The Macro-Economics of Superstars

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Introduction

Rosen (1981) first described the *Economics of Superstars*:

- [information] technology allows a small number of talented individuals to serve a large market and reap correspondingly large rewards
  - description pre-dated the Internet
  - Rosen's first example: comedians and TV
- superstars were a curious phenomenon in a handful of sectors
- but outside of the domain of traditional macroeconomics

Introduction

Over the past three decades, advances in information technology, chiefly the Internet, have *supercharged the superstars phenomenon*

Superstars (broadly defined to capture both individuals and firms):

- have become macroeconomically relevant
- are important drivers of several recent aggregate trends:
  1. declining demand for labor (and traditional capital)
  2. declining labor share
  3. increasing rents
  4. rise in income inequality

The Macro-Economics of Superstars analyzes

- the recent forces behind and
- the broader macro implications

Rising Superstar Profit Share

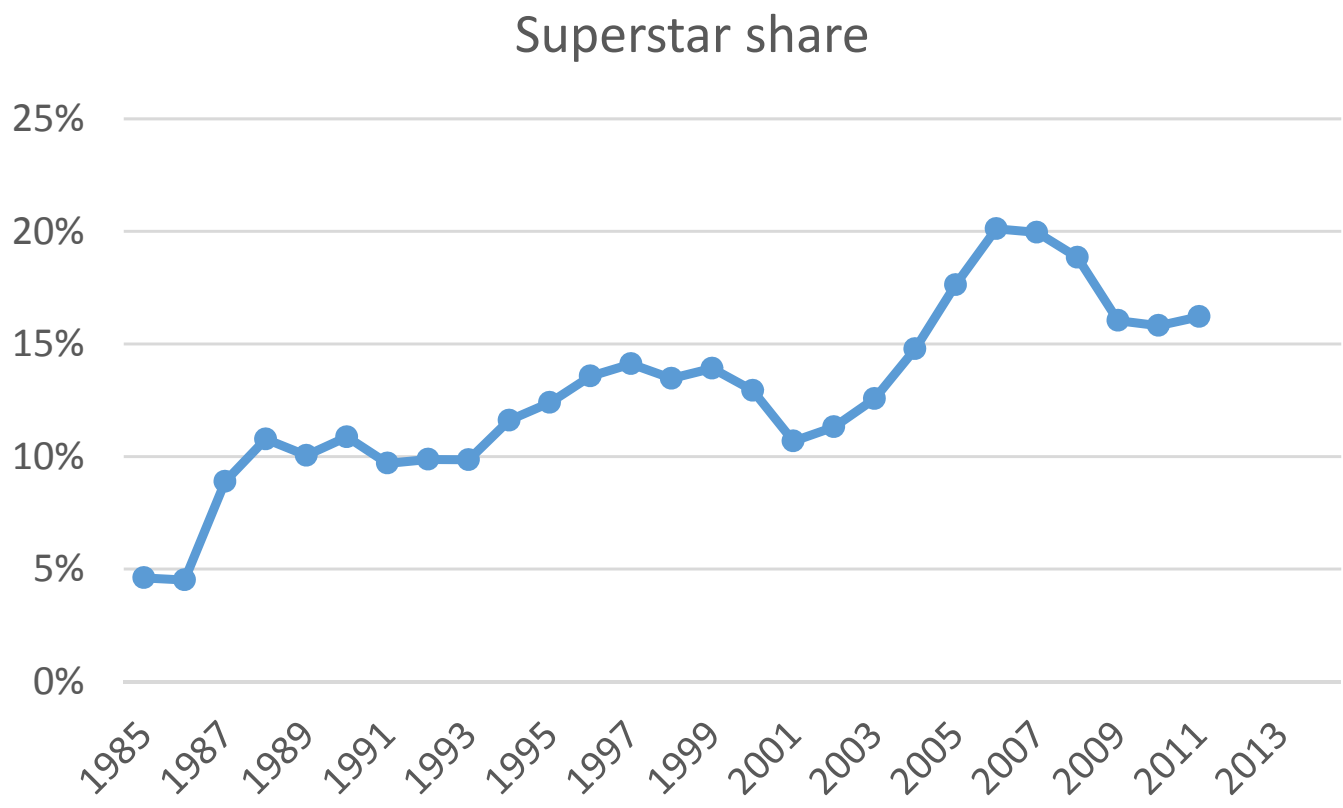


Figure: Estimate of superstar profit share in national income, 1984 - 2014 (Source: Authors' calculations based on Barkai, 2017, Piketty and Saez, 2017)

Information and Superstars

- Critical factor behind proliferation of superstars: *digital innovation*
  = advances in *collection, processing, and provision of information*

- ***Information* differs from traditional production factors**:
  - information is non-rival $\rightarrow$ can be copied at negligible cost
  - information is excludable $\rightarrow$ may generate monopoly power

$\rightarrow$ Information technology supercharges the superstar effect
  - Rosen's examples: comedians, musicians, authors, sport stars, artists, etc.
  - more generally: Internet entrepreneurs, finance professionals, franchise owners, manufacturers who automate, etc.

Summary of Contribution

- Our model of *digital innovation* leading to superstars
  = an innovation that replaces a fraction of production tasks by a digital process that can be scaled at negligible cost
  - $\rightarrow$ superstars technology features increasing returns
  - $\rightarrow$ superstars capture large market share, earn rents

  (in contrast to models of "factor-biased" technological change)

- We derive implications for:
  - factor prices and shares
  - market concentration
  - income distribution
  - public policy

Evolution of Aggregate Factor Shares

- Labor share declined across OECD (Karbarabounis and Neiman, 2014, Alvarez-Cuadrado et al, 2014, Elsby et al 2013)
  - US decline 64% to 58% from mid-1980s to mid-2010s
  - similar in other developed countries
  - at firm level, correlated with:
    - patents (Barrufaldi and Paunov, 2016)
    - information technology (Brynjolfsson et al, 2010)
    - rising market concentration (Autor et al, 2017)
- Traditional capital share has declined (e.g. Barkai, 2017)
- Profit share of income has increased

$\rightarrow$ our explanation: *rising superstar profits* as main driver

Overview of Model

Model structure:

- Representative consumer
- Two traditional factors: capital and labor
- Intermediate goods combined into final good a la Dixit-Stiglitz

Technologies for intermediate goods production:

- traditional CRS technology: Cobb-Douglas
- superstar technology: digital innovation automates a fraction of tasks involved in production

Baseline Model

Consumers:

- Inelastic labor supply $L = 1$
- Final good obtained from differentiated intermediate goods with $\epsilon > 1$

$$Y = \left(\int Y_i^{1-\frac{1}{\epsilon}} di \right)^{\frac{\epsilon}{\epsilon-1}}$$

with price of final good $P = \left(\int P_i^{1-\epsilon} di \right)^{\frac{1}{1-\epsilon}} = 1$ as numeraire

- Demand for each intermediate good is

$$Y_i = (P_i)^{-\epsilon} Y$$

$\rightarrow$ inverse demand curve $P_i(Y_i; \cdot)$

Traditional Technology

- Traditional technology for intermediate goods:

$$Y_i = F_i(K_i, L_i) = A_i K_i^{\alpha} L_i^{1-\alpha}$$

  open access $\rightarrow$ perfect competition
- Factors are hired at market prices R and W
- Total cost function with traditional technology

$$TC^T(Y_i) = \left(\frac{R}{\alpha}\right)^{\alpha} \left(\frac{W}{1-\alpha}\right)^{1-\alpha} \frac{Y_i}{A_i}$$

- Constant unit cost

$$UC^T(Y_i) = \left(\frac{R}{\alpha}\right)^{\alpha} \left(\frac{W}{1-\alpha}\right)^{1-\alpha} / A_i$$

Superstar Technology

- Consider an entrepreneur in sector i who develops a digital innovation
  - that imposes a fixed cost $\xi_i \geq 0$ but
  - that automates a fraction $\gamma_i \in (0, 1)$ of production tasks at negligible marginal cost
  - in baseline model: entrepreneur has *exclusive* right to the innovation (e.g. patent)
- The total and unit cost functions of superstars are

$$TC^S(Y_i) = \xi_i + (1 - \gamma_j) TC^T(Y_i)$$
$$MC^S(Y_i) = (1 - \gamma_j) UC^T(Y_i)$$

$\rightarrow$ fixed cost generates increasing return
$\rightarrow$ exclusiveness generates market power

Superstar Strategy

- Adopting the superstar technology is profitable
  if fixed cost ξ_i sufficiently low / cost-saving γ_i sufficiently high
- Superstars internalize demand curve $P_i(Y_i; Y)$ and maximize

$$\max_{P_i, Y_i} \Pi^S(Y_i) = P_i Y_i - TC^s(Y_i) \qquad \text{s.t.} \qquad P_i = P_i(Y_i; Y) \leq UC_i^T \tag{1}$$

  - if cost savings small ($\gamma_i < 1/\epsilon$) then constrained by competition from traditional firms:

$$P_i = UC_i^T$$

  - if cost savings large ($\gamma_i \geq 1/\epsilon$) then charge optimal monopoly price:

$$\underbrace{P_Y(Y_i; \cdot) Y_i + P_i(Y_i; \cdot)}_{\text{Marg Rev.}} = \underbrace{(1 - \gamma_j) UC_i^T}_{\text{Marg Cost}}$$

$\rightarrow$ superstar price and markup

$$P_i^S = \mu_i \cdot UC_i^T \qquad \text{where} \qquad \mu_i = \min\left\{1, \frac{\epsilon}{\epsilon - 1}(1 - \gamma_i)\right\}$$

Digital Innovation and Superstars

Proposition (Digital innovation and superstar effect in sector i)

- *if digital innovation is small ($\gamma_i < 1/\epsilon$), further innovation:*
  - *leaves the price charged and the output level unchanged*
  - *linearly reduces demand for labor and capital*
  - *linearly increases superstar profits (rents & inequality)*

  $\rightarrow$ *labor-saving effect of innovation, divergence of output and employment*
- *if digital innovation is large ($\gamma_i > 1/\epsilon$), further innovation:*
  - *reduces the price charged, with a constant markup $\frac{\epsilon}{\epsilon-1}$*
  - *increases factor demands, output and superstar profits in a convex fashion*

  $\rightarrow$ *output scale effect of innovation*

Digital Innovation and Superstars

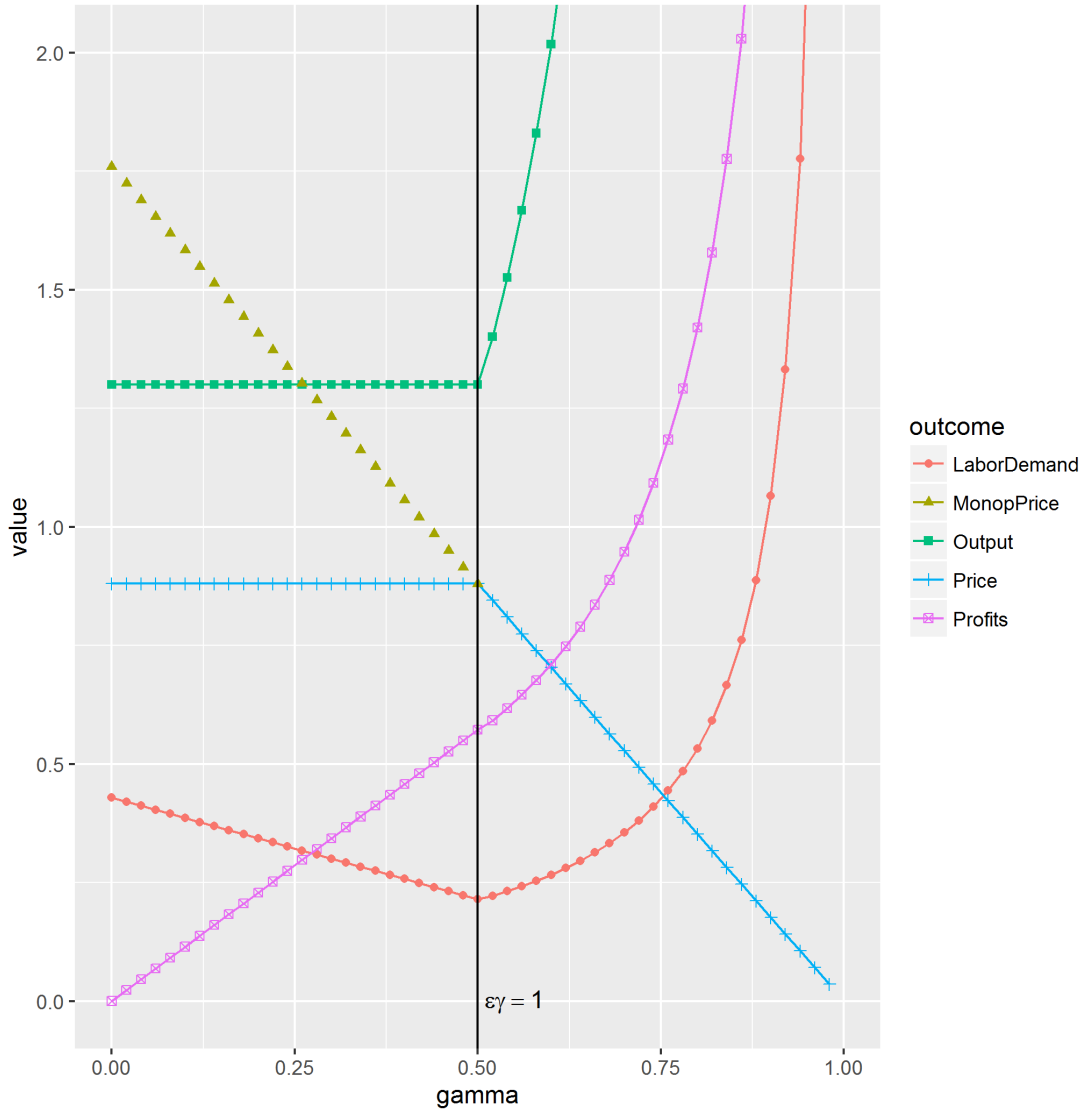


Figure: Effect of increasing digital innovation

Superstar Effect in General Equilibrium

Consider synchronized cost-savings γ_i for all sectors $i \in [0, 1]$:

Proposition (Superstars and Factor Shares in GE)

Superstars earn a profit share of

$$\sigma = \min \{\gamma_i, 1/\epsilon\}$$

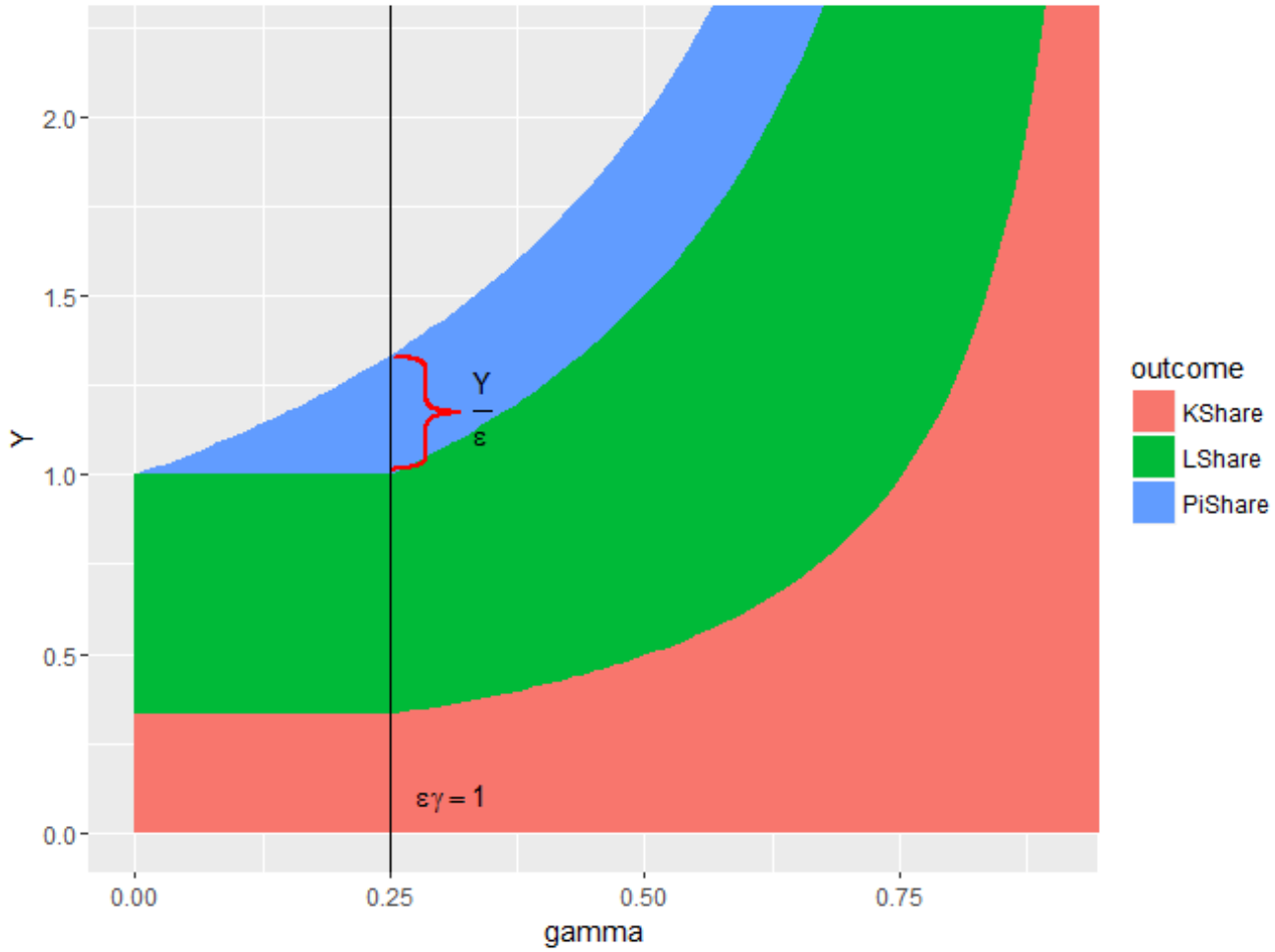
as well as a capital share of $\alpha (1 - \sigma)$ *and a labor share of* $(1 - \alpha)(1 - \sigma)$.

Intuition:

- before the optimal monopoly markup is reached, superstars absorb *all* cost-savings as profits
- once cost savings are sufficiently high, they cut prices to increase quantities

But: this involves significant monopoly rents and inequality

Digital Innovation and Superstars



Welfare Analysis

Proposition (Monopoly Distortions from Digital Innovation)

The decentralized equilbrium exhibits

- *insufficient digital innovation*
- *inefficiencly low quantities*

Intuition:

- markups distort both innovation decision and quantities after innovation implemented

Policy Remedies:

- use public investment to finance digital innovation
- offset monopoly markups via subsidy
- charge consumers fixed + variable cost

Extensions

Dynamic model:

- additional capital K is only accumulated once $\gamma > {}^{1}/_{\epsilon}$

More general market structure for superstars:

- overall rents lower the more competition
- but fixed cost creates a natural monopoly
  $\rightarrow$ trade-off btw duplicating innovation and markups

Digital innovation with endogenous choice of γ:

- superstars earn rents as long as decreasing returns to innovation

Conclusions

Digital Innovation and Superstar Technologies

- first lead to a reallocation from traditional factor income to superstar rents
  - but superstars keep prices low
- once superstars earn their optimal monopoly rents, further innovation expands income for all
  - but monopoly deadweight losses

  $\rightarrow$ role for policy intervention