Misallocation or Mismeasurement?

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Overview

I commend the authors for writing this paper

1. We need more work on how measurement error in production microdata affects inference in general

2. Recent work investigating robustness of Hsieh-Klenow distortion metrics; measurement error a known issue but as yet unaddressed

Logic

The paper has a lot of equations

I found it easier to think about the intuition behind empirical specification:

$$\Delta\hat{R} = \Psi \cdot \Delta\hat{I} + \Phi \cdot f(\ln TFPR) + \Psi(1-\lambda) \cdot \Delta\hat{I} \cdot g(\ln TFPR)$$

where $\lambda \equiv \frac{\sigma^2_{\ln \tau}}{\sigma^2_{\ln TFPR}}$ and $f(\cdot)$ and $g(\cdot)$ are polynomials

If elasticity of measured revenue with respect to inputs *varies with the TFPR level*, then $\lambda \neq 1$ and measurement error is implied

- If inputs change marginally but revenue doesn't, probably measurement error in either or both
- How much measurement error depends on size of $cov(\eta_{RI}, \ln TFPR)$

Logic—Going Deeper

When is elasticity of measured revenue w.r.t. measured inputs invariant to measured TFPR level?

$$\eta_{RI} \equiv \frac{\partial R}{\partial I}\frac{I}{R} = \frac{\frac{\partial R}{\partial I}}{\frac{R}{I}} = \frac{MRPI}{TFPR} = \frac{MRPI}{ARPI}$$

I.e., when is $\frac{d}{dTFPR}\left(\frac{MRPI}{ARPI}\right) = 0$ at all TFPR levels?

Two cases:

1. Measured MRPI is always zero (dismiss)
2. **Measured MRPI scales exactly with measured ARPI (TFPR)**

Logic—Going Deeper

Q: When does MRPI scale exactly with TFPR (ARPI) *in absence of distortions or measurement error*?

A: If and only if the revenue function is a single-termed power function, i.e., $R = rI^{\rho}$, where I is profit-maximizing inputs. Then MRPI/ARPI = ρ

For this, need isoelastic demand and a PF that is a power function

$$R = P(Q)Q = D\left(AI^{\theta}\right)^{-\sigma}\left(AI^{\theta}\right) = D\left(AI^{\theta}\right)^{1-\sigma} = DA^{1-\sigma}I^{\theta(1-\sigma)}$$

Thus specification is actually joint test: null of zero measurement error *and* that revenue function is a power function (i.e., isoelastic demand plus a power function PF plus no adjustment costs plus no fixed costs)

- Otherwise MRPI will vary with TFPR even w/o measurement error

Additivity Assumption

Method requires measurement error be additive rather than multiplicative

Reason: Distortions are assumed to be multiplicative; cannot separately identify measurement error from distortions if both are multiplicative

Thoughts on this assumption

- Restrictive (though ME variance allowed to vary with TFPQ and τ)
- Pretty arbitrary
  - No evidence offered for functional form
  - Actually, arbitrariness applies to distortion assuptions too
    - Don’t we have just as much ex ante justification to assume measurement error is multiplicative and distortions *additive*?

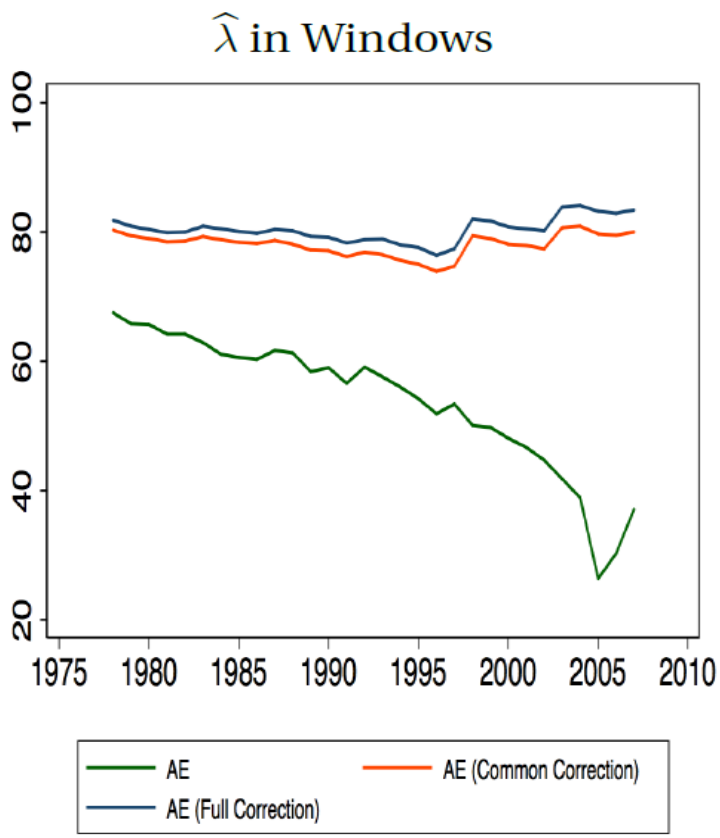
Additivity Assumption: Evidence

Little evidence on what actual measurement error distributions look like

- Paper reports frequency of existence of errors and average (percentage) magnitudes, but not distributions
- Very little in literature more generally
- A possible test:
  - Absent assumptions beyond second moments, symmetric multiplicative measurement errors are *skewed in levels*
  - Paper's assumed additive errors are *symmetric in levels*
  - So the question is, are the measurement errors not skewed?
    - One type of ME explored in the literature is imputation (White, Reiter, and Petrin). Imputing a skewed true distribution (revenues, inputs) to a level average results in skewed measurement error. (Not classical ME either)

Decreasing Allocative Efficiency or Increasing Measurement Error in ASM?

One of the most striking results in the paper is the implied large decrease in AE, or alternatively, increase in ME in US manufacturing:



Decreasing Allocative Efficiency in ASM?

Could AE really have fallen by more than half, from 70% to 35%?

For given levels of TFPQ dispersion, variety (number of plants), and average TFPQ, this means aggregate TFP falls by half!

In the data, you might be able to argue that TFPQ in 2007 is 10-15% lower than it “ought” to be based on 1977 levels (note 2007 is before most of the recent slowdown)

Could the TFPQ distribution have changed enough to counteract the AE drop? (Plants haven’t changed much at all)

Decreasing Allocative Efficiency in ASM?

Note plant-level TFPQ/TFPR ratio is just transformation of revenue:

$$\frac{TFPQ_{sit}}{TFPR_{sit}} = \frac{\left(\hat{R}_{sit}\right)^{\frac{\epsilon}{\epsilon-1}}}{\hat{R}_{sit}} = \left(\hat{R}_{sit}\right)^{\frac{1}{\epsilon-1}}$$

AE definition: $\widehat{AE}_{st} = \left[\sum_{i=1}^{N_{st}} \left(\frac{TFPQ_{sit}}{TFPR_{sit}}\right)^{\epsilon-1} \left(\frac{TFPQ_{st}}{TFPR_{st}}\right)^{1-\epsilon}\right]^{\frac{1}{\epsilon-1}}$

Substitute and simplify:

$$\widehat{AE}_{st} = \frac{TFPR_{st}}{TFPQ_{st}} \left[\hat{R}_{st}\right]^{\frac{1}{\epsilon-1}}$$

Decreasing Allocative Efficiency in ASM?

$$\widehat{AE}_{st} = \frac{TFPR_{st}}{TFPQ_{st}} \left[\hat{R}_{st}\right]^{\frac{1}{\epsilon-1}}$$

Might think that $\frac{TFPR_{st}}{TFPQ_{st}} = 1$, so AE ends up being just aggregate revenue

- It seems it would if sectoral price index is correct
- One assumes this when using industry-level data in national accounts

But $\frac{TFPR_{st}}{TFPQ_{st}} \neq 1$ in the model

- I am not exactly sure why
- Nevertheless, AE ends up being sector revenue exponentiated and multiplied by a ratio

Increasing Measurement Error in ASM?

Paper suggests the drop in AE is actually increasing ME

Recall, however, specification is a joint test of no measurement error *and*:

- Isoelastic demand
- Power function PF
- No adjustment costs
- No fixed costs

I have no idea about trends in deviations from isoelastic demand or power function PFs

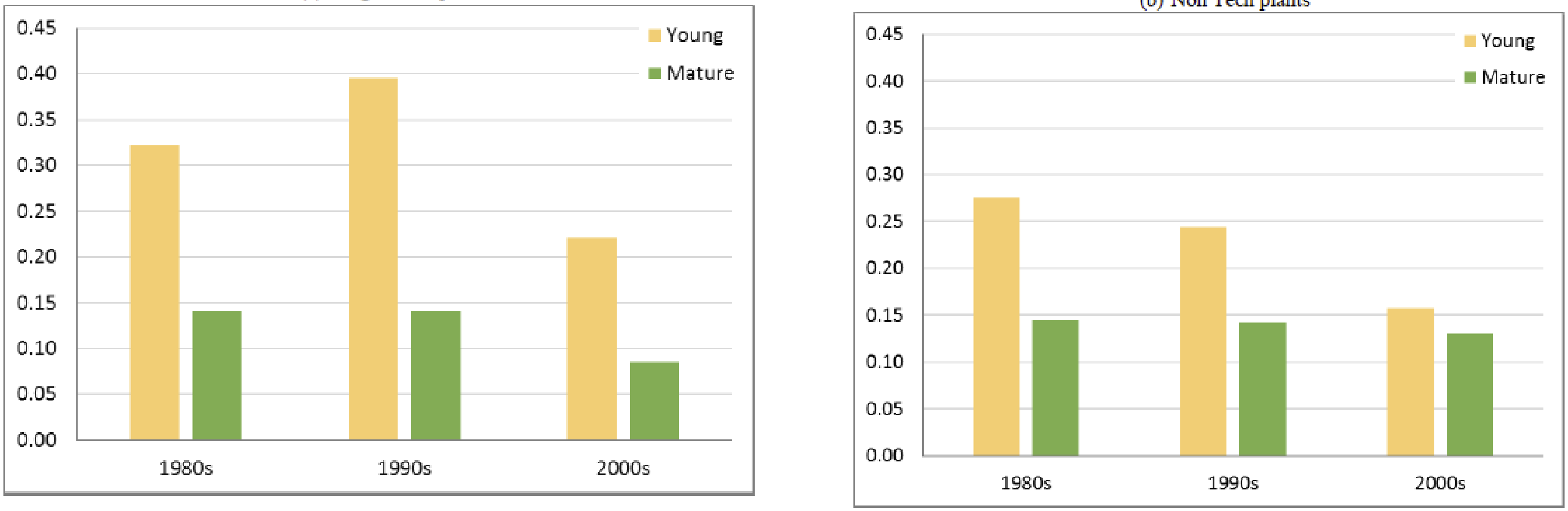
But…

Increasing Measurement Error in ASM?

Adjustment costs in MFG might be trending higher (Decker et al., 2017):

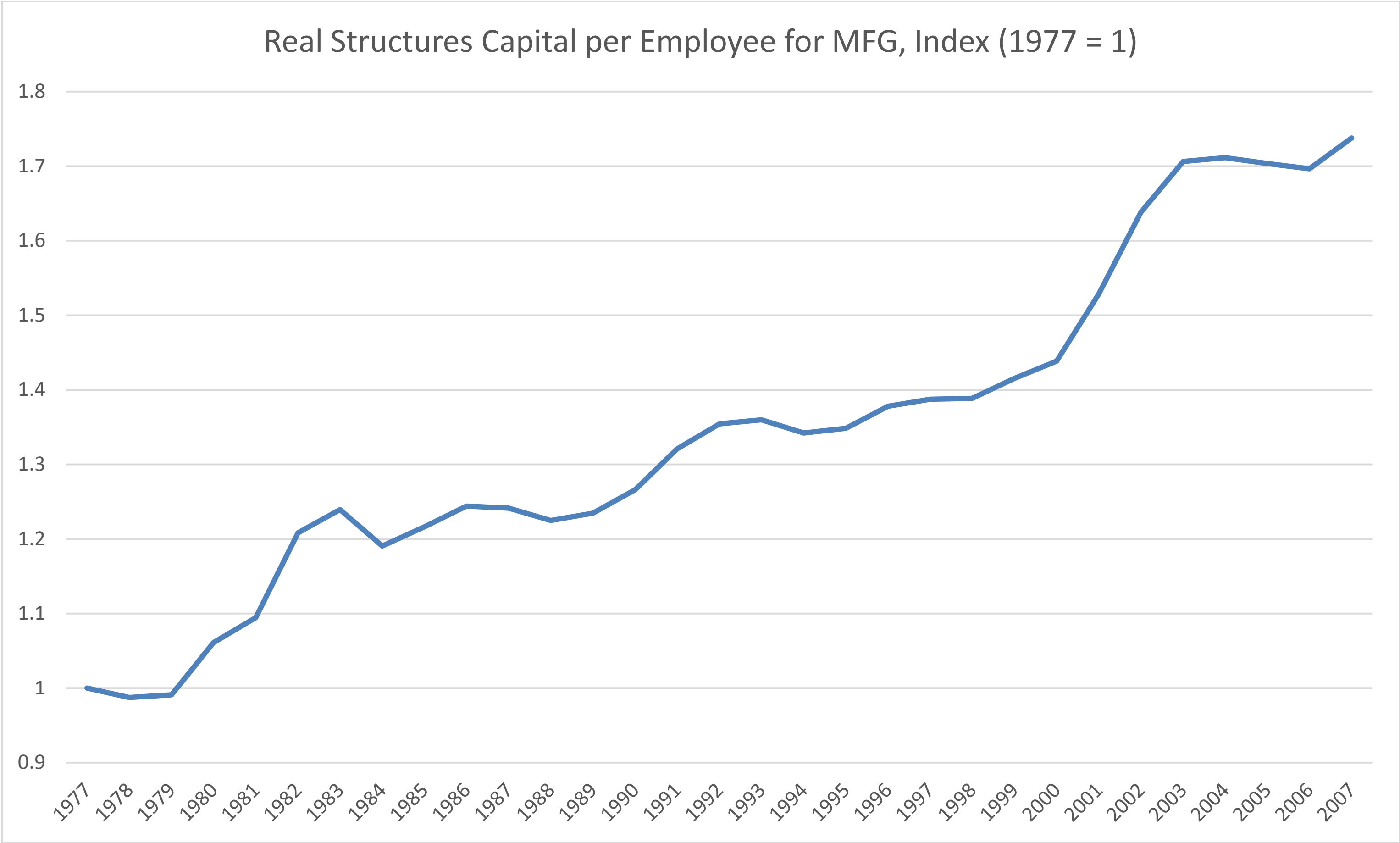
Figure 6: Marginal effect of TFP on plant-level net employment growth: young vs. mature

(a) High-Tech plants (b) Non Tech plants



Increasing Measurement Error in ASM?

Fixed costs in manufacturing are almost surely trending higher:



Trusting Models

The model takes advantage of strong assumptions, and the results are accepted as correct

I am nervous about taking the quantitative implications of structurally identified unobservables at face value

- This goes for many of us, and I have been guilty of it too

A little verification with independent data could go a long way

- Do actual measurement error distributions look additive?
- Are distortions correlated with observables we would think ex ante are likely to reflect distortions?
- Do data segments that model implies have greater measurement error actually show signs of having greater measurement error?