PRODUCTIVITY AND MISALLOCATION IN GENERAL EQUILIBRIUM

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Overview

Motivation

- How can we aggregate microeconomic shocks in economies with distortions?
- They provide nonparametric formulas
- The foundations of macroeconomics rely on Domar aggregation: changes in a constant-returns-to-scale index are approximated by the sales-weighted average of the changes in its components.
- **Hulten's Theorem**: In perfectly competitive economies:

$$\frac{\Delta Y}{Y} - \sum_f \Lambda_f \frac{\Delta L_f}{L_f} \approx \sum_k \lambda_k \frac{\Delta TFP_k}{TFP_k} \tag{1}$$

- Y is real GDP, L_f is supply of factor f, Λ_f is its income share in GDP, TFP_k is total factor productivity (TFP) of producer k, and λ_k is its sales as a share of GDP, also known as its **Domar weight**.

Main Story

- New and structurally interpretable decomposition of changes in aggregate TFP into:
    - pure (exogenous) changes in technology
    - (endogenous) changes in allocative efficiency
- In efficient economies: allocative efficiency are zero to a first order
- Define a new measure of aggregate TFP growth that nets out the purely technological impact of factor growth from output growth.

Main Story in Data

- How have changes in the allocation of resources contributed to TFP growth in the U.S. over the past 20 years?
  - U.S. over the period 1997–2014. firm-level markups as a source of distortions: allocation of resources across firms accounts for about 50% of the cumulated growth in aggregate TFP.
  - average markups have been increasing: firms with high markups have been getting larger, and not because of a within-firm increase in markups
- What are the gains from eliminating markups in the U.S., and how have these gains changed over time?
  - in the U.S. in 2015, eliminating markups would raise aggregate TFP by about 10–25%

Final Demand anb Producers.

- Real GDP is the maximizer of a constant returns aggregator of final uses of goods:

$$Y = max_{c_i} D(c_1, ..., c_N) \tag{2}$$

$$s.t. \sum_{i}^{N}(1-\tau_{0i})p_i c_i = \sum_{f}^{F} w_f L_f + \sum_{i}^{N} \pi_i + \tau \tag{3}$$

- Good i is produced using a constant-returns technology described by the cost function:

$$\frac{1}{A_i} C_i((1+\tau_{i1})p_1, ..., (1+\tau_{i1}^f)w_1, ...)y_i \tag{4}$$

, and assume that

$$p_i = \frac{C_i}{A_i}\mu_i \tag{5}$$

Input-Output Definitions

- Final Expenditure Shares: b is $N \times 1$ vector whose:

$$b_i = \frac{p_i c_i}{\sum_{j=1}^{N} p_j c_j} \tag{6}$$

  sum of final expenditures are nominal GDP.
- Input-Output Matrices:
  - revenue-based input-output matrix Ω is the $(N+F) \times (N+F)$ matrix whose ijth element is equal to i's expenditures on inputs from j as a share of its total revenues :

$$\Omega_{ij} \equiv \frac{p_j x_{ij}}{p_i y_i} \tag{7}$$

  - The cost-based input-output matrix $\tilde{\Omega}$is the $(N+F) \times (N+F)$

$$\tilde{\Omega} ij \equiv \frac{\partial log C_i}{\partial log p_j} = \frac{p_j x_{ij}}{\sum_{k=1}^{N+F} p_k x_{ik}} \tag{8}$$

Domar's Weights

- he revenue-based Domar weight λ_i of producer i is its sales as a fraction of GDP:

$$\lambda_i \equiv \frac{p_i y_i}{\sum_{j=1}^{N} p_j c_j} \tag{9}$$

- From firm's accounting identity:

$$p_i y_i = p_i c_i + \sum_j p_j x_{ij} = b_i(\sum_j p_j c_j) + \sum_j \Omega_{ji} p_j y_j \tag{10}$$

- From this paper gets a result which I don't understand

$$\lambda' = b'\psi, \tag{11}$$

in which $\psi \equiv (I - \Omega)^{-1}$

- Define cost-based Domar weights:

$$\lambda' = b'\tilde{\psi} \tag{12}$$

Ex Post Reduced-Form Results

- Let X be an $(N+F) \times (N+F)$ admissible allocation matrix, where $X - ij = \frac{x_{ij}}{y_j}$
- The level of output at equilibrium is given by $Y(A, X(A, \mu))$.
- The change in aggregate output in response to technology and allocation shocks:

$$dlogY = \underbrace{\frac{\partial logY}{\partial logA} dlogA}_{\text{Technology}} + \underbrace{\frac{\partial logY}{\partial logX} dlogX}_{\text{Allocative Efficiency}} \tag{13}$$

Main Theorem

- Consider some distribution of resources X corresponding to the general equilibrium allocation at the point (A, μ), then

$$\frac{dlogY}{dlogA_k} = \tilde{\lambda}_k - \sum_f \tilde{\Lambda}_f \frac{dlog\Lambda_f}{dlogA_k} \tag{14}$$

and

$$\frac{dlogY}{dlog\mu_k} = -\tilde{\lambda}_k - \sum_f \tilde{\Lambda}_f \frac{dlog\Lambda_f}{dlog\mu_k} \tag{15}$$

therefore:

$$dlogY = \tilde{\lambda}' dlogA - \tilde{\lambda}' dlog\mu - \tilde{\Lambda}' dlog\Lambda \tag{16}$$

- (Hulten). If the initial equilibrium is efficient so that there are no markups/wedges $\mu = 1$, then

$$\frac{dlogY}{dlogA_k} = \lambda_k, \quad \frac{dlogY}{dlog\mu_k} = 0 \tag{17}$$

Illustration

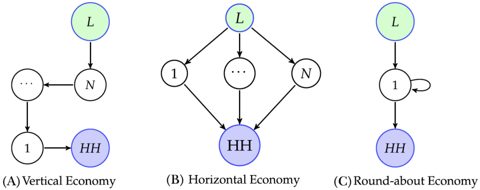

FIGURE I

Vertical, Horizontal, and Round-About Economies

- These different economies help illustrate the two ways Hulten's theorem can break down: (i) the equality of revenue-based and cost-based Domar weights (used to weigh the pure effects of technology); and (ii) the absence of changes in allocative efficiency (reflecting the efficiency of the initial allocation). The vertical economy breaks (i) but not (ii), the horizontal economy breaks (ii) but not (i), and the round-about economy breaks (i) and (ii).

Illustration: continued

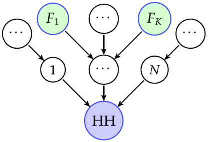

FIGURE II
Acyclic Economies

- there is no misallocation: the decompositions of Basu-Fernald and Petrin-Levinsohn fail to capture this.
- Gollop, Fraumeni, and Jorgenson only allow for markups/ wedges in factor markets, but not in intermediate input markets.

Investigating Markups

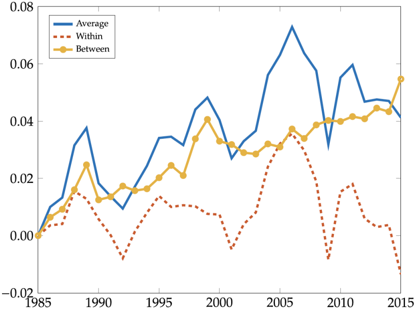

FIGURE III

Decomposition of the Growth in the Average Markup

Decomposition of the increase in the average markup into a between and within effect, using the user-cost approach markup data. All the changes are cumulated over time. See footnote 38 for more information.

- trend is overwhelmingly due to the between effect: average markups are increasing mostly because high-markup firms are getting larger on average, and not because firms are increasing their markups on average.

Investigating TFP

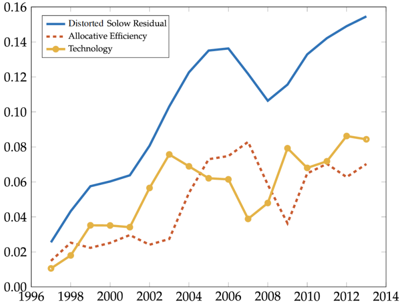

FIGURE IV

Decomposition of Aggregate TFP Growth (Distortion-Adjusted Solow Residual)

- assume that the only factors are labor and capital, and we abstract away from barriers to reallocation of factors like adjustment costs as well as from variable capacity utilization which matter more at businesscycle frequencies.
- reallocation account for about 50% of aggregate
- increase over time in average markups is largely driven by a

Investigating TFP: sector level

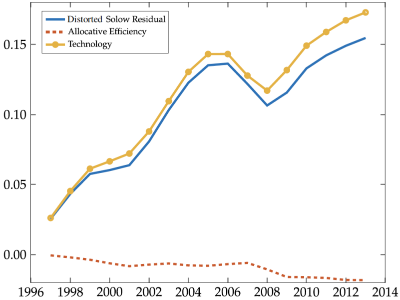

FIGURE V

Decomposition of Aggregate TFP Growth (Distortion-Adjusted Solow Residual) with Sectoral Data

- compositional effects and the reallocation effects have occurred across firms within industries and not across industries.

World Without Markups:

- Using the benchmark UC markups, we find that eliminating markups, holding fixed technology, would increase aggregate TFP by around 13%.

Conclusion

- Two effects have to be considered when investigating the aggregate economy:
  - Allocation effect
  - Markup effect
- It's possible to answer aggregate economy equations with non-parametric approaches.