Allocating Misallocation: Decomposing Measures of Aggregate Allocative Efficiency[1]

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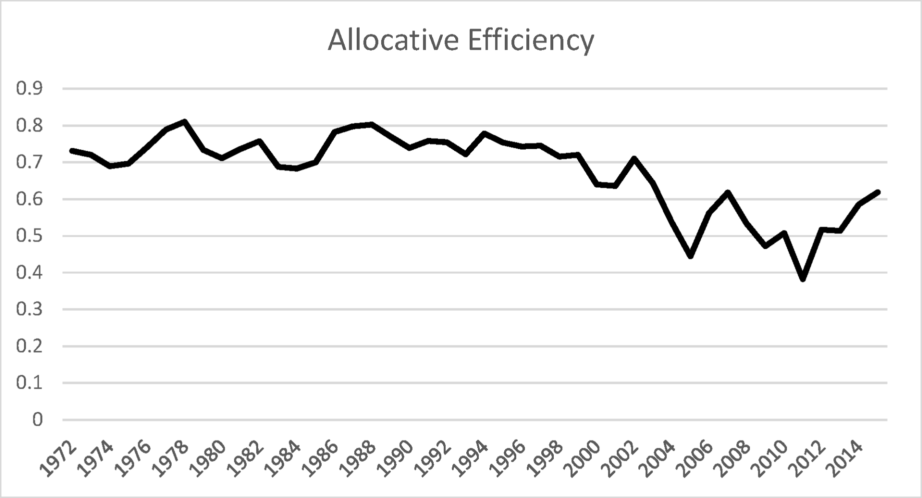
Motivation

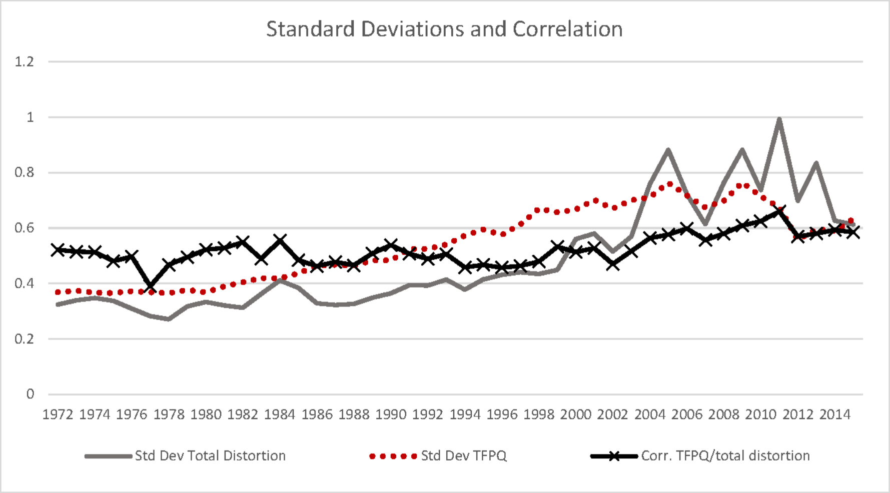
- Secular decline in measures of dynamism: reallocation and young firm activity
  - Adverse implications for productivity if due to rising frictions and distortions,
  - Alternative hypothesis is that patterns reflect changing business structure (e.g., large, global chains in retail trade are more stable and productive)
  - Both hypotheses might be true. If latter dominates, why has productivity growth been so anemic since early 2000s?
- We use existing model of misallocation to look at this question indirectly (Hsieh and Klenow (2009), Bils, Klenow and Ruane (2017) and Blackwood et. al. (2019))
  - We know measured allocative efficiency declines in U.S. manufacturing especially post-2000, driven by rising dispersion in revenue productivity (TFPR)
  - Increasing correlation between TFPR and TFPQ (technical efficiency + demand = "fundamentals") is also important (Blackwood et al. (2019))
- Building on this approach, we decompose distortions into scale and mix components
- Most of the focus in declining dynamism and misallocation literature has been on distortions to the size of businesses. We also explore the contribution of factor mix.

Measured AE in the US Manufacturing Sector: 1972-2015



Authors' calculations using Census micro data of U.S. manufacturing.

Moments of TFPQ and “Distortions”



Rising TFPR (composite distortion) and TFPQ (fundamentals) dispersion and correlation between them.

Our Approach: Decomposing AE into Scale and Factor Mix Distortions

- Some frictions/distortions impact only scale/size (e.g., markups)
- Others impact both scale and factor mix (e.g., factor-specific adjustment costs)
  - An increase in labor adjustment costs impacts size distribution of firms (scale) and factor mix of labor relative to other inputs (mix).
- We develop a decomposition of AE that permits identification of scale and mix components of distortions.
- Sheds light into the mechanisms at work for declining AE.
  - For example, if all decline in AE due to rising dispersion of markups, then only scale components of misallocation should increase.

The Framework

$$Q = \prod_s Q_s^{\theta_s} \qquad Q_s = \left(\sum_i^{N_s} Q_{is}^{\rho_s} \right)^{\frac{1}{\rho_s}} \qquad Q_{is} = A_{is} \prod_j X_{ijs}^{\gamma_s \alpha_{js}}$$

Plant Profit Maximization:

$$\pi_{is} = \max_{X_{ijs}} \left(1 - \tau_{is}^R\right) P_{is} Q_{is} - \sum_j (1 + \tau_{ijs}) w_{js} X_{ijs}.$$

- If no distortions: $\frac{R_{is}}{TC_{is}} = \frac{1}{\rho_s \gamma_s}$, $\frac{c_{ijs}}{c_{iks}} = \frac{\alpha_{js}}{\alpha_{ks}}$
- Literature has focused on plant-level composite distortion (HK): $\tau_{is} = \frac{\prod_j (1+\tau_{ijs})^{\alpha_{js}}}{(1-\tau_{is}^R)}$.

  Well-known example to motivate: Only distortion is idiosyncratic markups ($\tau_{ijs} = 0$)
  - Markup: $\mu_{is} = R_{is} / TC_{is} \propto (1 - \tau_{is}^R)^{-1}$, $c_{ijs} / c_{iks} = \alpha_{js} / \alpha_{ks}$. Only scale effects, no mix effects
- Objective is to decompose τ_{is} into scale vs. mix effects. We need additional condition that preserves the link between markup and scale distortion.

Scale vs. Mix Decomposition

Using plant-level normalization of distortions achieves this objective:

$$\left(\sum_j \frac{\alpha_{js}}{1+\tau_{ijs}}\right)^{-1} = 1 \implies \begin{cases} \frac{R_{is}}{TC_{is}} = \frac{1}{\rho_s \gamma_s} \frac{1}{\left(1-\tau_{is}^R\right)} \\ \\ \frac{\alpha_{js}}{c_{ijs}} = \left(1+\tau_{ijs}\right) \end{cases}$$

- Can identify scale vs. mix distortions with readily computable moments.
- Many sources of misallocation.
  - Pure scale sources include: markups, measurement error in revenue (only)
  - Pure sources: only scale neutral component, no scale effect (e.g., heterogeneous technologies)
  - Other sources have both mix and scale effects (e.g., adjustment frictions)
  - All of these sources affect *measured* misallocation. However, measurement and specification error does not affect true AE

Key Equations

Sectoral TFP

$$A_s = \frac{Q_s}{\prod_j X_{js}^{\alpha_{js}}} = \left(\sum_i A_{is}^{\frac{\rho_s}{1-\rho_s}} \left(\frac{\tau_{is}}{\tau_s} \right)^{\frac{-\rho_s}{1-\rho_s}} \right)^{\frac{1-\rho_s}{\rho_s}} \qquad A_s^* = \left(\sum_i A_{is}^{\frac{\rho_s}{1-\rho_s}} \right)^{\frac{1-\rho_s}{\rho_s}}$$

Allocative Efficiency: $AE_s = A_s / A_s^*$, "distance" from A_s^*

$$AE_s = \left(\frac{1}{N_s} \sum_i \left(\frac{A_{is}}{\widetilde{A}_s} \right)^{\frac{\rho_s}{1-\rho_s}} \left(\frac{\tau_{is}}{\tau_s} \right)^{\frac{-\rho_s}{1-\rho_s}} \right)^{\frac{1-\rho_s}{\rho_s}}$$

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$$AE_s^{-rev} = \left(\frac{1}{N_s} \sum_i \left(\frac{A_{is}}{\widetilde{A}_s} \right)^{\frac{\rho_s}{1-\rho_s}} \left(\frac{(1-\tau_s^R)}{(1-\tau_s^R)} \right)^{\frac{-\rho_s}{1-\rho_s}} \prod_j \left(\frac{(1+\tau_{ijs})^{\alpha_{js}}}{(1+\tau_{js})^{\alpha_{js}}} \right)^{\frac{-\rho_s}{1-\rho_s}} \right)^{\frac{1-\rho_s}{\rho_s}}$$

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AE^{-rev} also interpretable as AE due to mix distortions only.

Key Equations

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$$AE_s^{-mix} = \left(\frac{1}{N_s} \sum_i \left(\frac{A_{is}}{\widetilde{A}_s} \right)^{\frac{\rho_s}{1-\rho_s}} \left(\frac{(1-\tau_s^R)}{(1-\tau_{is}^R)} \right)^{-\frac{\rho_s}{1-\rho_s}} \right)^{\frac{1-\rho_s}{\rho_s}}$$

AE^{-mix} also interpretable as AE due to scale distortions only.

Key Equations

Sectoral TFP

$$A_s = \frac{Q_s}{\prod_j X_{js}^{\alpha_{js}}} = \left(\sum_i A_{is}^{\frac{\rho_s}{1-\rho_s}} \left(\frac{\tau_{is}}{\tau_s} \right)^{\frac{-\rho_s}{1-\rho_s}} \right)^{\frac{1-\rho_s}{\rho_s}} \qquad A_s^* = \left(\sum_i A_{is}^{\frac{\rho_s}{1-\rho_s}} \right)^{\frac{1-\rho_s}{\rho_s}}$$

Allocative Efficiency: $AE_s{=}A_s\,/\,A_s^*$, "distance" from A_s^*

$$AE_s = \left(\frac{1}{N_s} \sum_i \left(\frac{A_{is}}{\widetilde{A}_s} \right)^{\frac{\rho_s}{1-\rho_s}} \left(\frac{\tau_{is}}{\tau_s} \right)^{\frac{-\rho_s}{1-\rho_s}} \right)^{\frac{1-\rho_s}{\rho_s}}$$

This paper:

$$AE_s^{-TFPQ} = \left(\frac{1}{N_s} \sum_i \left(\frac{(1-\tau_s^R)}{(1-\tau_{is}^R)} \right)^{\frac{-\rho_s}{1-\rho_s}} \prod_j \left(\frac{(1+\tau_{ijs})^{\alpha_{js}}}{(1+\tau_{js})^{\alpha_{js}}} \right)^{\frac{-\rho_s}{1-\rho_s}} \right)^{\frac{1-\rho_s}{\rho_s}}$$

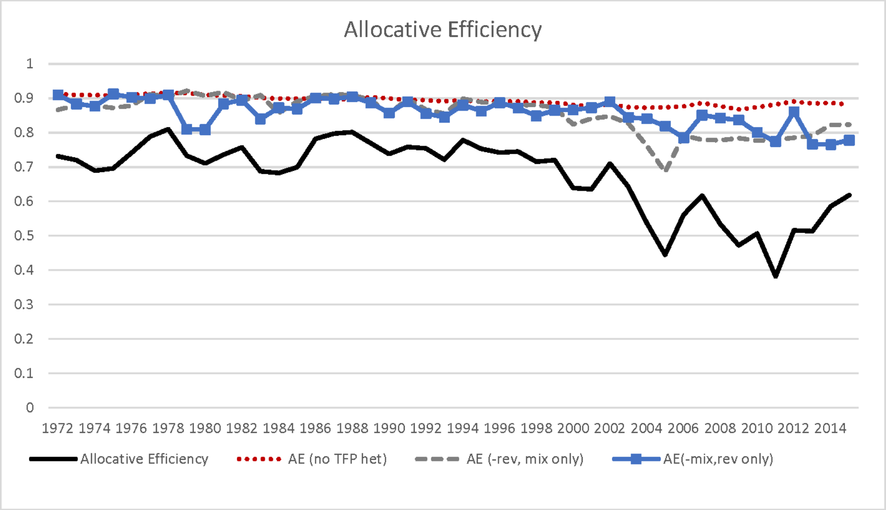
Data

CMP Dataset: 1972-2015

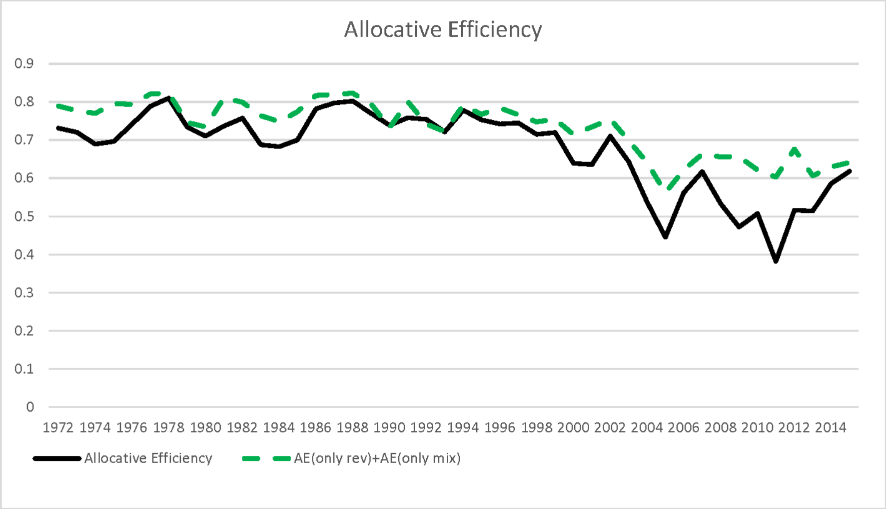
- ASM/CM data (ASM sample only, weighted): revenue, expenditures, inputs, industry
    - Capital stock built using perpetual inventory method
- External data on rental prices, deflators, etc. from BLS, NBER, BEA
- Cleaning: trim 1% tails on Average Revenue products, only include plants with positive measured profit

Implementation

- Key parameters (output elasticities, demand elasticities) estimated within the dataset

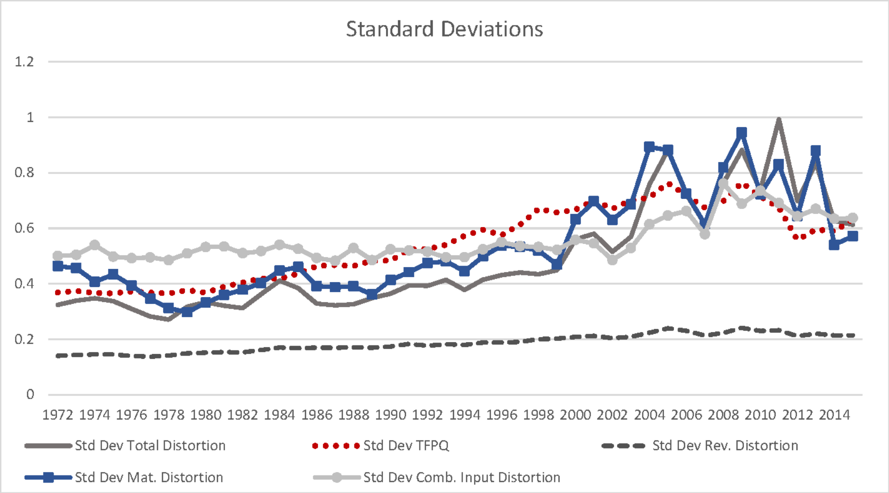


Scale and mix distortions about equally important. AE much higher without TFPQ dispersion even with idiosyncratic distortions, suggesting correlation between TFPQ and distortions is important.



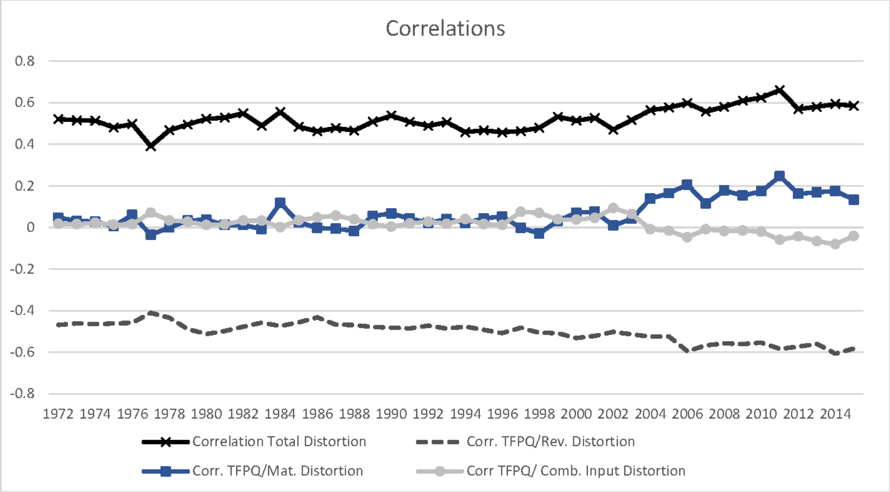
Scale (only) plus Mix (only) not equal to overall AE given covariance effects

Moments of TFPQ and "Distortions"



Decomposition shows rising dispersion in both scale and mix distortions.

Moments of TFPQ and "Distortions": 1972-2015



Increased correlation between TFPQ and overall distortion has both scale and mix components.

Summary and Next Steps

Key Findings:

- Scale vs. mix distortions can be identified from revenue/total cost and cost share dispersion
- Both scale and mix distortions about equally important for declining AE (literature has focused mostly on scale!)
- Explanations of declining AE (whether or not associated with declining dynamism) require accounting for both scale and mix effects.

Tentative Implications for Specific Mechanisms (work in progress):

- Rising idiosyncratic markups or revenue measurement error can account for at most half of declining AE (scale)
- Rising heterogeneity in production technology can account for at most half of declining (measured) AE (mix)
- Either multiple mechanisms at work or mechanism (e.g., adjustment costs) that has both scale and mix effects