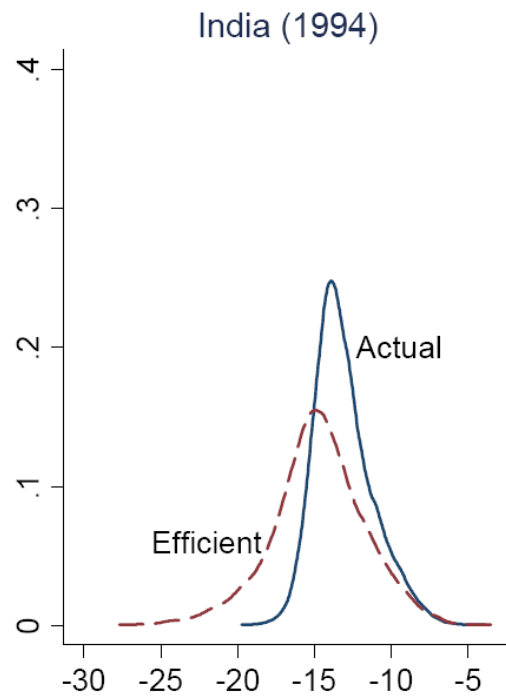## Efficiency gains in India
(Fixed Capital)

	$\sigma = 3$ $\varepsilon = 0.01$	$\sigma = 5$ $\varepsilon = 0.01$	$\sigma = 3$ $\varepsilon = 0.02$
1989-1990	2.12	2.85	1.83
1994-1995	2.17	3.11	2.03

Efficiency gains in China (Fixed Capital)

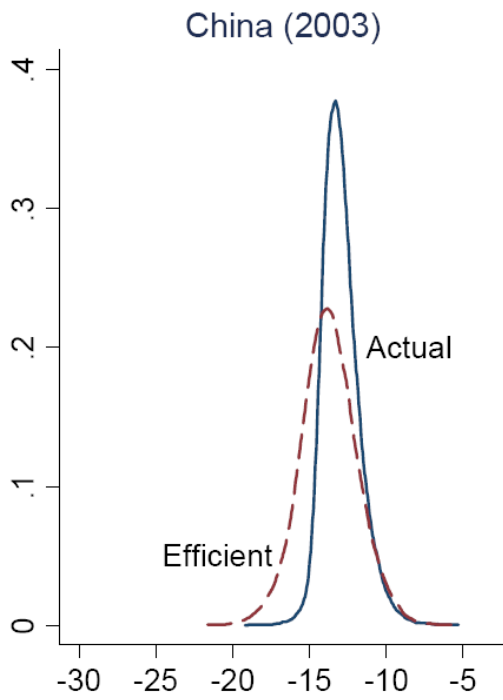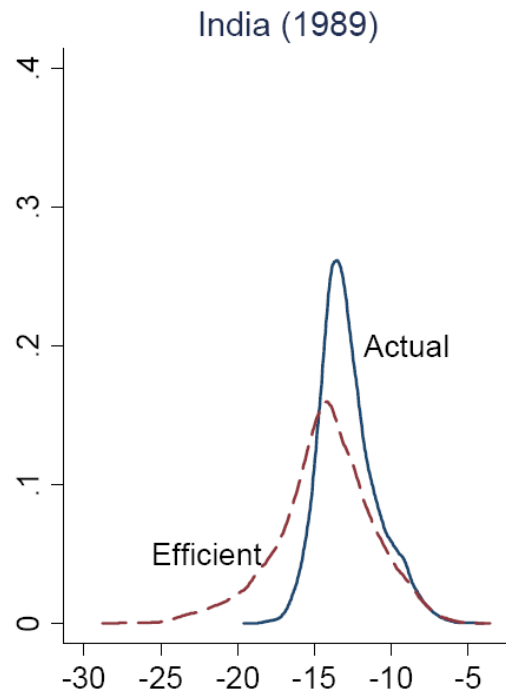|	$\sigma = 3$ $\varepsilon = 0.01$	$\sigma = 5$ $\varepsilon = 0.01$	$\sigma = 3$ $\varepsilon = 0.02$
1995	1.92	3.25	1.73
1998	2.06	3.37	1.86
1999	1.96	3.14	1.78
2001	1.91	3.04	1.73
2003	1.86	2.98	1.67

Efficiency gains in India
(Fixed Capital)

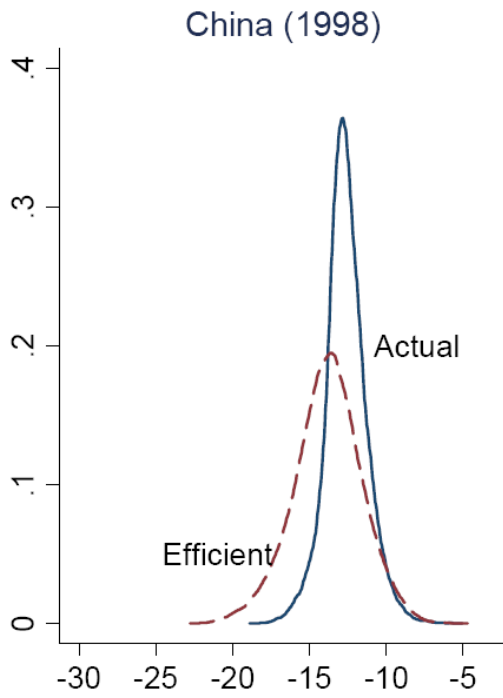|	$\phi = 1/2$	$\phi = 1$	$\phi = 3$
1989-1990	1.94	2.12	2.31
1994-1995	1.99	2.17	2.36

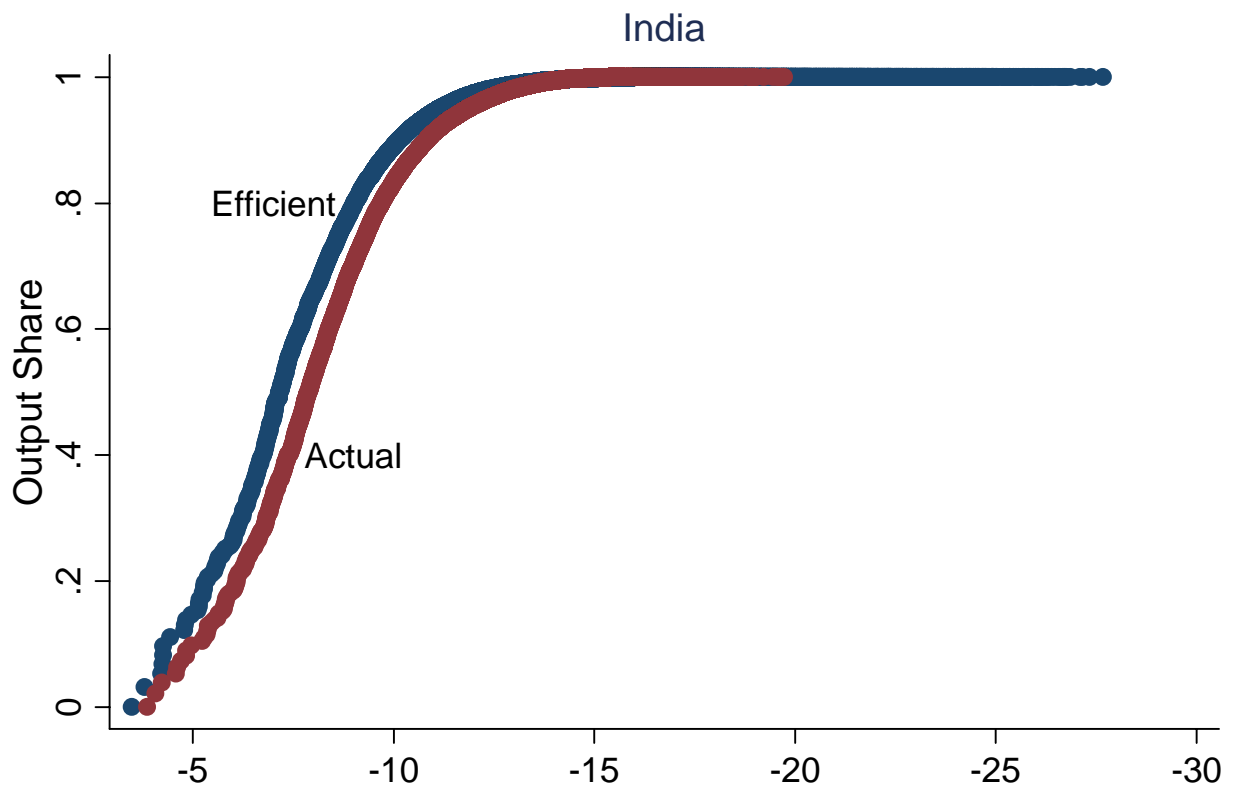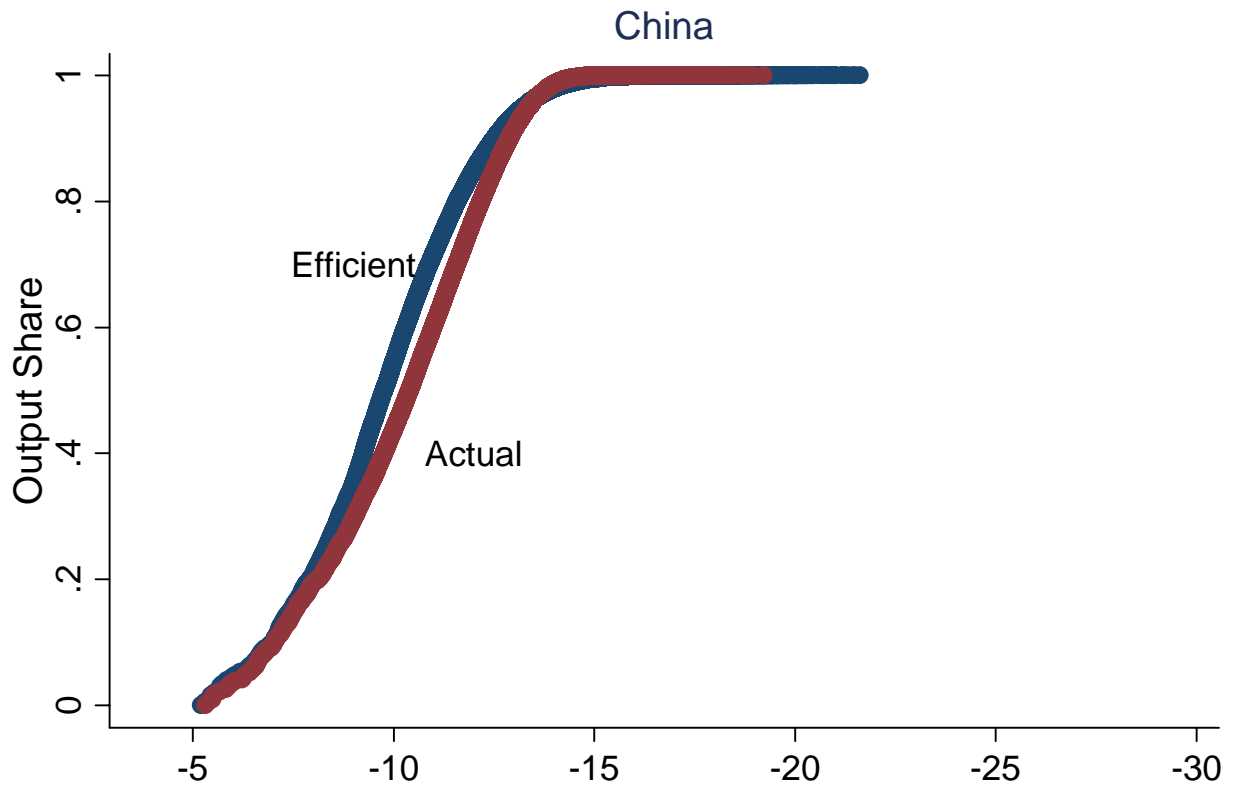# Efficiency gains in China
(Fixed Capital)

	$\phi = 1/2$	$\phi = 1$	$\phi = 3$
1995	1.84	1.92	1.98
1999	1.90	1.96	2.01
2003	1.80	1.86	1.90

Distribution of Plant Value-Added

China (1998)

India (1989)

China (2003)

India (1994)

Cumulative Distribution of Plant Output

Median Share of Top 10 Plants

China

Actual: 0.317

Efficient: 0.365

India

Actual: 0.722

Efficient: 0.807

Gains from Partial Liberalizations in India (Fixed Capital)

	Removing Both Distortions	Removing only the Output Distortion	Removing only the Capital Distortion
1989-90	2.12	1.20	1.17
1994-95	2.17	1.20	1.07

Gains from Partial Liberalizations in China (Fixed Capital)

	Removing Both Distortions	Removing only the Output Distortion	Removing only the Capital Distortion
1995	1.92	1.35	1.12
1999	1.96	1.18	1.19
2003	1.86	1.15	1.22

Measurement Error?

IV (for China): 3.09

Characteristics of TFRP:

	5-Year Persistence	Exit	Entry
US	0.277	-0.023	0.008
China	0.353	-0.025	0.013

Where do we go from here?

- U.S. Manufacturing Census

- What is the right model of firm heterogeneity?

- Agricultural sector