Misallocation or Mismeasurement?

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From Micro to Macro:
Market Power, Firms' Heterogeneity and Investment

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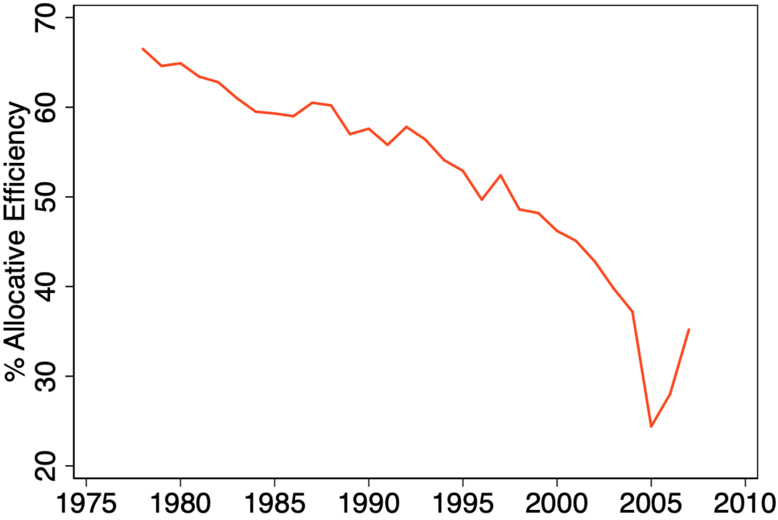
Motivation

- Sizable dispersion across plants in revenue/inputs (TFPR)
  - Syverson (2011)
- Huge potential gains from reallocating inputs
  - Restuccia & Rogerson (2008)
  - Hsieh & Klenow (2009)
  - Baqaee & Farhi (2018)
- But differences in *measured average* products need not reflect differences in *true marginal* products

U.S. manufacturing in recent decades

- Sharply rising TFPR dispersion
  - Suggests falling allocative efficiency
- It would seem to imply:
  - A drag on TFP growth of 1.75 percentage points per year
- Has misallocation really increased dramatically?
  Or has mismeasurement worsened?

U.S. allocative efficiency



What we do

- Propose a way to quantify measurement error
  - in revenue and inputs
  - exploiting panel data
- Adjust for measurement error and revisit allocative efficiency
  - manufacturing plants in the U.S. 1978–2007
  - manufacturing plants in India 1985–2013

Simple model setup

- $Y = \left(\sum_i Y_i^{1-\frac{1}{\epsilon}} \right)^{\frac{1}{1-\frac{1}{\epsilon}}}$
- $Y_i = A_i I_i$
- $\max \left(1 - \tau_i^Y\right) P_i Y_i - w I_i$
  - Monopolistic competitor takes w and Y as given
- $\widehat{R}_i = \widehat{P_i Y_i} = R_i + g_i$

Simple model TFPR

- P_i = markup $\times$ marginal cost
- $P_i = \left(\frac{\epsilon}{\epsilon - 1}\right) \times \left(\tau_i \cdot \frac{w}{A_i}\right)$, where $\tau_i \equiv \frac{1}{1 - \tau_i^Y}$
- $\frac{R_i}{I_i} \ \propto \ \tau_i$
- $\text{TFPR}_i \ \equiv \ \frac{\widehat{R_i}}{I_i} \ \propto \ \tau_i \cdot \frac{\widehat{R_i}}{R_i}$

Levels and growth rates of revenue and inputs

If constant τ, constant measurement error in revenue, and no measurement error in inputs (all relaxed in the paper):

$$\widehat{R} = R + g = \left(\frac{\tau}{A}\right)^{\epsilon-1} + g$$

$$\text{TFPR} \equiv \frac{\widehat{R}}{I} = \tau \cdot (1 + g/R)$$

$$d\ln\left(\widehat{R}\right) = d\ln(I) + d\ln(\text{TFPR})$$

$$d\ln\left(\widehat{R}\right) = d\ln(I) - \frac{g}{\widehat{R}} \cdot d\ln(R)$$

Measurement error and the elasticity of revenue wrt inputs

$$d\ln\left(\widehat{R}\right) = d\ln(I) - \frac{g}{\widehat{R}} \cdot (\epsilon - 1) \cdot d\ln A$$

$$d\ln\left(\widehat{R}\right) = d\ln(I) - \frac{g}{\widehat{R}} \cdot d\ln I$$

$$d\ln\left(\widehat{R}\right) = (1 - g/\widehat{R}) \cdot d\ln I$$

$$\frac{d\ln\widehat{R}}{d\ln I} = \frac{\tau}{\text{TFPR}} \quad \Rightarrow \quad \tau = \frac{d\ln\widehat{R}}{d\ln I} \cdot \text{TFPR} = \delta \cdot \text{TFPR}$$

Adjusting for measurement error in TFPR

For a sample of plants in a given year:

Step 1: Regress $d \ln \widehat{R}$ on $d \ln \widehat{I}$ to get $\widehat{\delta}$ for 10 deciles of plant TFPR

(note: instrument for $d \ln \widehat{I}$ with plant employment growth)

Step 2: Add the log $\widehat{\delta}$ coefficients from Step 1 to ln TFPR

Step 3: Add back lognormal noise to arrive at $\widehat{\tau}$ such that:

$$var_{\widehat{\tau}} = var_{\text{TFPR}} + cov_{\text{TFPR},\widehat{\delta}}$$

Step 4: Recalculate allocative efficiency with $\widehat{\tau}$ instead of TFPR

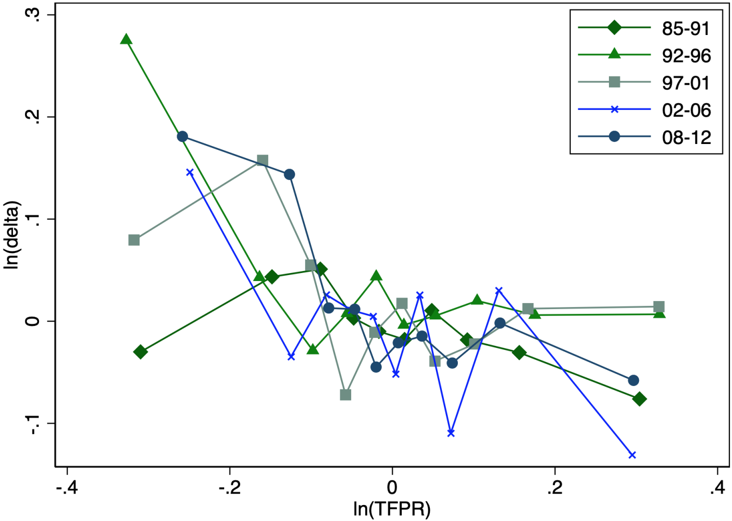
Indian *Annual Survey of Industries* (ASI)

- Survey of Indian manufacturing plants
  - Long panel 1985–2013
- Sampling frame
  - All plants $>$ 100 or 200 workers (45% of plant-years)
  - Probabilistic if $>$ 10 or 20 workers (55% of plant-years)
  - $\sim$ 43,000 plants per year
- Variables used
  - Gross output (R_i), intermediate inputs (X_i), labor (L_i), wage bill (wL_i), and capital (K_i)

U.S. *Longitudinal Research Database* (LRD)

- U.S. Census Bureau data on manufacturing plants
  - Long panel, 1978–2007
- Sampling frame
  - Annual Survey of Manufacturing (ASM) plants
  - $\sim$ 50k plants per year with at least one employee
  - Probabilistic sampling for $\sim$ 34k plants, certainty for other $\sim$ 16k
- Variables used
  - Gross output (R_i), intermediate inputs (X_i), labor (L_i), wage bill (wL_i), and capital (K_i)

$\ln(\widehat{\delta})$ vs. ln(TFPR) in India



Corrected average allocative efficiency

	uncorrected AE	corrected AE
India	49%	53%
U.S.	50%	>50%
U.S. / India	0%	>0%

Corrected *changes* in allocative efficiency

	uncorrected change per year	corrected change per year
India	0.0%	0.2%
U.S.	–1.8%	>–1.8%

Relaxing our simplifying assumptions

Allowing changes in τ and measurement error, and including measurement error in inputs, we get:

$$\frac{d\ln\widehat{R}}{d\ln\widehat{I}} = \frac{\tau}{\text{TFPR}} \cdot \left[1 + \frac{d\ln\tau}{d\ln I}\right] \cdot \left[\frac{d\ln I}{d\ln I + df/I}\right] + \frac{dg/\widehat{R}}{d\ln\widehat{I}}$$

We use simulations to see how far this deviates from τ/TFPR.

Simulations to test the validity of our strategy

- A_{it} and τ_{it} follow

$$ln(x_{it}) = \rho_x \cdot ln(x_{it-1}) + \eta_{it}^x \text{ where } \eta_{it}^x \sim N(0, \sigma_x^2)$$

- g_{it} follows

$$g_{it} = \rho_g \cdot g_{it-1} + \eta_{it}^g \cdot R_{it} \text{ where } \eta_{it}^g \sim N(0, \sigma_g^2)$$

- Use $\epsilon = 4$, $\rho_a = \rho_\tau = \rho_g = 0.9$

- Estimate $\{\sigma_a, \sigma_\tau, \sigma_g\}$ to fit $\{\widehat{\delta}$ by TFPR, $\sigma_{\text{TFPQ}}, \sigma_{\text{TFPR}}\}$

Takeaways from simulations

$\ln(\delta)$ vs. ln(TFPR) approach:

- does well at correcting for additive measurement error
- does not at all correct for multiplicative measurement error
- does not at all correct for adjustment costs