The Rise of Market Power and the Macroeconomic Implications

Jan De Loecker[1] Jan Eeckhout[2] Gabriel Unger[3]

[1]KU Leuven, NBER and CEPR
[2]University College London and UPF
[3]Harvard

IIES
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Motivation

- Several secular trends in last decades
- Market Power: common cause?
- Little known about evolution & cross-section markup in macro
  1. Data needed: long time series of firm-level data
  2. Estimation methods: demand approach uses model of consumer behavior and competition
- This paper:
  1. Document time-series and cross section of markup 1955-2016
  2. Cost-based method; no inference from demand; mkt structure
  3. Macro Implications: secular trends
- Today, do not focus on causes of change in markup Causes?

Data

- Accounting data on publicly listed firms:
  - Long time series: 1955–2016
  - Broad Cross Section: average 5,000 firms per year
- Selection?
  - Large firms; miss many small firms
  - Small subset of all firms
  - Publicly traded $\neq$ privately held firms
- But:
  - Covers all sectors and industries (contrast: Cens. of Manuf.)
  - 30% of US employment (Cens. of Manuf. 8.8%)

$\Rightarrow$ Allow for markup variation across producers and time; heterogeneity has substantial economic implications

Estimating Markups

- Two steps:
  1. Estimate Production Function: different models
  2. Derive Markup
- Important Caveats about the method:
  1. Frictionless adjustment (variable inputs) – ideally, e.g. electricity
  2. Use 'Cost of Goods Sold' as a variable input *bundle*
  3. Construct 'User Cost of Capital'
  4. Markup = Market Power?

▸ Intangibles?

- Cost vs. Demand approach: De Loecker-Scott (2016)
  Beer industry $\rightarrow$ similar estimates $\mu \approx 1.5$ (7 case studies Appendix)

Producer Behavior

- Production technology
$$Q_{it}(\boldsymbol{V}_{it}, K_{it}, \Omega_{it}) = F_{it}(\boldsymbol{V}_{it}, K_{it})\Omega_{it},$$
  - $\boldsymbol{V}_{it}$: variable inputs (labor, intermediate inputs)
  - K_{it}: capital stock
  - Ω_{it}: Hicks-neutral productivity term (TFP)
- Associated Lagrangian function (with *one* composite input):
$$\mathcal{L}(V_{it}, K_{it}, \lambda_{it}) = P_{it}^{V} V_{it} + r_{it} K_{it} - \lambda_{it}(Q_{it}(\cdot) - Q_{it})$$
- Consider FOC wrt the variable input V:
$$\frac{\partial \mathcal{L}_{it}}{\partial V_{it}} = P_{it}^{V} - \lambda_{it} \frac{\partial Q_{it}(\cdot)}{\partial V_{it}} = 0$$
- Rearranging $\Rightarrow$ expression of output elasticity of input V_{it}:
$$\theta_{it}^{V} \equiv \frac{\partial Q_{it}(\cdot)}{\partial V_{it}} \frac{V_{it}}{Q_{it}} = \frac{1}{\lambda_{it}} \frac{P_{it}^{V} V_{it}}{Q_{it}}$$

Producer Behavior

- Lagrangian multiplier λ is a direct measure of marginal cost
- Define markup $\mu = \frac{P}{\lambda}$ or

$$\mu_{it} = \theta_{it}^{V} \frac{P_{it} Q_{it}}{P_{it}^{V} V_{it}}.$$

  depending on Sales $S_{it} = P_{it} Q_{it}$ and expenditure share θ_{it}^{V}, which is specific to technology
- Method:
  - Hall (1988): aggregate data
  - De Loecker-Warzynski (2012): micro data

Estimating markups

$$\mu_{it} = \theta_{it}^{V} \frac{P_{it} Q_{it}}{P_{it}^{V} V_{it}}.$$

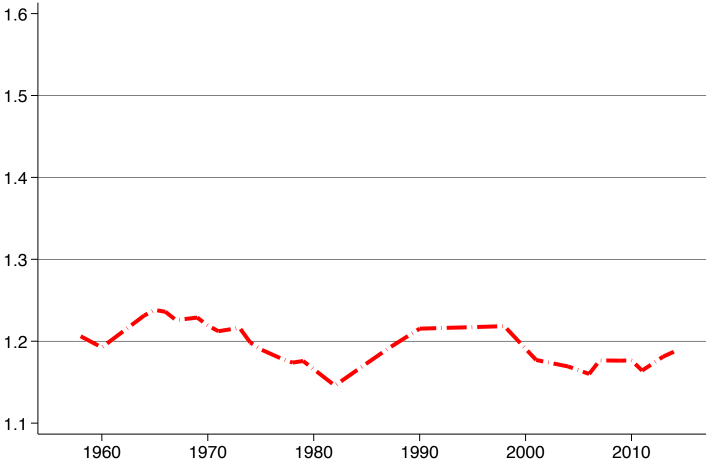
- The method relies heavily on the data: sales/input expenditure
- Ratio is scaled by elasticity, $\theta(\beta)$:
  1. Estimate production function (parametric):
     1.1 Benchmark: time, sector-varying Cobb-Douglas ($q_{it} = x\beta_{st} + \omega_{it}$)
     1.2 Constant by sector/year, ($q_{it} = x\beta + \omega_{it}$)
     1.3 Firm/time specific: Translog ($q_{it} = x\beta_{1,s} + x^2\beta_{2,s} + \omega_{it}$)

     With correction for unanticipated shocks to output (ξ) Estimation
  2. Estimate cost-shares ("non-parametric", but... CRTS CD)
- Average markup (weighted by sales share m_{it}):

$$\mu_t = \sum_i m_{it} \mu_{it}$$

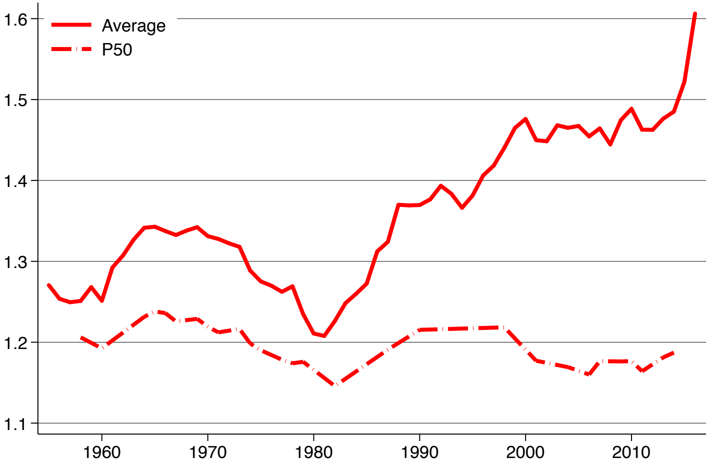
Benchmark

No Change...



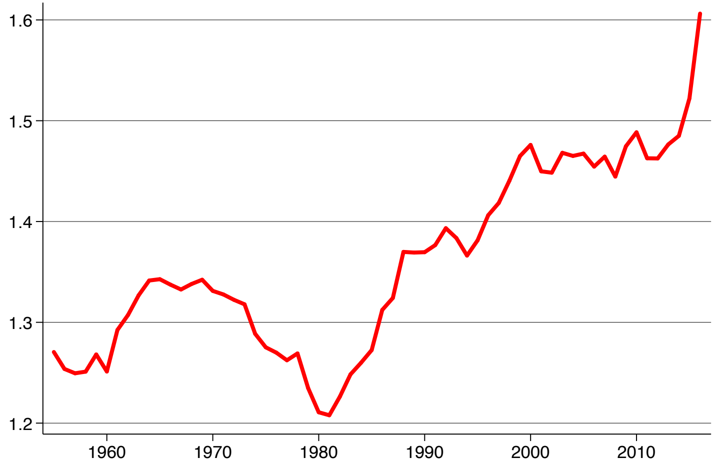
Benchmark

No Change... in median markup



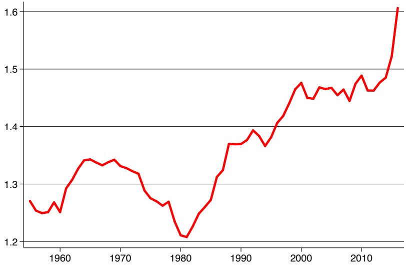
Benchmark

Secular Increase since 1980: +40 pts

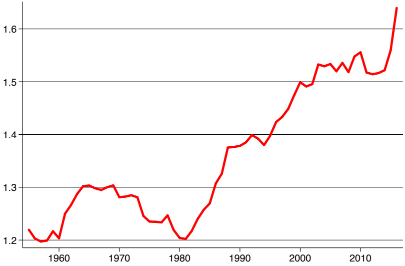


Different Estimates for θ_{it}

Benchmark



Constant θ



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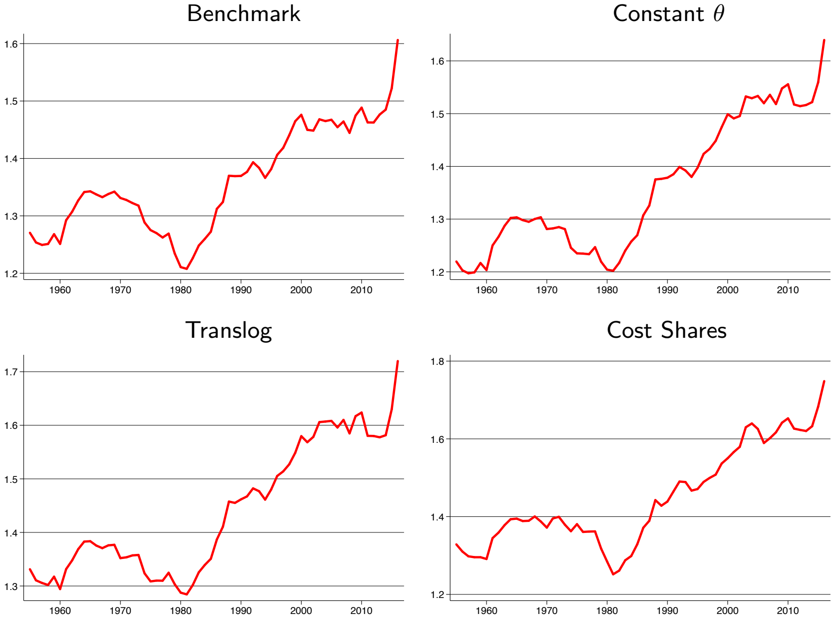
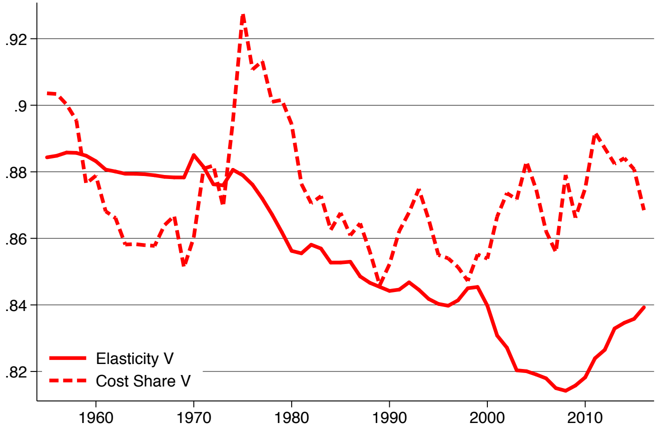


Evolution of Elasticities and Cost Shares

$$\frac{p^V V}{p^V V + rK} \text{ and } \theta^V$$



Overhead

- Conventional production function: treat overhead as a fixed cost ("overhead is necessary, but does not increase units manufactured")

$$\Pi = PQ(V, K) - p^V V - rK - F$$

Overhead

- Conventional production function: treat overhead as a fixed cost ("overhead is necessary, but does not increase units manufactured")

$$\Pi = PQ(V, K) - p^V V - rK - F$$

vs.

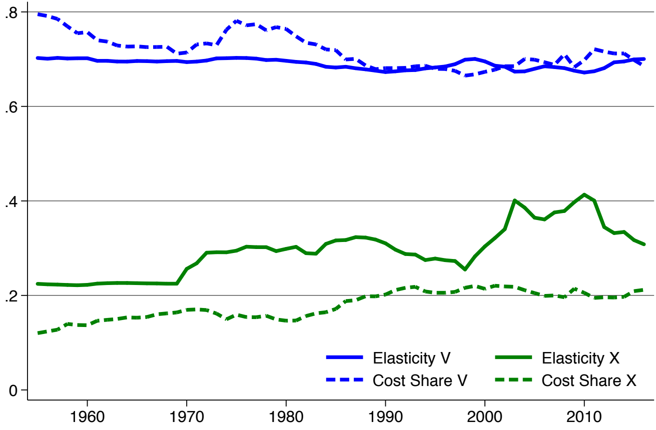
$$\Pi = PQ(V, K, X) - p^V V - rK - p^X X$$

- Overhead as an input of production: $Q(V, K, X)$ where $p^X X = F$
- In accounting, SG&A: Selling, General & Administrative Expenses
- Shed light on rise of Intangible Capital (e.g. Corrado, Hulten, Sichel)

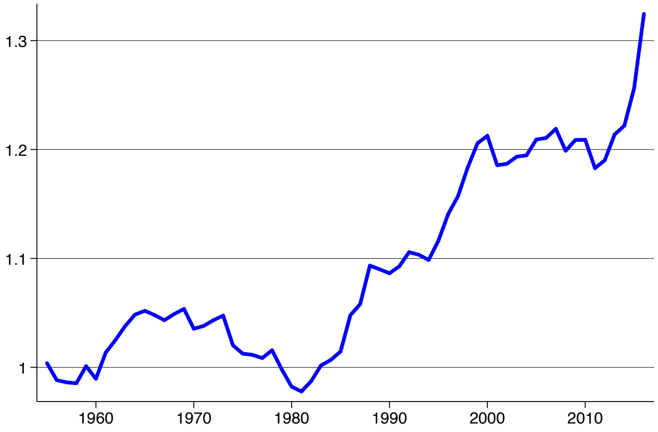
Overhead

Evolution of Elasticities and Cost Shares

$$\frac{p^V V}{p^V V + rK + p^X X} \text{ and } \theta^V$$

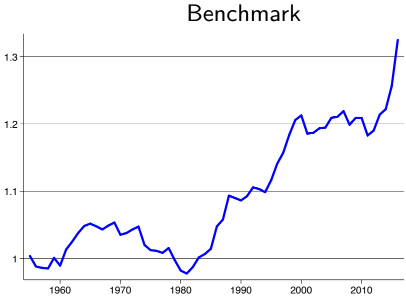


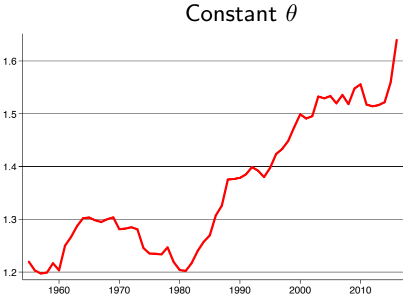
Production Function: Overhead as Factor



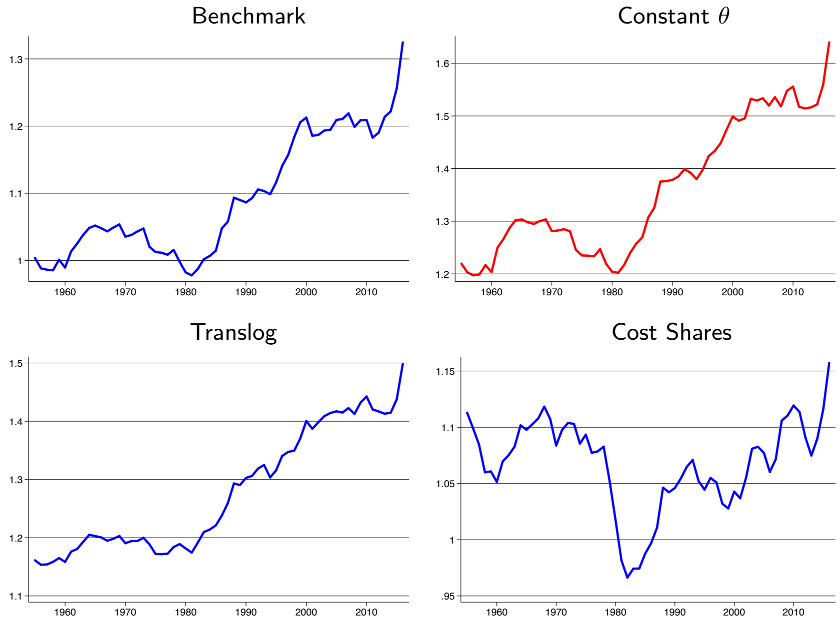
+30 ppt (+40 ppt under traditional PF)

Different Estimates for θ_{it}



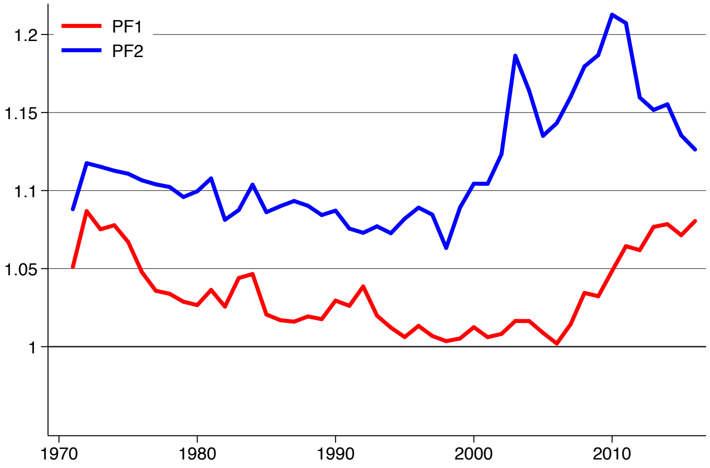


Different Estimates for θ_{it}



Returns to Scale

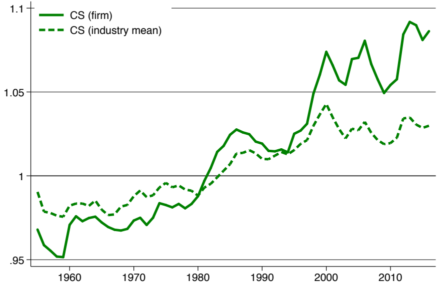
Estimated PF Technologies



Returns to Scale

Syverson (2004)

$$q = \gamma\left[\alpha_V v + \alpha_K k + \alpha_X x\right] + \omega$$



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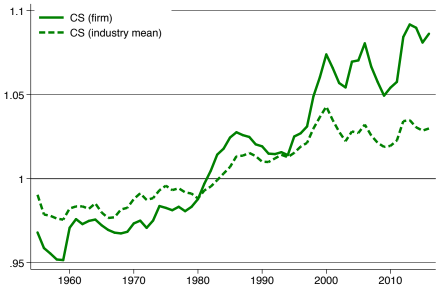
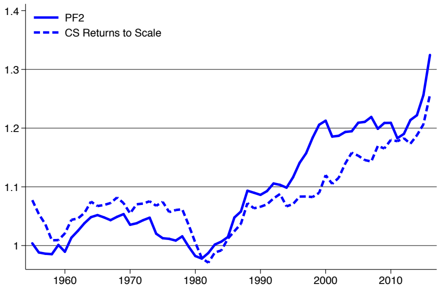
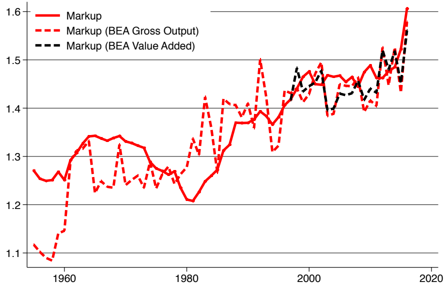
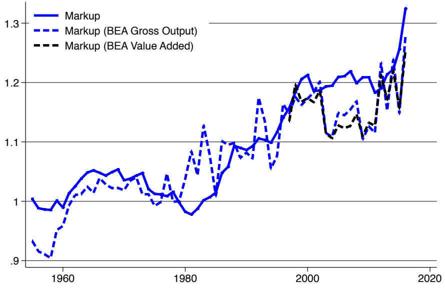




Representativeness of Sample

BEA Economy-wide Weights





Predominantly Within Industry

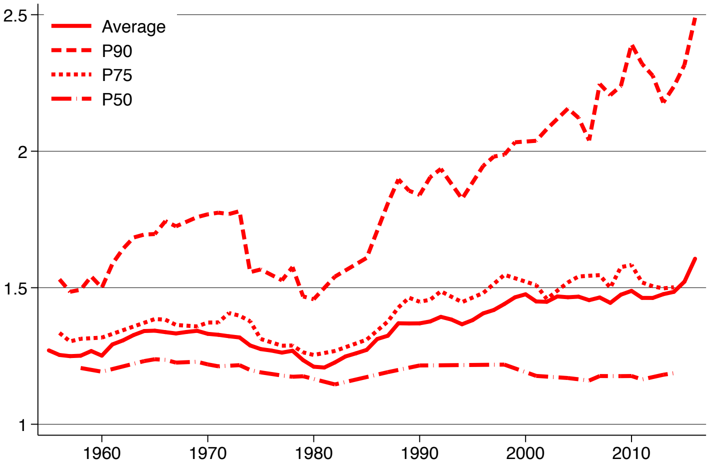
In **All** Sectors (2-digit)

$$\Delta U_t = \underbrace{\sum_s s_{s,t-1}\Delta\mu_{st}}_{\Delta \text{ within}} + \underbrace{\sum_s \mu_{s,t-1}\Delta s_{s,t}}_{\Delta \text{ between}} + \underbrace{\sum_s \Delta\mu_{s,t}\Delta s_{s,t}}_{\Delta \text{ reallocation}}.$$

	Markup	Δ Markup	Δ Within	Δ Between	Δ Realloc.
1966	1.337	0.083	0.057	-0.017	0.041
1976	1.270	-0.067	-0.055	0.002	-0.014
1986	1.312	0.042	0.035	0.010	-0.003
1996	1.406	0.094	0.098	0.004	-0.008
2006	1.455	0.049	0.046	0.007	-0.005
2016	1.610	0.154	0.133	0.014	0.007

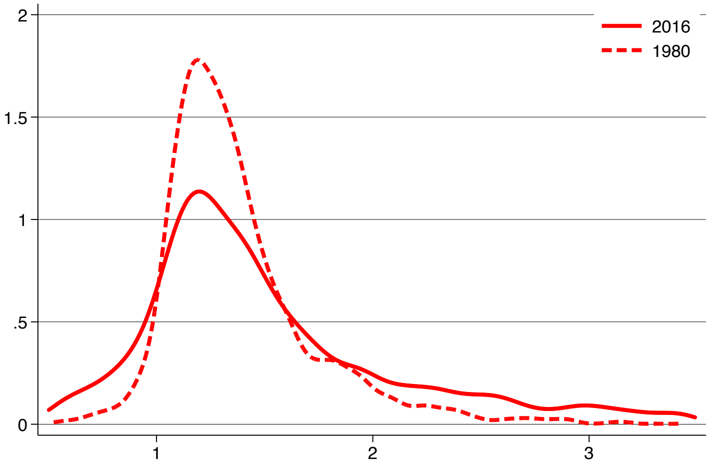
Dispersion of Markup

All Action in Upper Half Distribution



Dispersion of Markup

Kernel Density 1980, 2016



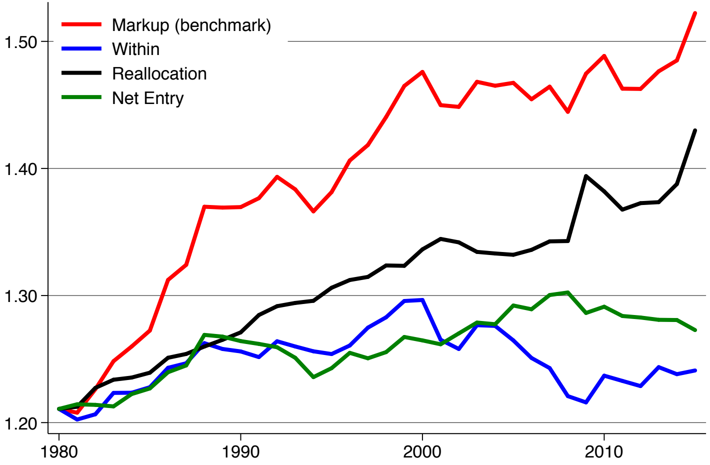
Markup vs. Reallocation

Decomposition at the Firm Level

$$\Delta\mu_t = \underbrace{\sum_i m_{i,t-1}\Delta\mu_{it}}_{\Delta \text{ within}} + \underbrace{\sum_i \mu_{i,t-1}\Delta m_{i,t}}_{\Delta \text{ market share}} + \underbrace{\sum_i \Delta\mu_{i,t}\Delta m_{i,t}}_{\Delta \text{ cross-term}}$$

$$+ \underbrace{\sum_{i\in \text{Entry}} \mu_{i,t} m_{i,t} - \sum_{i\in \text{Exit}} \mu_{i,t-1} m_{i,t-1}}_{\text{net entry}}$$

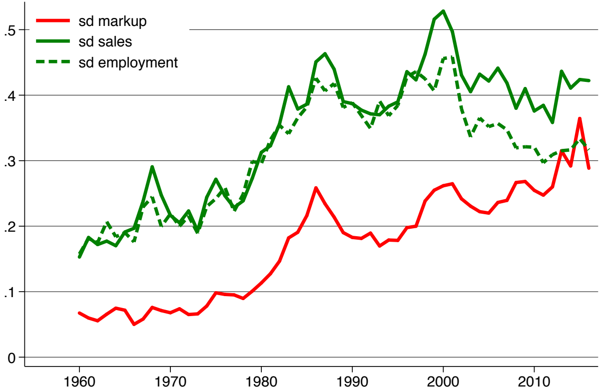
Markup and Firm Size



The Process of Markups

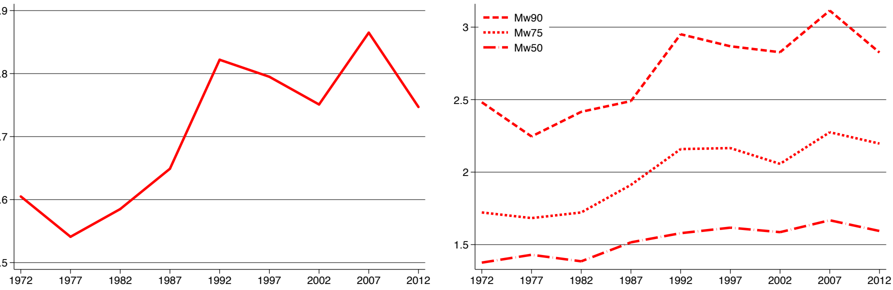
Suppose markup, sales and employment follow an AR process ($\hat{\rho} = 0.84$):

$$x_{it} = \rho x_{it-1} + \varepsilon_{it}, \quad x \in \{\log \mu, \log S, \log L\}$$



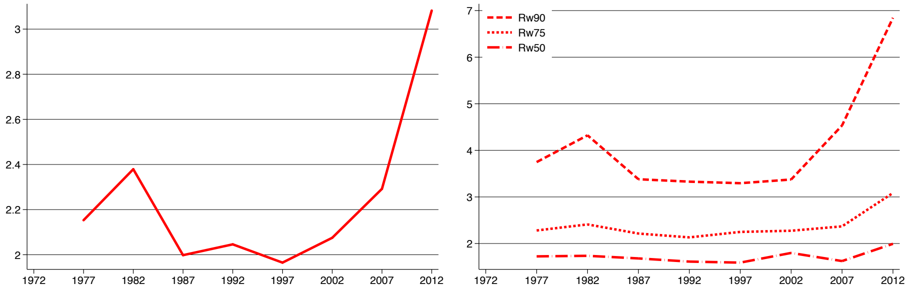
Robustness: US Censuses

Manufacturing



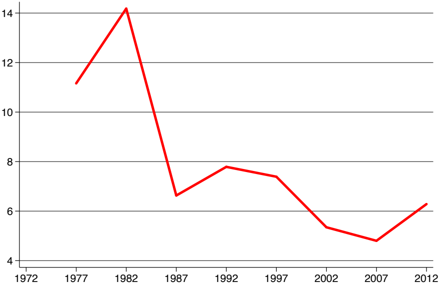
Robustness: US Censuses

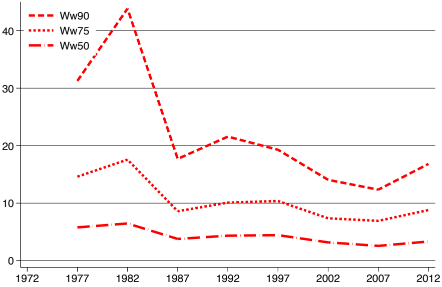
Retail



Robustness: US Censuses

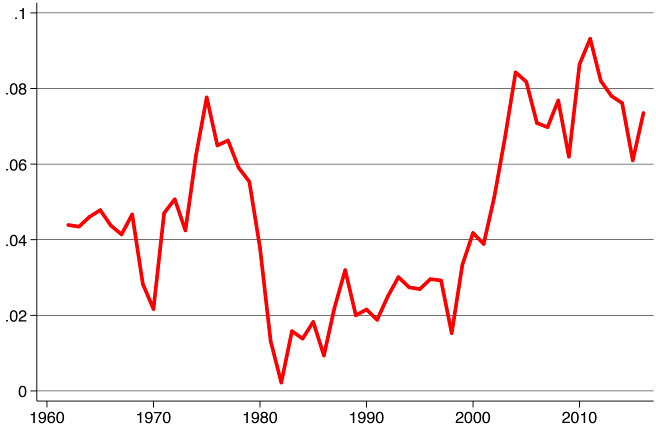
Wholesale





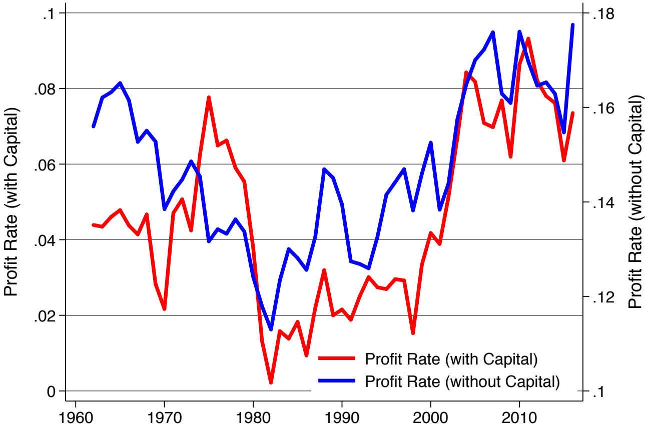
Markup = Market Power?

Profit Rate: + 7 ppt



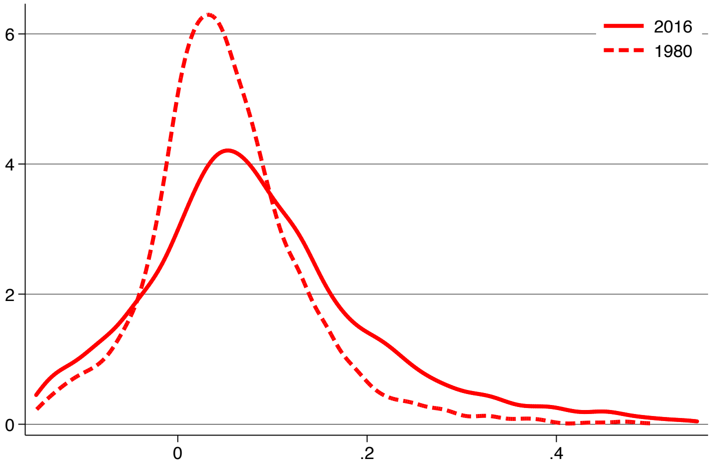
Markup = Market Power?

Profit Rate: No Capital



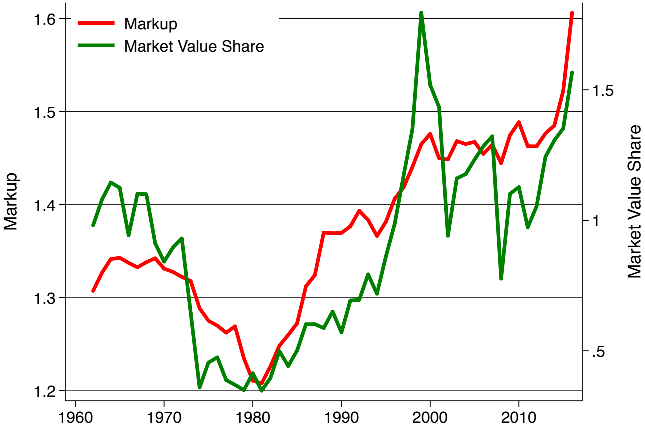
Markup = Market Power?

Profit Rate: Kernel Density



Markup = Market Power?

Market Value



Markup = Market Power?

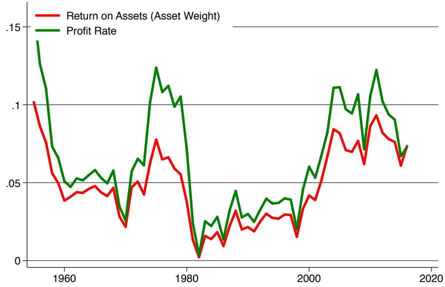
At the Firm Level

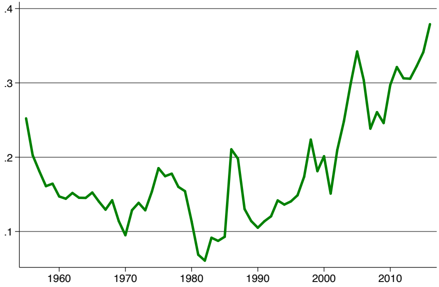
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\ln\left(\frac{\text{Market Value}}{\text{Sales}}\right)$				ln(Market Value)			
ln(Markup PF1)	0.71	0.64	0.56	0.17	0.71	0.65	0.58	0.27
	(0.03)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
ln(Sales)					0.81	0.81	0.83	0.68
					(0.00)	(0.00)	(0.00)	(0.01)
Year Fixed Effects		Y	Y	Y		Y	Y	Y
Sector Fixed Effects			Y				Y	
Firm Fixed Effects				Y				Y
R^2	0.05	0.13	0.21	0.68	0.68	0.71	0.73	0.89

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\ln\left(\frac{\text{Dividends}}{\text{Sales}}\right)$				ln(Dividends)			
ln(Markup PF1)	1.05	0.97	0.80	0.26	1.03	0.93	0.78	0.26
	(0.04)	(0.03)	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)	(0.05)
ln(Sales)					0.94	0.92	0.93	0.76
					(0.01)	(0.01)	(0.01)	(0.02)
Year Fixed Effects		Y	Y	Y		Y	Y	Y
Sector Fixed Effects			Y				Y	
Firm Fixed Effects				Y				Y
R^2	0.06	0.11	0.17	0.70	0.66	0.68	0.70	0.89

Markup = Market Power?

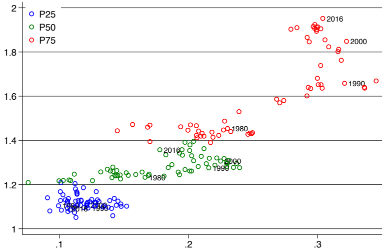
Return on Assets

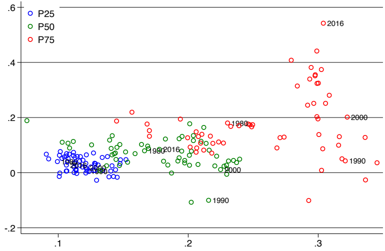




Markup = Market Power?

Profits and SG&A





Markup = Market Power?

Profits and SG&A

	Markup (log)			Profit Rate (log)	
	(1)	(2)	(3)	(4)	(5)
SG&A (log)	0.56			0.15	
	(0.01)			(0.03)	
R&D Exp. (log)		0.16			0.10
		(0.01)			(0.01)
Advertising Exp. (log)		0.05			0.03
		(0.00)			(0.01)
R&D dummy			0.06		
			(0.01)		
Advertising dummy			-0.00		
			(0.03)		
R^2	0.61	0.07	0.43	0.04	0.05
N	26,743		247,615	26,743	

Magnitude of Increase

Profit Rate vs Markup

- The profit rate:

$$\pi_{it} = \frac{P_{it}Q_{it} - C(Q_{it})}{P_{it}Q_{it}} = 1 - \frac{1}{\mu_{it}}\frac{AC_{it}}{MC_{it}}$$

$\Rightarrow$ With μ : 1.2 $\rightarrow$ 1.6, implied profit rate in 2016 is 50% of sales

Magnitude of Increase

Profit Rate vs Markup

- The profit rate:

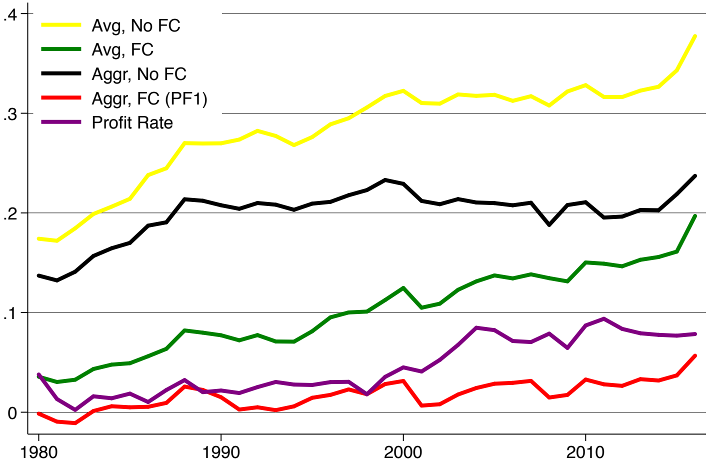
$$\pi_{it} = \frac{P_{it}Q_{it} - C(Q_{it})}{P_{it}Q_{it}} = 1 - \frac{1}{\mu_{it}}\frac{AC_{it}}{MC_{it}}$$

$\Rightarrow$ With $\mu : 1.2 \to 1.6$, implied profit rate in 2016 is 50% of sales

- This logic uses:
  1. Representative Firm Economy: but Aggregation (Jensen's Inequality)
  2. Returns to Scale constant: but $\frac{AC_{it}}{MC_{it}} \uparrow$ (Overhead $\uparrow$)

Magnitude of Increase

Profit Rate vs Markup



Magnitude of Increase

Profit Rate vs Markup

- Markups based on COGS *and* SG&A: $V + X$?
- Then

$$\tau_{it} = \theta^{V+X} \frac{PQ}{p^V V + p^X X}$$

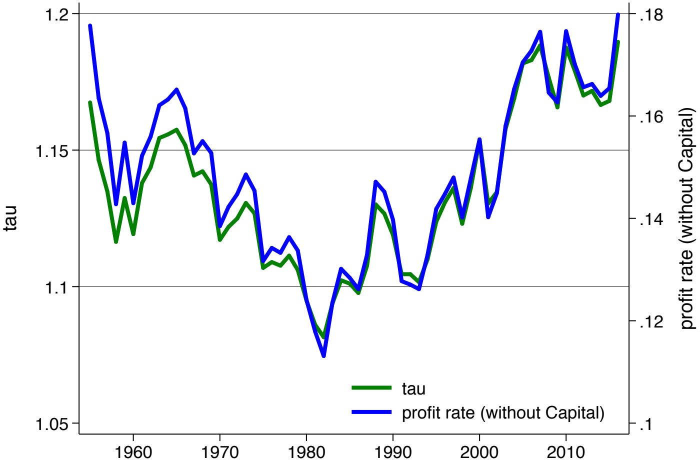
measure proposed by James Traina

- τ equivalent to (operating) profit rate $\pi^k = \frac{PQ - p^V V - p^X X}{PQ}$:

$$\tau_{it} = \theta^{V+X} \frac{1}{1 - \pi^k_{it}}$$

Magnitude of Increase

Profit Rate vs Markup

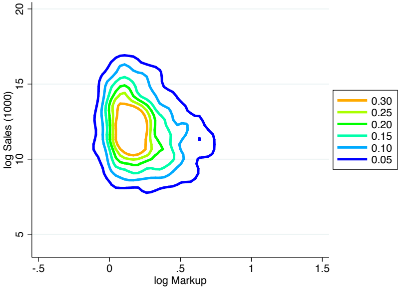


Summary of Facts

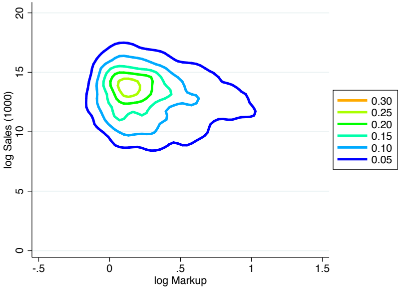
1. Markup $\neq$ Profit Rate
   - Markup since 1980: $+30-40$ points
   - Profit rate since 1980: $+7-8$ points
2. Driven by Heterogeneity:
   - Only in the upper half of distribution (P90 $\uparrow\uparrow$; P50 constant)
   - Mostly within industry (in all; no particular industries)
   - Substantial Reallocation: 2/3 of rise

Summary of Facts

Joint Distributions



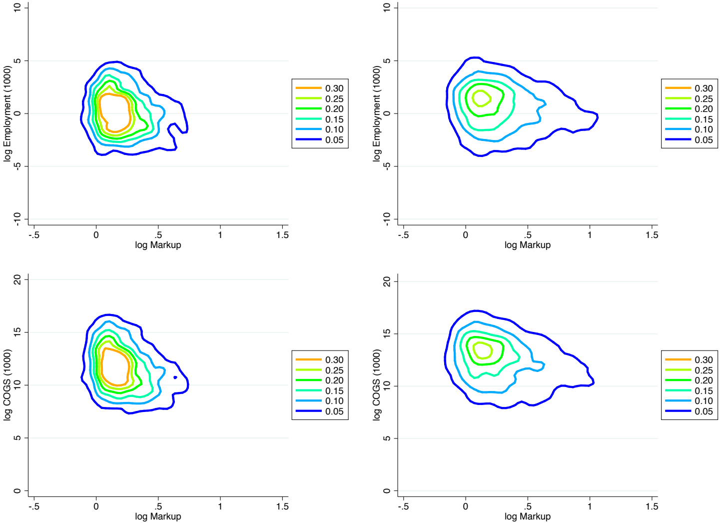
1980



2016

Summary of Facts

Joint Distributions

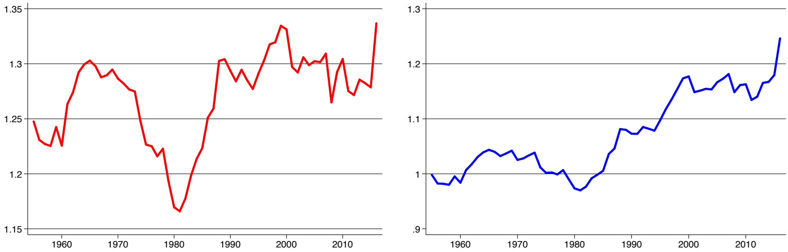


1980

2016

Summary of Facts

Input Weights



Global Markup

134 countries; 70,000 firms; 1980-2016

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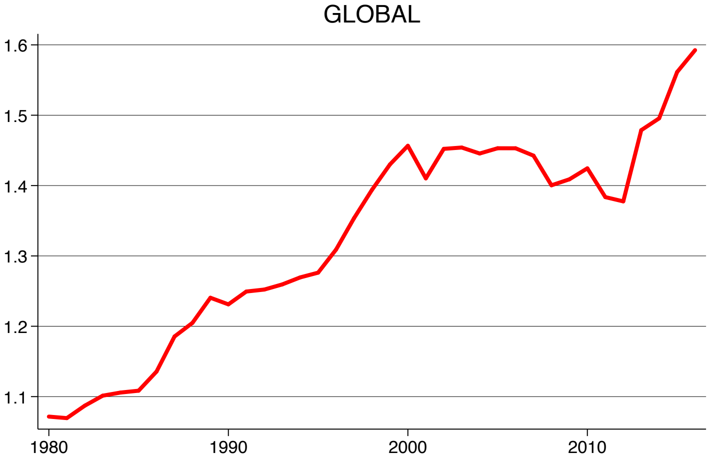
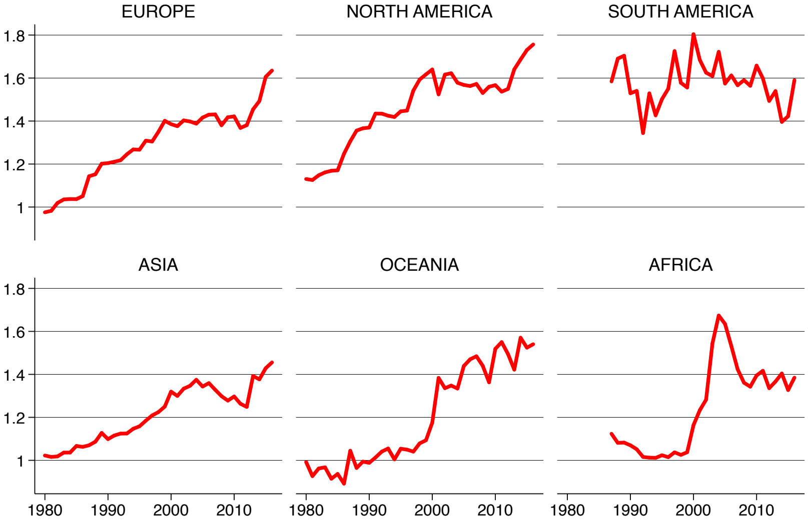
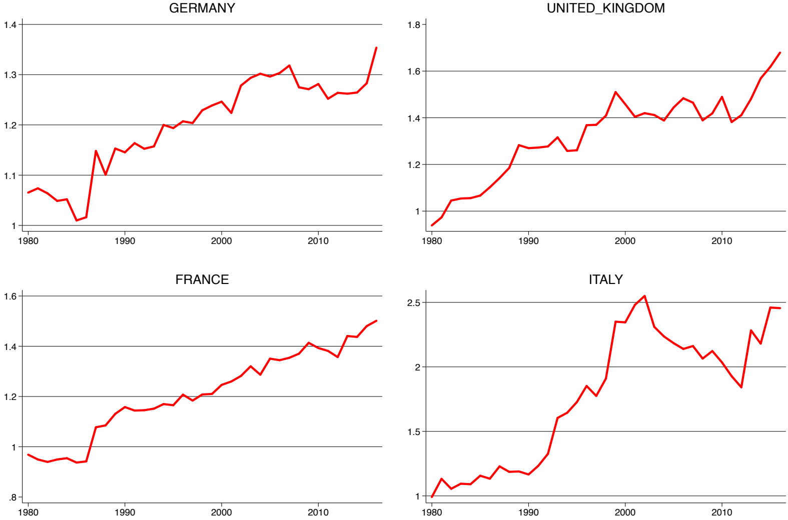


Markup Continents

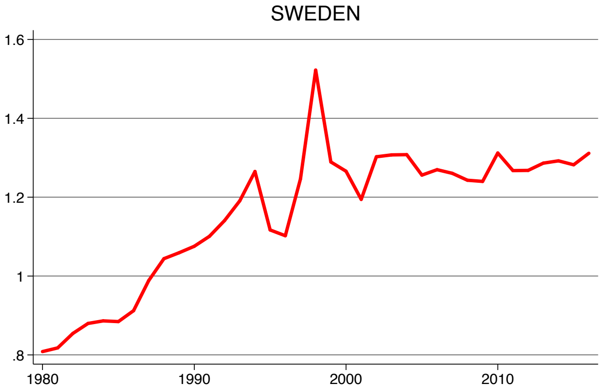


Europe



GERMANY
1.4
1.3
1.2
1.1
1
1980
1990
2000
2010
UNITED_KINGDOM
1.8
1.6
1.4
1.2
1
1980
1990
2000
2010
FRANCE
1.6
1.4
1.2
1
.8
1980
1990
2000
2010
ITALY
2.5
2
1.5
1
1980
1990
2000
2010

SWEDEN



Macroeconomic Implications

Decline in Labor Share

$$\mu_{it} = \theta_{it}^{V} \frac{P_{it} Q_{it}}{P_{it}^{V} V_{it}} \quad \overset{V=L}{\Longrightarrow} \quad \frac{w_t L_{it}}{S_{it}} = \frac{\theta_{it}^{L}}{\mu_{it}}$$

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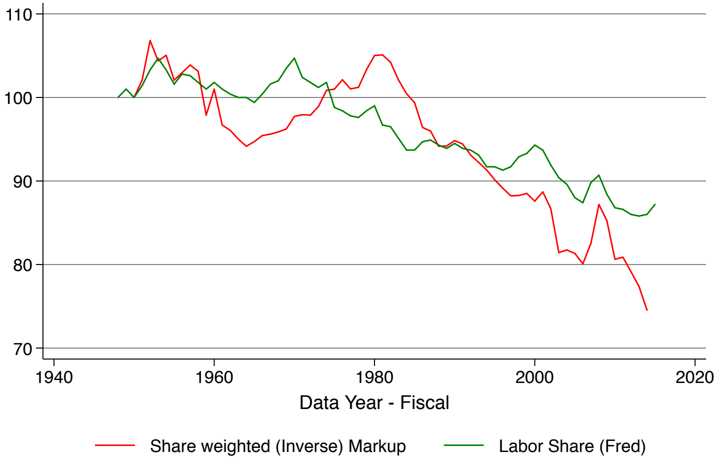


Decline in Labor Share

Relation at Firm Level?

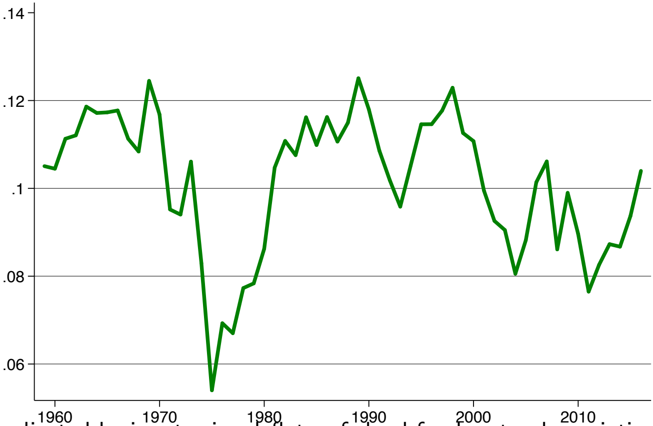
	Labor Share (log)			
	(1)	(2)	(3)	(4)
Markup (log)	-0.24	-0.23	-0.20	-0.24
	(0.03)	(0.03)	(0.03)	(0.03)
Year F.E.		X	X	X
Industry F. E.			X	
Firm F.E.				X
R^2	0.02	0.08	0.21	0.88

Decline in Capital Share

$$K \text{ variable} \quad \overset{V=K}{\Rightarrow} \qquad \frac{r_t K_{it}}{S_{it}} = \frac{\theta_{it}^k}{\mu_{it}}$$

Decline in Capital Share

$$K \text{ variable} \overset{V=K}{\Rightarrow} \qquad \frac{r_t K_{it}}{S_{it}} = \frac{\theta^k_{it}}{\mu_{it}}$$



Gross Capital adjusted by input price deflator, federal funds rate, depreciation rate 12%.

$$wL + rK + \Pi_i = S_i \iff \quad \frac{wL_i}{S_i} + \frac{rK_i}{S_i} + \frac{\Pi_i}{S_i} = 1$$

Other Implications

- Decline in (Low-skill) Wages
- Decline in Labor Force Participation
- Decline in Labor Reallocation (and in Migration)
- Decline in Output Growth
- Increase in Wage Inequality

$\Rightarrow$ Quantify the macroeconomic implications: market power in a GE model (new paper with Jan De Loecker and Simon Mongey)

Conclusions

1. Sharp rise in Market Power since 1980
    - Markups: increase $30 - 40$ points
    - Profit Rate: increase $7 - 8$ points
2. Heterogeneity: no representative firm
    - Median constant; P90 $\uparrow\uparrow$
    - Substantial reallocation
3. Significant macroeconomic implications
    - Labor and Capital share decline
    - (Low skill) wages and LF participation
    - Reallocation rates, job flows and migration decline
    - Measured TFP

    $\Rightarrow$ aim to quantify market power in oligopolistic GE framework

The Rise of Market Power and the Macroeconomic Implications

Jan De Loecker[1] Jan Eeckhout[2] Gabriel Unger[3]

[1]KU Leuven, NBER and CEPR
[2]University College London and UPF
[3]Harvard

IIES
December 13, 2018

Estimation Elasticities: Detail

- Translog production function for each industry:

$$q_{it} = \beta_{v1} v_{it} + \beta_{k1} k_{it} + \beta_{v2} v_{it}^2 + \beta_{k2} k_{it}^2 + \omega_{it} + \epsilon_{it}$$

- Variation output elasticity over time and firms
- Output elasticity of the composite variable input:

$$\theta_{it}^{v} = \beta_v 1 + 2\beta_{v2} v_{it}$$

- Preserves identification results, with two key ingredients:
  1. $v = h(k, \omega)$
  2. $\omega = g(\omega) + \xi$
- Moment conditions from static optimization of variable inputs:

$$\mathbb{E}\left(\xi_{it}(\beta) \begin{bmatrix} v_{it-1} \\ v_{it-1}^2 \end{bmatrix}\right) = 0$$

Return

Estimation Production Technology

- Cobb Douglas:

$$q_{it} = \beta_v v_{it} + \beta_k k_{it} + \omega_{it} + \epsilon_{it}$$

- Olley-Pakes (1996): productivity is function of inputs: $\omega_{it} = h(v_{it}, k_{it})$
- Let:

$$q_{it} = \phi_t(v_{it}, k_{it}) + \epsilon_{it} \quad \text{where} \quad \phi = \beta_v v_{it} + \beta_k k_{it} + h(v_{it}, k_{it})$$

- Assume AR(1) productivity process: $\omega_{it} = \rho\omega_{it-1} + \xi_{it}$
    1. Regress deflated sales on variable inputs, capital and year dummies
    2. $\xi_{it}(\beta_v)$: from $\omega_{it}(\beta_v)$ on $\omega_{it-1}(\beta_v)$, where $\omega_{it} = \phi_{it} - \beta_v v_{it} + \beta_k k_{it}$
- Identify output elasticities $\mathbb{E}(\xi_{it}(\beta_v) v_{it-1}) = 0$ under assumption:
    1. v_{it} responds to productivity shock
    2. v_{it-1} does not

Return

Translog Production Technology

- Industry-specific, time-varying output elasticities
- Preserves identification results (De Loecker-Warzynski (2012))
- Moment conditions from static optimization of variable inputs:

$$\mathbb{E}\left(\xi_{it}(\beta)\begin{bmatrix} v_{it-1} \\ v_{it-1}^2 \end{bmatrix}\right) = 0,$$

- With translog production function for each industry:

$$q_{it} = \beta_{v1} v_{it} + \beta_{k1} k_{it} + \beta_{v2} v_{it}^2 + \beta_{k2} k_{it}^2 + \omega_{it} + \epsilon_{it}$$

- Variation output elasticity over i, t, no longer attributed to markup
- Output elasticity of the composite variable input:

$$\theta_{it}^{v} = \beta_{v}1 + 2\beta_{v2} v_{it}$$

- Markup defined as before; level difference, but normalization

Return