A Theory of Falling Growth and Rising Rents

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Motivation

The U.S. economy in recent decades:

1. Slow growth (interrupted by a burst of growth)
2. Rising firm concentration within industries at the national level
3. Reallocation of market share to low labor share firms

Our story

Theory of endogenous growth with heterogeneous firms

IT improvements extend the boundary of high-productivity firms

High-productivity firms (with high markups and low labor shares) expand in response

This deters innovation and undermines long-run growth (after an initial burst of growth)

Related literature

Declining growth and rising concentration

De Ridder (2020), Liu et al. (2020), Akcigit & Ates (2019)

Rising concentration

Autor et al. (2020), Hsieh & Rossi-Hansberg (2020), Hopenhayn et al. (2019)

Reallocation to low labor share firms

Kehrig & Vincent (2020), De Loecker et al. (2020), Baqaee & Farhi (2020)

Our contribution: a model generating all three patterns (plus a temporary burst of growth) in response to increased span of control

Roadmap

Motivating facts

Theoretical framework

Quantification

- Steady state
- Transition dynamics

Trade and Services

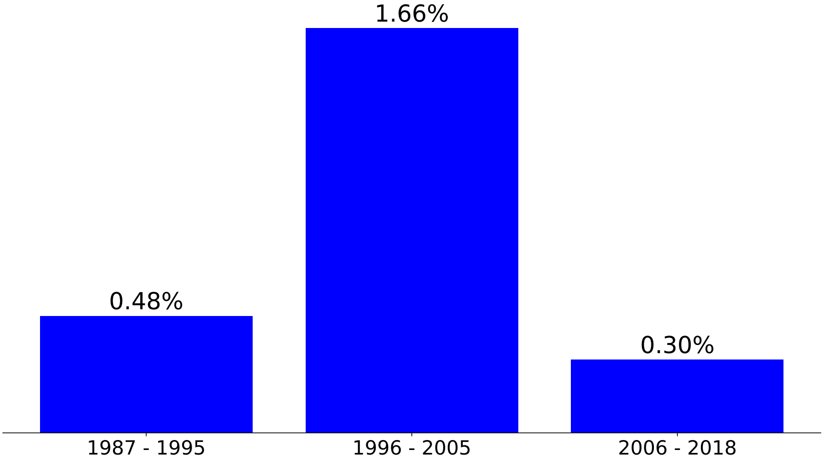
We focus on Retail Trade, Wholesale Trade, and Services

1/2 of value added, 2/3 of employment in nonfarm business sector

Guarantees coverage before 1992 for key ingredients

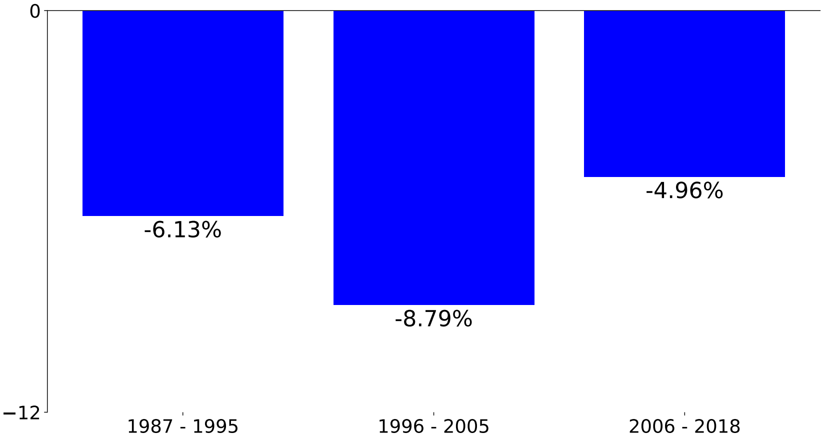
Excludes manufacturing (automation, China shock)

Rise and decline in TFP growth in Trade and Services



Source: BLS TFP growth + R&D and IP

Relative price of IT



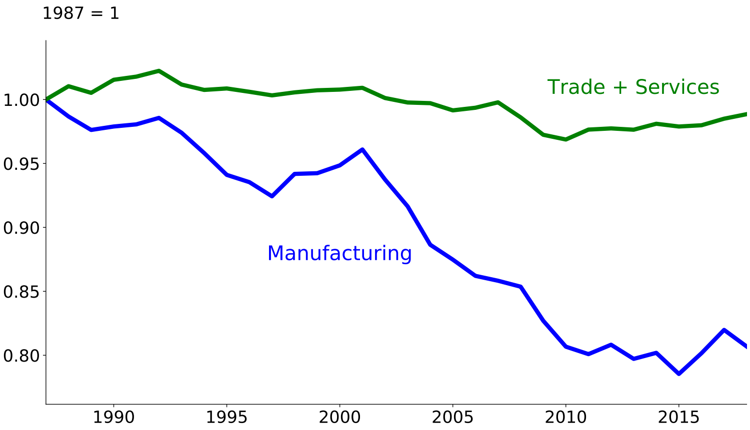
Source: BEA average annual growth rate of IT price relative to GDP deflator

Rising national concentration

	RET	WHO	SRV	ALL 3
Top 20 firms sales share in 1982	29	45	21	27
Top 20 firms sales share in 2012	46	57	27	35
Change	17	12	6	8

Source: Autor et al. (2020). ALL 3 =Retail + Wholesale + Services.

Labor share in Trade + Services vs. in Manufacturing



Source: U.S. Bureau of Labor Statistics KLEMS Dataset.

Cumulative change in labor share from 1982–2012 (in ppt)

	RET	WHO	SRV
$\Delta \frac{\text{Payroll}}{\text{Sales}}$	-0.85	-0.08	0.23
Within firms	4.39	4.66	1.73
Between firms	-5.44	-4.59	-0.76

Source: Autor et al. (2020).

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Model

Representative household with log utility

Final good produced competitively with Cobb-Douglas technology

Intermediate goods J firms

- exogenous and permanent difference in process efficiency:
  ϕ fraction with φ_H and $1-\phi$ with φ_L, $\frac{\varphi_H}{\varphi_L} = \Delta > 1$
- endogenous, evolving differences in product-specific quality: R&D spending of $\psi_r \cdot Y$ increases the frontier quality of a randomly drawn line by factor $\gamma > 1$
- per-period overhead cost for n products of $\boldsymbol{\psi_o} \cdot \frac{1}{2}n^2 \cdot Y$

Markup

Bertand competition within each line $\Rightarrow$ leading firm sets quality-adjusted price to the quality-adjusted marginal cost of the second best firm

Markup in a line with leader j and follower j', $\mu := \dfrac{p(j,j')}{w/\varphi(j)}$ is given by

$$\mu = \begin{cases} \gamma\Delta, & \text{if } j = H\text{-type}, j' = L\text{-type} \\ \gamma, & \text{if type of } j = \text{type of } j' \\ \gamma/\Delta, & \text{if } j = L\text{-type}, j' = H\text{-type} \end{cases}$$

Profits

Period profits of a firm producing in n lines and facing a share s of H-type competitors

H-type firms

$$\Pi_H(n,s) = \left[ns\left(1-\frac{1}{\gamma}\right) + n(1-s)\left(1-\frac{1}{\Delta\gamma}\right) - \psi_o \frac{1}{2}n^2\right] Y$$

L-type firms

$$\Pi_L(n,s) = \left[ns\left(1-\frac{\Delta}{\gamma}\right) + n(1-s)\left(1-\frac{1}{\gamma}\right) - \psi_o \frac{1}{2}n^2\right] Y$$

H-type firms have higher markups

Firm problem in steady state

Focus on steady state where the fraction of lines served by H-type firms $S^\star \in (0,1)$ and the rate of creative destruction $z^\star$ and hence $g^\star$ are both constant over time.

For H-type and L-type firms, respectively:

$$v_H(n) = \max_{n'} \left\{ \pi_H(n, S^\star) - \left[n' - n(1 - z^\star)\right] \psi_r + \beta v_H(n') \right\}$$

$$v_L(n) = \max_{n'} \left\{ \pi_L(n, S^\star) - \left[n' - n(1 - z^\star)\right] \psi_r + \beta v_L(n') \right\}$$

subject to

$$n' \geq n(1 - z^\star)$$

Steady state characterization

$(S^\star, z^\star, n_H^\star, n_L^\star)$ can be determined analytically from

$$\psi_r = \frac{1 - S^\star \frac{1}{\gamma} - (1 - S^\star)\frac{1}{\gamma \Delta} - \psi_o n_H^\star}{1/\beta - 1 + z^\star}$$

$$\psi_r = \frac{1 - S^\star \frac{\Delta}{\gamma} - (1 - S^\star)\frac{1}{\gamma} - \psi_o n_L^\star}{1/\beta - 1 + z^\star}$$

$$\phi J n_H^\star = S^\star, \quad (1 - \phi) J n_L^\star = 1 - S^\star$$

In steady state, H-type firms operate more lines and have lower labor share and higher average markup than L-type firms.

Steady state comparison: ψ_o drops

Recall overhead costs are $\boldsymbol{\psi_o}\frac{1}{2}n^2Y$ for a firm

How does the steady state change when $\boldsymbol{\psi_o}$ drops permanently to a lower level?

For a range of parameter values we see:

- An increase in concentration $S^\star$
- A decline in the aggregate labor share but an increase in within-firm labor shares
- A falling long run growth rate $g^\star$ and rate of creative destruction $z^\star$
- Rising rents as a share of GDP

Mechanism

Within firm markup *declines* as lower ψ_o raises $S^\star$ and hence the share of lines with a H-type follower $\rightarrow$ higher labor share within firms

Between firm markup component *increases* as lower ψ_o raises the share of products by H-types, who have higher markups $\rightarrow$ negative between change in labor share

Direct effect on growth: more incentive to innovate as lower ψ_o raises the marginal value of innovating on an additional line.

GE effect on growth: less incentive to innovate as lower ψ_o raises $S^\star$ and reduces expected markup *within* each product line.

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Quantification

Overall strategy:

- Calibrate baseline parameter values to initial period (before the 1996–2005 burst)
- Calibrate changes in $\boldsymbol{\psi_o}$, ψ_r and Δ to match the changes in concentration, productivity growth, and relative markups
- See how the $\boldsymbol{\psi_o}$ change alters the growth rate for 1996–2005 and 2006 onward

Calibration targets for the initial steady state

Targeted	Years	Data	Model
1. percentile of top 20 firms	1987	0.137	0.137
2. concentration	1987	26.7	26.7
3. productivity growth	1987–1995	0.48	0.48
4. price/cost markup	1988–2015	1.25	1.25
5. real interest rate	1980–1995	6.10	6.10
6. semi-elasticity of labor share wrt sales	1987	-2.18	-2.18

Sources: 1 and 2: Autor et al. (2020). 3: BLS KLEMS series. 4: Hall (2018). 5: Farhi and Gourio (2018). 6: Autor et al. (2020), and relative to the aggregate labor share.

Parameter values for the initial steady state

Calibrated	Parameter	Value
1. overhead costs	ψ_o^0	0.050%
2. R&D costs	ψ_r^0	2.201
3. productivity gap	Δ	1.134
4. quality step	γ	1.249
5. discount factor	β	0.947
6. share of H-type firms	ϕ	0.137%

Calibrated change in parameter values to fit the ending steady state

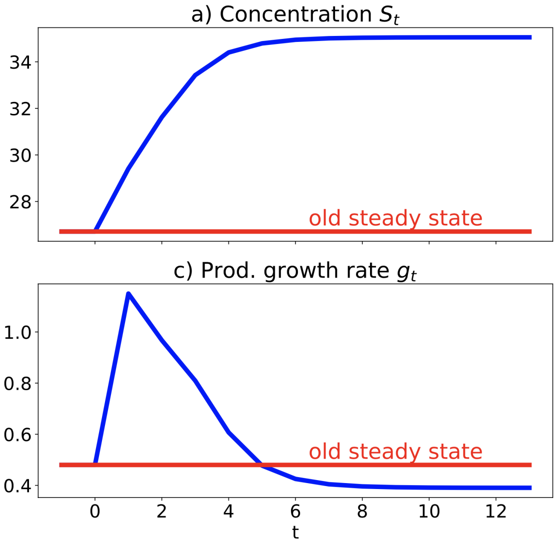
	Change	Targeted change	Data	Model
1. overhead costs ψ_o	–23.1%	concentration	8.3	8.3
2. R&D costs ψ_r	+5.8%	productivity growth	–0.18	–0.18
3. efficiency gap Δ	0%	relative markup	0	0

Sources: 1: Autor et al. (2020), change in the sales share of the top 0.137% firms between 1987 and 2012. 2: BLS KLEMS. 3: Autor et al. (2020), change in revenue per worker of the top 0.137% firms relative to the rest of the firms.

Contribution of overhead costs to the decline in steady state growth (in basis points)

	change in g
1. Both ψ_o falling and ψ_r rising	–18.0
2. Only ψ_r changing	–9.4
3. 1. minus 2.	–8.6
4. Only ψ_o changing	–8.9
5. ψ_o contribution (average of 3 and 4)	**–8.8**

Transition after $\psi_o \downarrow$



Contribution of the decline in ψ_o to the growth burst (in percentage points)

	Acceleration	Deceleration
Data	1.18	–1.36
1. Both ψ_o falling and ψ_r rising	0.04	–0.22
2. Only ψ_r changing	–0.09	0.00
3. 1. minus 2.	0.13	–0.22
4. Only ψ_o changing	0.12	–0.21
5. ψ_o contribution (average of 3 and 4)	**0.13**	**–0.22**

Welfare

Utility from a consumption path:

$$U(\{C_t\}_{t=0}^{\infty}) = \sum_{t=0}^{\infty} \beta^t \ln C_t$$

Consumption-equivalent variation ξ:

$$U(\{(1+\xi)\, C_t^{old}\}_t) = \frac{\ln(1+\xi)}{1-\beta} + U(\{C_t^{old}\}_t) = U(\{C_t^{new}\}_t)$$

ξ = % change in welfare from lowering ψ_o

Change in welfare (in percent) in response to lower ψ_o

	change in ξ
1. Both ψ_o falling and ψ_r rising	–0.57%
2. Only ψ_r changing	–1.01%
3. 1. minus 2.	0.43%
4. Only ψ_o changing	0.28%
5. ψ_o contribution (average of 3 and 4)	**0.36%**

Conclusion

We provide an endogenous growth theory built around firms with heterogeneous quality, process efficiency, and markups

As firm span of control increases, the theory predicts:

- A rise in concentration
- A reallocation of market share to firms with low labor shares
- A fall in TFP growth after an initial burst

The burst outweighs the fall in long run growth, leaving welfare modestly higher

Backup Slides

Dynamic firm problem

A firm with $n_t(j)$ highest quality patents and facing a share $s_t(j)$ of high-productivity competitors solves

$$
\begin{aligned}
V_t(n_t(j), s_t(j), S_t, \alpha_t, j) \quad = \quad & \max_{x_t(j), n_{t+1}(j), s_{t+1}(j)} \{\Pi_t(n_t(j), s_t(j), \alpha_t, j) \\
& - x_t(j)\psi_r Y_t P_t \\
& + \frac{1}{1+r_t} V_{t+1}(n_{t+1}(j), s_{t+1}(j), S_{t+1}, \alpha_{t+1}, j)\}
\end{aligned}
$$

s.t.

$$x_t(j) = n_{t+1}(j) - n_t(j)(1 - z_{t+1})$$

$$n_{t+1}(j)s_{t+1}(j) = s_t(j)n_t(j)(1 - z_{t+1}) + x_t(j)S_t$$

and

$$x_t(j) \geq 0$$

Decreasing cost of IT and rise of intangible investments

- Falling cost of IT
  - BEA IT deflator / GDP deflator
- Rising intangibles investment of large vs. small firms
  - Lashkari, Bauer and Boussard (2019)
  - Crouzet and Eberly (2019)
  - Bessen (2019)
  - Babina, Fedkyk, He and Hodson (2020)

How our story is distinct

Two of the closest papers in the literature:

- Akcigit and Ates (2019)
- De Ridder (2020)
- Liu, Mian and Sufi (2020)

We differ in

- our driving force
- generating opposite trends for labor's share (and markups) within versus across firms
- generating/emphasizing an initial burst of growth before the growth slowdown

A complementary paper

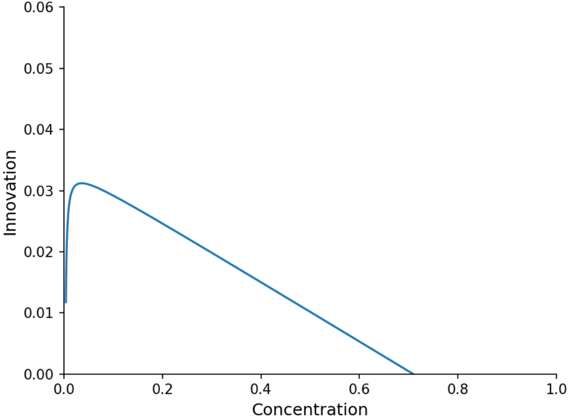
Hsieh and Rossi-Hansberg (2020):

- IT lowers marginal costs, raises fixed costs
- firms expand into more locations, raising national concentration
  - document this for Trade + Services
- boosts productivity (transitional growth)

We differ in having:

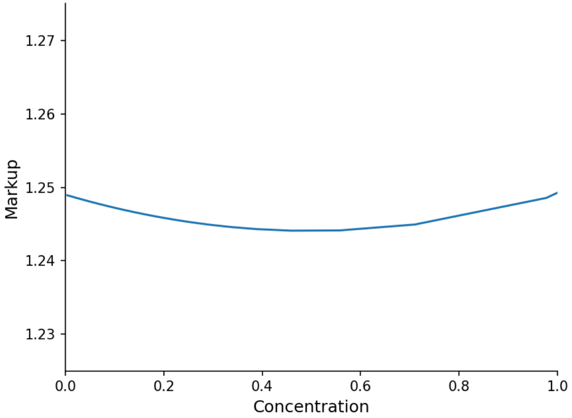
- markup dispersion
- within and between markup changes
- falling long run growth

Steady state rate of creative destruction and concentration



Note: Steady state values for S^* and z^* as ψ_o changes, holding fixed other parameters at the baseline values.

Steady state aggregate markup and concentration



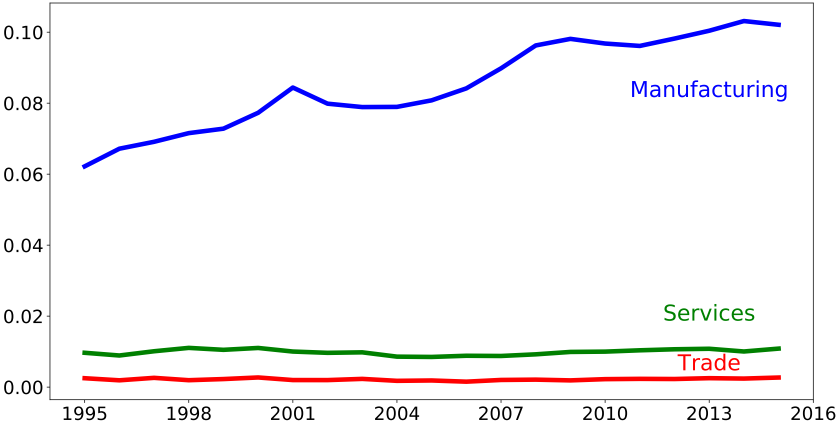
Note: Steady state values for S^* and μ^* as ψ_o changes, holding fixed other parameters at the baseline values.

Steady state change in labor's share (in percentage points)

	Total	Within	Between
Data change over 1987–2012	0.55	10.55	-10.01
Model 2006–onward vs. pre-1995	0.05	1.11	-1.06

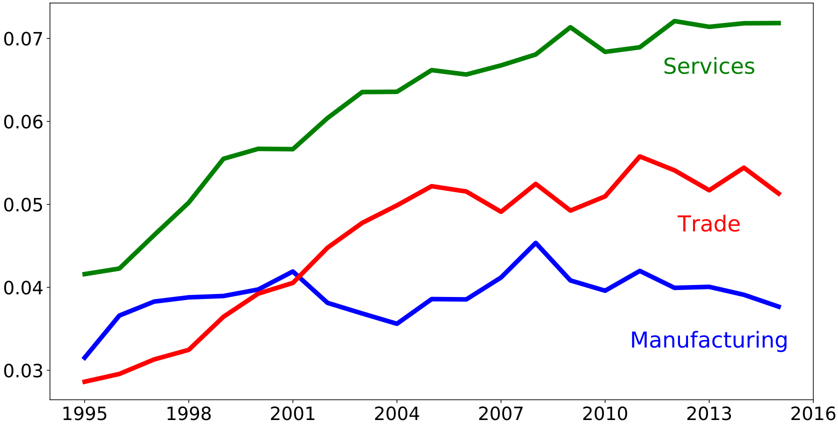
Source: Autor et al. (2020) data for Trade and Service industries.

R&D intensity



Source: Intan Invest database. RD investment divided by industry value added.

Intangibles



Source: Intan Invest database. Software and organizational capital investment divided by industry value added.