Digitization and 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 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 IT, 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

Introduction

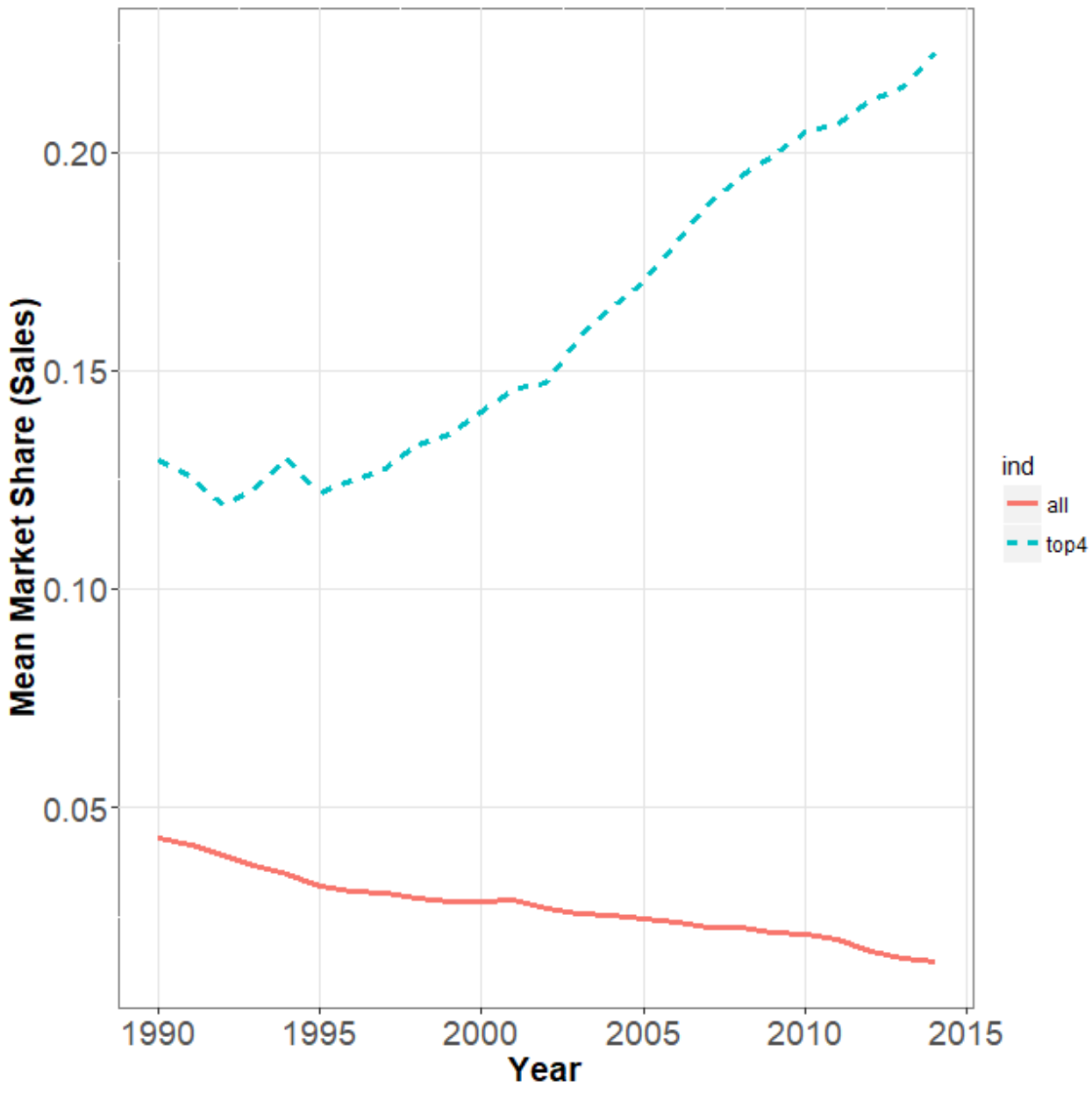
In *"The Macro-Economics of Superstars,"* we analyze

- the recent forces behind
- the broader macro implications
- policy remedies

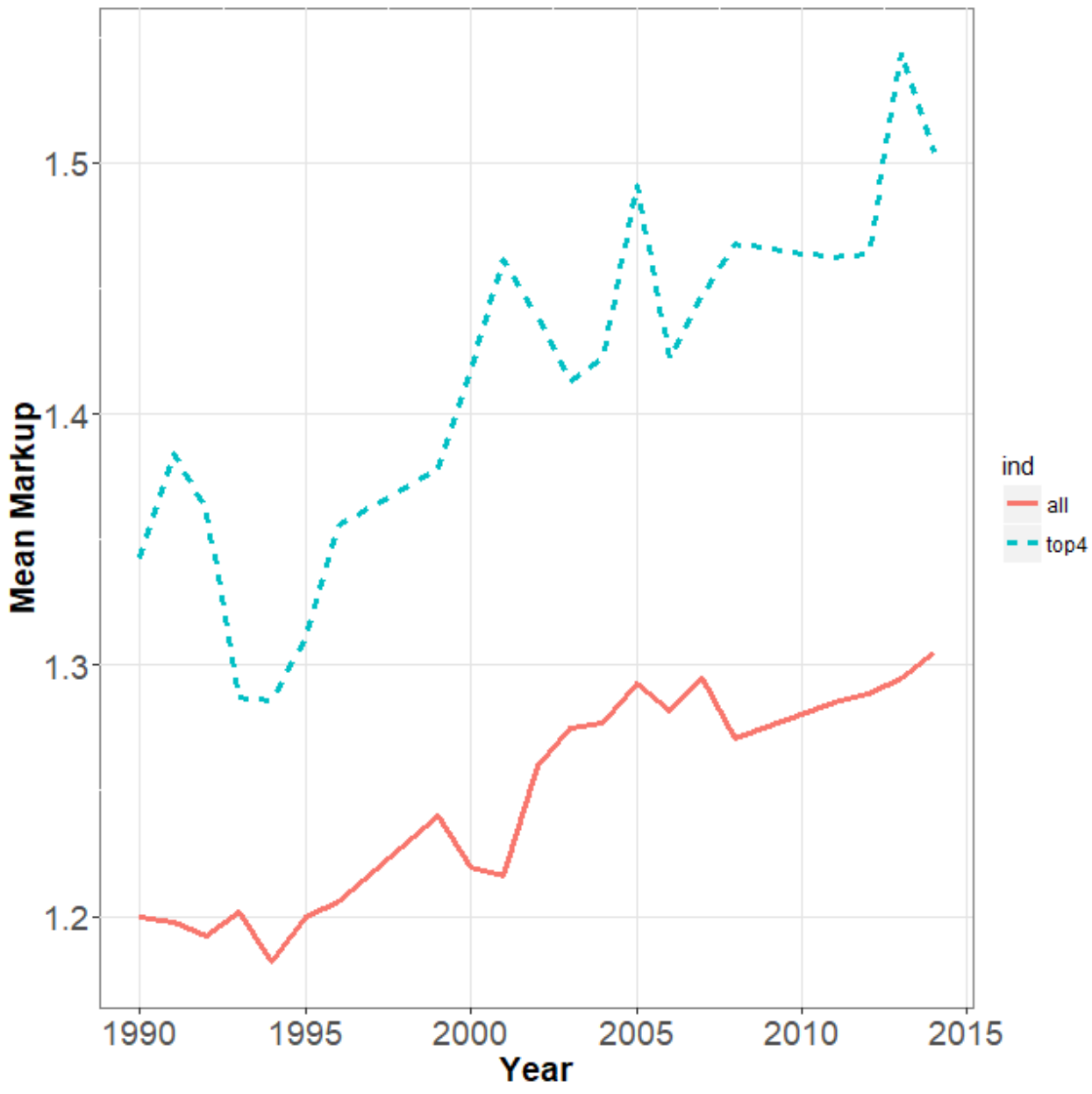
  – and –

- the implications for monetary policy

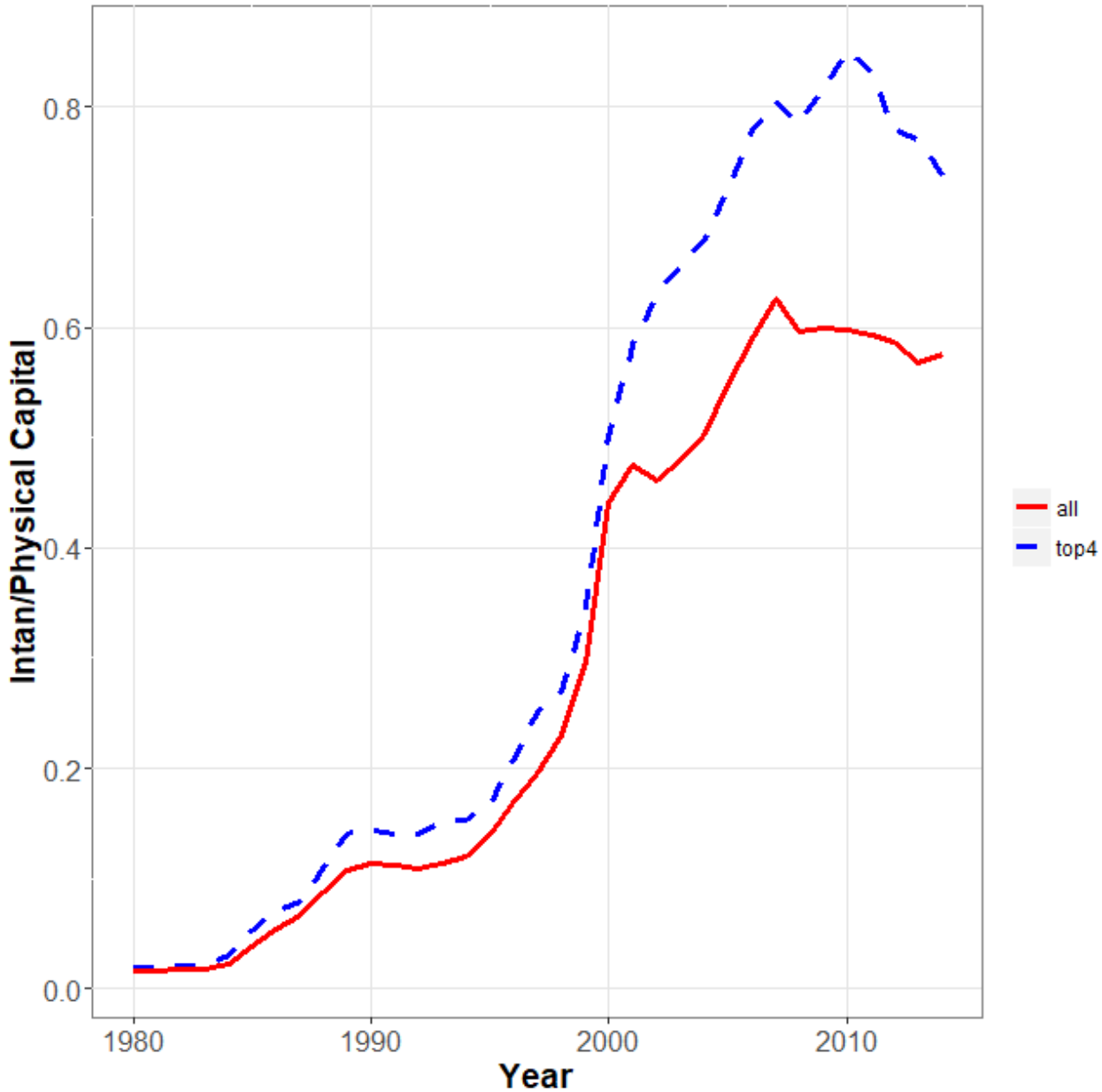
Rising Superstar Market Shares



Rising Markups



Intangible vs Physical Capital



The Macro-Economics of Superstars

Our paper argues that:

- Rise of superstars is natural result of ***digital innovation*** = advances in *collection, processing, and provision of information*

- ***Digital innovation*** allows firms/entrepreneurs
  - to replace tasks performed by traditional labor *and* capital
  - using a technology that is copied at negligible cost

Examples: Internet companies, telecoms, banks, sport stars, musicians, franchise owners, manufacturers who automate, etc.

Key Economic Mechanism

***Information* differs from other inputs to production:**

- information is *non-rival*
  - → digital innovation can supply a large market at low cost
  - → gives rise to increasing returns
- information is *excludable*
  - → generates monopoly power and economic rents (part of which are *actually needed* to pay for innovation)

→ Digital innovation supercharges the superstar effect

Baseline Model

Model structure:

- Unit mass of consumer-workers
- Two traditional factors: capital and labor
- Unit mass of intermediate goods combined into final good

Technologies for intermediate goods production:

- traditional technology: Cobb-Douglas CRS
- superstar technology: uses digital innovation to automate a fraction γ of 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 automates a fraction $\gamma_i \in (0, 1)$ of production tasks at negligible marginal cost
  - but that imposes a fixed cost $\xi_i \geq 0$
  - in baseline model: entrepreneur has *exclusive* right to the innovation (e.g. patent)
- The total and marginal cost functions of superstars are

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

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

Economic Effects of Superstar Technology

As an entrepreneur introduces a digital innovation/raises γ_i,

- she first out-competes traditional firms $\rightarrow$ superstar
- then profit margins rise with further digital innovation
- optimal markup is reached when $\gamma_i \geq 1/\epsilon$:
  $\rightarrow$ further cost savings passed on to consumers

Flip-side: demand for labor and wages:

- at first, decline due to cost savings
  $\rightarrow$ *labor-saving effect* of innovation
- then rise again as low cost generates more demand for output
  $\rightarrow$ *output scale effect* of innovation

Digital Innovation and Superstar Profits

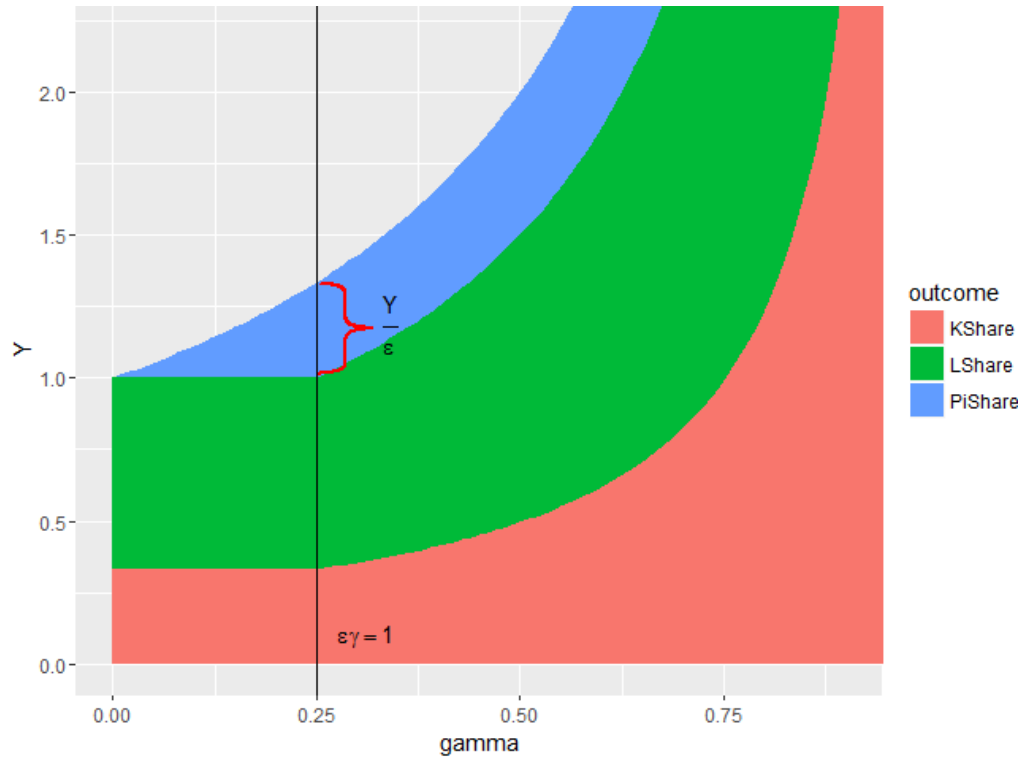


Figure: Digital innovation and aggregate factor shares

Note: asset prices also reflect PDV of superstar rents

Public Policy Implications

Proposition (Monopoly Distortions from Digital Innovation)

The free market economy suffers from

- *insufficient digital innovation*
- *inefficiencly low output*

Intuition: markups distort quantities and by extension innovation decision

Policy Remedies:

- 1st-best: use public investment to finance digital innovation
  $\rightarrow$ basic research should be public
- most other policy interventions have two-sided effects,
  e.g. breaking up monopolies, freeing information flows, etc.:
  - one the one hand, they reduce monopoly rents
  - on the other hand, they also reduce innovation

Digital Innovation and Factor Bias

Simple extension to focus on factor bias:

digital innovation ξ_i requires different factor inputs than traditional production

- typically intensive in higher-skilled labor, capital
- low-skilled labor experiences losses

Implications for International Affairs

First-order implications for international affairs:

Note: global superstars are global natural monopolies

If superstar and displaced traditional firms located in different countries:

- superstar countries experience most of the gains from progress
- other countries increasingly left behind
  (esp. developing countries without domestic superstars)

$\rightarrow$ introduces novel considerations for trade policy

Implications for Monetary Policy

Let me speculate on three implications:

1. falling labor demand but sticky nominal wages
   $\rightarrow$ transitional unemployment

2. redistribution from high-MPC workers to low-MPC superstars
   $\rightarrow$ lower natural interest rate

3. greater role for fixed cost & diminished role of variable costs
   $\rightarrow$ flatter Phillips curve

Superstars and Future Advances in AI

- the rise of human superstars is just the beginning
- *artificially intelligent agents* (AIAs)
  - are increasingly generating superstar rents of their own
  - and absorb them in the form of investment expenditure
  - while leaving regular human workers behind
- future economy increasingly "of the machines, by the machines, for the machines"

$\rightarrow$ see my paper on "The Rise of Artificially Intelligent Agents"

Conclusions

Information economy drives creation of superstars:

- digitization gives rise to natural monopolies
- generates large inequality
  (silver lining: limited by optimal monopoly markup)
- creates dilemmas for regulators and policymakers,
  and significant changes for monetary policy