Misallocation Across Plants and Occupations

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Econ821

March 8, 2016

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Misallocation Across Plants

The key paper: Hsieh and Klenow (2009)

The idea:

- the most productive plants should be the largest
- if not, moving capital and labor from low to high efficiency plants could increase output

To quantify this:

- write down a model with heterogeneous plants
- each plant is a monopolist
- benchmark: "revenue productivity" should be equated across plants
- obtain data on distribution of revenue productivity for manufacturing plants in US, India, China
- infer distortions
- compute output gain from lowering distortions to U.S. levels (about 50%)

Model

Static

The only agents are plants

Final output

$$Y = \Pi_{s=1}^{S} Y_s^{\theta_s} \tag{1}$$

Sector output:

$$Y_s = \left(\sum_{i=1}^{M_s} Y_{si}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{1-\sigma}{\sigma}} \tag{2}$$

Firm output

$$Y_{si} = A_{si} K_{si}^{\alpha_s} L_{si}^{1-\alpha_s} \tag{3}$$

Market clearing

$$K = \sum_s \sum_i K_{si} \tag{4}$$

$$L = \sum_s \sum_i L_{si} \tag{5}$$

Factor supplies are fixed

Final Goods Producer

Perfect competition

Static cost minimization yields

$$Y_s = \theta_s Y P / P_s \tag{6}$$

with

$$P = \Pi_s \left(P_s/\theta_s\right)^{\theta_s} \equiv 1 \tag{7}$$

Intermediate Goods Producer

Static profit maximization

$$\pi_{si} = (1 - \tau_{Ysi})\, P_{si} Y_{si} - wL_{si} - (1 + \tau_{Ksi})\, RK_{si} \tag{8}$$

The firm takes the demand function (with price elasticity σ) as given.
The τ are distortions that affect

- size of the firm (τ_Y)
- capital-labor allocation (τ_K)

Implications for the Allocation

Without distortions, marginal revenue products of K and L are equated across all firms.

- $MRPL_{si} = w/(1 - \tau_{Ysi})$
- $MRPK_{si} = R\frac{1+\tau_{Ksi}}{1-\tau_{Ysi}}$

Backing Out TFP

The object of interest: TFP_s, defined by

$$Y_s = TFP_s K_s^{\alpha_s} L_s^{1-\alpha_s} \tag{9}$$

This determines aggregate output via

$$Y = \Pi_s \left(TFP_s K_s^{\alpha_s} L_s^{1-\alpha_s} \right)^{\theta_s} \tag{10}$$

TFP_s aggregates the A_{si}

The task: convert TFP_s into something observable.

Backing Out TFPs

Key result (15):

$$TFP_s = \left[\sum_i \left(A_{si} T\bar{F}PR_s / TFPR_{si} \right)^{\sigma - 1} \right]^{1/(\sigma - 1)} \tag{11}$$

where

$$TFPR_{si} \propto \frac{P_{si} Y_{si}}{K_{si}^{\alpha_s} \left(w L_{si} \right)^{1 - \alpha_s}} \propto \frac{\left(1 + \tau_{Ksi} \right)^{\alpha_s}}{1 - \tau_{Ysi}} \tag{12}$$

is revenue TFP

and $T\bar{F}PR_s$ is a (geometric) average of $TFPR_{si}$.

Key: $TFPR_{si}$ is observable (up to a scale factor).

A bit of trickery: to account for labor quality, measure labor input by the wage bill.

Some intuition:

- In the undistorted case, $TFPR_{si} / T\bar{F}PR_s = 1$
- Under some assumptions, dispersion in $TFPR_{si}$ reduces TFP_s

Motivating Evidence

Large dispersion of revenue TFP in China and India vs U.S.

TABLE II
DISPERSION OF TFPR

China	1998	2001	2005
S.D.	0.74	0.68	0.63
75 – 25	0.97	0.88	0.82
90 – 10	1.87	1.71	1.59
India	1987	1991	1994
S.D.	0.69	0.67	0.67
75 – 25	0.79	0.81	0.81
90 – 10	1.73	1.64	1.60
United States	1977	1987	1997
S.D.	0.45	0.41	0.49
75 – 25	0.46	0.41	0.53
90 – 10	1.04	1.01	1.19

Empirical Strategy

Start with a dataset of plants for a given country.

Data on Y_{si}, K_{si}, wL_{si}.

Use equations for marginal revenue products to back out distortions.

- $MRPL_{si} = w/(1 - \tau_{Ysi})$
- $MRPK_{si} = R\frac{1+\tau_{Ksi}}{1-\tau_{Ysi}}$

Since marginal products are not observed, use the ones implied by the model:

- $\frac{\sigma}{\sigma-1}\frac{wL_{si}}{(1-\alpha_s)P_{si}Y_{si}} = 1 - \tau_{Ysi}$
- $\frac{\alpha_s}{1-\alpha_s}\frac{wL_{si}}{RK_{si}} = 1 + \tau_{Ksi}$

In words:

- τ_K distorts the capital / labor allocation (measured by factor shares)
- τ_Y really distorts the scale of the plant; it moves along the demand curve

Also compute A_{si} to match $TFPR_{si}$.

Gains From Removing Distortions

Compute the efficient allocation (setting all $\tau = 0$).

Holding capital and labor supplies fixed.

This simply amounts to setting all $TFPR_{si}$ equal, so that

$$TFP_s = \left[\sum_i (A_{si})^{\sigma-1} \right]^{1/(\sigma-1)} \tag{13}$$

Many caveats:

- dispersion in U.S. $TFPR$ could represent something other than distortions (model misspecification)
- measurement error could be larger in low income countries
- etc

Main Result

TABLE IV
TFP GAINS FROM EQUALIZING TFPR WITHIN INDUSTRIES

China	1998	2001	2005
%	115.1	95.8	86.6
India	1987	1991	1994
%	100.4	102.1	127.5
United States	1977	1987	1997
%	36.1	30.7	42.9

Gains from removing distortions are much larger in China / India than in U.S.

Moving to "U.S. Efficiency"

A bit of a strange calculation:

How much larger are welfare gains from moving to the efficient allocation for China vs. U.S.?

Call that the gains from moving to U.S. efficiency (which it is not)

TABLE VI

TFP GAINS FROM EQUALIZING TFPR RELATIVE TO 1997 U.S. GAINS

China	1998	2001	2005
%	50.5	37.0	30.5
India	1987	1991	1994
%	40.2	41.4	59.2

Notes. For each country-year, we calculated $Y_{\text{efficient}}/Y$ using $Y/Y_{\text{efficient}} = \prod_{s=1}^{S} \left[\sum_{i=1}^{M_s} \left(\frac{A_{si}}{A_s} \right. \right.$ $\left. \left. \frac{\overline{\text{TFPR}}_s}{\text{TFPR}_{si}} \right)^{\sigma-1} \right]^{\theta_s/(\sigma-1)}$ and $\text{TFPR}_{si} \equiv \frac{P_{si} Y_{si}}{K_{si}^{\alpha_s} (w_{si} L_{si})^{1-\alpha_s}}$.

We then took the ratio of $Y_{\text{efficient}}/Y$ to the U.S. ratio in 1997, subtracted 1, and multiplied by 100 to yield the entries above.

Result: Moving to "US efficiency" increases TFP by roughly 50%

For comparison: TFP gap is about 150%

Comments

A really nice idea.

Difficult to implement quantitatively.

The answer depends on functional forms (elasticity of demand, nature of distortions, ...).

There is also a serious concern that more dispersion in TFPR in low income countries could be

- efficient or
- measurement error.

Other Sources of Misallocation

1. Credit frictions
2. Regulations that restrict the size of establishments or that lead to informality
3. Regulations that limit competition

Unexplored (as far as I know):

Do the "right" people get allocated to the "right" jobs / education levels?

Papers for student presentations

Misallocation across occupations:

- Hsieh et al. (2013), Guner et al. (2015)

Agriculture:

- Lagakos and Waugh (2013), Adamopoulos and Restuccia (2014), Restuccia and Santaeulalia-Llopis (2015)

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