More Than the Sum of Its Parts?

Markups and the Role of Establishments

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Introduction

In many services industries, firms expand along the intensive and extensive margins

- Sales per establishment and number of establishments
- New establishments allow firms to sell new products or reach new markets

Services and the extensive margin are becoming more important, for example in the US

How do product market distortions affect these two margins?

- What are the implications for shocks and policies that target firms based on total sales?

Size-Dependent Markups Across Firms vs. Establishments

Size-dependent markups are an important type of product market distortion

- Within industries, larger firms set higher markups (in line with oligopolistic competition theory)
- Large firms underproduce: optimal policy gives a relative subsidy to large firms

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Using data on the universe of Swedish establishments in services industries, we find:

Size-dependent *firm* markups are just a symptom of size-dependent *establishment* markups

...large firms have large establishments, which set high markups

Size-dependent *establishment* markups imply different distortions for intensive and extensive margins

Intensive: Firms produce too much at small establishments vs. large establishments

Extensive: Firms open too many small establishments vs. large establishments

Intensive vs. Extensive: Firms open too many establishments vs. producing at establishments

What We Do

Empirics: using data on the universe of Swedish establishments in services industries

1) Number of establishments is an important margin for large firms
2) Positive size-markup relationship is all sales per establishment not number of establishments
3) Each successive establishment opened by a firm is smaller

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Theory: firms choose number of establishments (extensive) and production at each (intensive)

Establishment opening cost and quality vary across firms and establishments

Positive size-markup relationship at each establishment due to non-CES demand

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Results: characterize inefficient distortions in the competitive equilibrium, then calibrate

Extensive margin generates only 9% of misallocation (rises 10x without declining quality (fact 3))

But makes firm size-dependent policy only 40% as effective; **less valuable to subsidize large firms**

Empirical Results

Model

Quantifying the Model

Misallocation

Firm Size-Dependent Policy

Extensions

Data Overview

Data on the universe of Swedish firms from 1997-2017... 3,470,991 firm-year observations

We focus on services industries (about 60% of sales)

Sales, inputs, and number of establishments at each firm

Employment, wage bill, municipality, industry, and firm ID for each establishment (but not sales)

- There are 423 5-digit services industries, with an average of 422 firms
- There are 291 municipalities from Stockholm (1 million workers) to Bjurholm (960 workers)

Fact 1: Importance of the Extensive Margin

Multi-establishment firms		**Decomposing multi-establishment firm sales**	
Firm share	*Sales share*	*Relative sales per establishment*	*Relative number of establishments per firm*
2.7%	48.7%	4.7	7.2

Fact 2: Size-Dependent Markups

Regress log firm markups on log firm size measures:

$$\ln(\underbrace{\text{sales/intermediates}_{i,j,t}}_{\text{markup}}) = \vec{\beta}\ln(\text{size}_{i,j,t}) + \text{fixed effects}_{i,j,t} + \epsilon_{i,j,t}$$

- To proxy for a firm's *relative* markup, use sales over intermediates and include industry-year FEs
- Size measure is some combination of sales, sales per establishment, and number of establishments
- Main regression only uses firm observations with at least 2 establishments

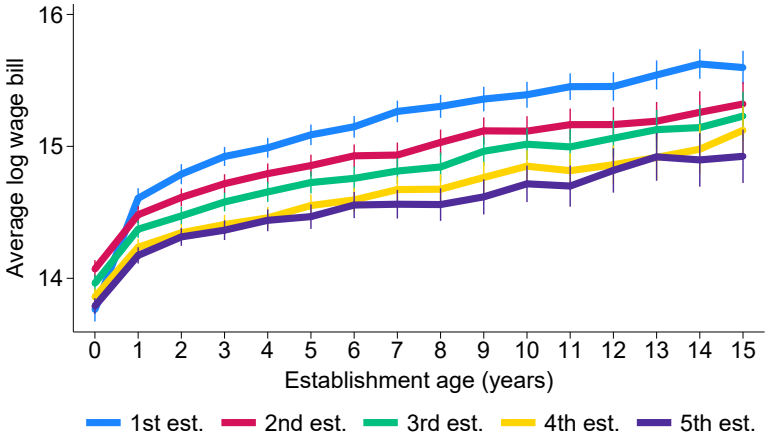
Fact 2: Size-Dependent Markups

	Log relative markup			
Log relative sales	0.062			
	(0.006)			
Log relative sales per establishment		0.087		0.087
		(0.009)		(0.009)
Log relative number of establishments			0.021	0.008
			(0.007)	(0.007)
R^2	0.542	0.545	0.532	0.545
Number of observations	93,164	93,164	93,164	93,164

Similar results: including all firms; instrumenting with lagged sales per establishment

Positive relationship for sales per establishment; no clear relationship for number of establishments

Fact 3: Size at Successive Establishments



Each successive establishment is smaller, controlling for establishment age

The same pattern holds for different numbers of establishments, and using employment

Fact 3: Size at Successive Establishments

Regress log establishment size on log establishment order n

- Establishment size is employment or wage bill
- A firm's first establishment has order $n = 1$, its second has $n = 2$, etc.

$$\ln(\text{estab. size}_{i,j,t}(n)) = \beta \ln(n) + \text{fixed effects}_{i,j,t}(n) + \epsilon_{i,j,t}(n)$$

Fact 3: Size at Successive Establishments

	Log estab. employment			*Log estab. wage bill*		
Log estab. order	-0.201	-0.197	-0.196	-0.198	-0.195	-0.194
	(0.021)	(0.020)	(0.020)	(0.020)	(0.019)	(0.020)
Fixed effects						
Estab. age, firm, year	✓	✓	✓	✓	✓	✓
Municipality-industry		✓	✓		✓	✓
Firm age			✓			✓
R^2	0.840	0.861	0.861	0.740	0.756	0.756
Observations	6,925,089	6,914,070	6,914,070	6,925,089	6,914,070	6,914,070

Declining size at new estabs. is not from expanding to smaller municipalities/industries or firm aging

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Model Overview

One period model

A representative household inelastically supplies labor, owns firms, consumes the numeraire final good

Firms use labor to open establishments and produce a differentiated good at each establishment

Perfectly competitive final good producers aggregate goods from establishments into the final good

Firms

Each firm $i \in [0, 1]$ chooses measure $N(i)$ of establishments and price $p(i, n)$ for each $n \in [0, N(i)]$

Hires labor at wage W

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Establishment opening: firm i's first unit measure of establishments is free (first establishment)

Cost of opening establishment $n > 1$ is $\kappa(i,n) > 0$ in labor, where $\kappa(i,\cdot)$ is continuous

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Establishments are ordered so that firm i's value of opening establishment n is strictly decreasing in n

...a firm sees a range of establishment opportunities and picks the best ones

Demand

Perfectly competitive final good producers aggregate differentiated establishment goods:

$$\int_0^1 \int_0^{N(i)} \varphi(i,n)\Upsilon(q(i,n))dndi = 1 \qquad \text{where } q(i,n) \equiv \frac{y(i,n)}{Y} \text{ is relative output}$$

- Defines final good output Y given real purchases $y(i,n)$ from each firm i establishment n
- $\varphi(i,n)$ is the quality of firm i's establishment n
- $\Upsilon(\cdot)$ is strictly increasing and concave Kimball aggregator function with $\Upsilon(0) = 0$
  - There are diminishing returns to each establishment's good
  - CES is a special case with $\Upsilon(q) = q^{\frac{\bar{\sigma}-1}{\bar{\sigma}}}$

Demand

Demand for firm i's establishment n is $y(i,n)$, which is given by

$$p(i,n) = \varphi(i,n)\Upsilon'(q(i,n))D \qquad \text{where } q(i,n) \equiv \frac{y(i,n)}{Y} \text{ is relative output}$$

- D is an aggregate index

$\Rightarrow$ Demand shifts with quality $\varphi(i,n)$ and is independent of firm i's other establishments

$$\text{demand elasticity:} \qquad \sigma(q(i,n)) \equiv \left| \frac{p(i,n)}{y(i,n)} \frac{\partial y(i,n)}{\partial p(i,n)} \right| = \frac{-\Upsilon'(q(i,n))}{q(i,n)\Upsilon''(q(i,n))}$$

Under CES demand, $\sigma(q)$ is constant at $\bar{\sigma}$

Instead, we suppose $\sigma(q)$ is weakly decreasing in relative output q

Firm Decisions

Prices: an establishment's outcomes depend only on its quality $\varphi(i,n)$

$$\text{markup} = \frac{p(i,n)}{W} = \frac{\sigma(q(i,n))}{\sigma(q(i,n)) - 1}, \qquad \text{which is decreasing in the demand elasticity } \sigma(q(i,n))$$

A higher quality establishment has a higher price, output, sales, markup, and profits

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Establishments: firm i opens establishment n if profits $\pi(\varphi(i,n))$ exceed the opening cost $W\kappa(i,n)$

Firm i is single-establishment (sets $N(i)=1$) if $\pi(\varphi(i,1)) \leq W\kappa(i,1)$...

i.e., if its first additional establishment ($n=1$) has low quality relative to opening cost

Otherwise, firm i is multi-establishment (sets $N(i)>1$)

Aggregate Productivity and Consumption

Household consumption C is our measure of welfare

They consume all final good output:

$$C = Y = Z\left(\bar{L} - \int_0^1 \int_1^{N(i)} \kappa(i,n)\,dn\,di\right)$$

Production labor is inelastic labor supply $\bar{L}$ not used for opening establishments

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Aggregate productivity Z is implied by firms' equilibrium choices:

$$Z = \left(\int_0^1 \int_0^{N(i)} q(i,n)dndi\right)^{-1}$$

Inefficient Distortions in the Competitive Equilibrium

The competitive equilibrium can be inefficient due to misallocation of the fixed labor supply

$V_{prod}(i, n)$ is the marginal social value of using labor to produce at firm i's establishment n

$V_{estab}(i)$ is the marginal social value of using labor to open establishments at firm i

We can increase welfare by reallocating labor...

...toward production at establishments with higher $V_{prod}(i, n)$

...toward opening establishments at firms with higher $V_{estab}(i)$

Inefficient Distortions in the Competitive Equilibrium

Theorem: If the demand elasticity $\sigma(q)$ is constant, then the competitive equilibrium is efficient

If the demand elasticity $\sigma(q)$ is strictly decreasing, then the competitive equilibrium is inefficient

(1) **Production:** $V_{prod}(i,n) > V_{prod}(j,m)$ if $q(i,n) > q(j,m)$

(2) **Establishments:** $V_{estab}(i) > V_{estab}(j)$ if $q(i,N(i)) > q(j,N(j))$ and firm i is multi-estab.

(3) **Production vs. opening establishments:** $V_{prod}(i,n) > V_{estab}(j)$ if $q(i,n) \geq q(j,N(j))$

(1) Reallocate production from small establishments to large establishments

(2) Reallocate establishments from firms with small marginal establishments to firms with large ones

(3) Close establishments to increase production at larger establishments (or somewhat smaller ones)

...especially powerful in calibrated model where firms' marginal establishments are their smallest

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Intuition: A low demand elasticity lowers the private value of output relative to the social value

If $\sigma(q)$ is decreasing, firms undervalue each successive unit of an establishment's output by more, so:

- At larger establishments, they undervalue *marginal* output more (1) and *average* output more (2)
- They undervalue *marginal* output more than they undervalue *average* output (3)

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Functional Forms

All firms face the same constant elasticity cost of opening establishments: $\kappa(i, n) = \bar{\kappa} n^{\theta}$

- The cost of opening each successive establishment can be higher ($\theta > 0$) or lower ($\theta < 0$)

Establishment quality distributions vary across firms: $\varphi(i, n) = \bar{\varphi}(i)\max\{n, 1\}^{-\rho}$

- Firm i's initial unit measure of establishments, $n \in [0, 1]$, all have quality $\bar{\varphi}(i)$
- For $n > 1$, quality at each successive establishment declines at rate $\rho > 0$
- Firms are heterogeneous in their "baseline quality" $\bar{\varphi}(i)$, drawn from a Pareto distribution

The demand elasticity is given by the Klenow and Willis (2016) specification: $\sigma(q) = q^{-\epsilon/\bar{\sigma}}$

- $\bar{\sigma} > 1$ is the demand elasticity at relative sales of $q = 1$
- $\epsilon/\bar{\sigma}$ is the superelasticity; $\epsilon = 0$ means $\sigma(q)$ is constant (CES); $\epsilon > 0$ means $\sigma(q)$ is decreasing

Calibration

Set labor supply $\bar{L}$ to get final good output $Y = 1$

There are six parameters to calibrate... we exactly match six moments in the Swedish services data

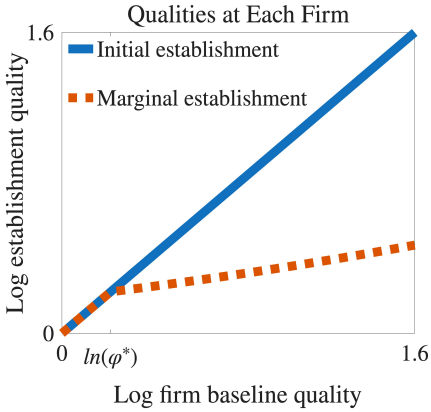
Moment	**Data**	**Model**
fraction of firms that are multi-establishment	0.027	0.027
sales share of multi-establishment firms	0.49	0.49
log(markup) on log(sales/establishment) for multi-establishment firms	0.087	0.087
sales-weighted average markup (Sandström (2020))	1.15	1.15
wage bill decline across successive establishments	-0.20	-0.20
average number of establishments	1.17	1.17

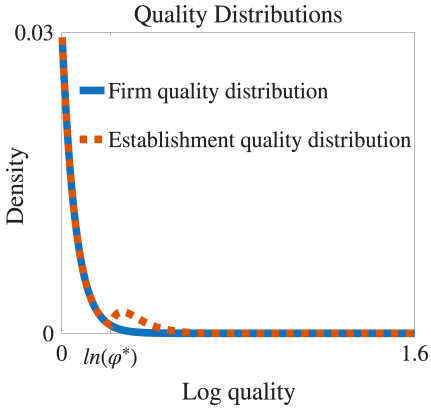
Calibration

Parameter	**Value**
$\bar{\kappa}$ (establishment building cost shifter)	0.192
θ (establishment opening cost elasticity)	0.076
firm baseline quality tail parameter	16.43
$\bar{\sigma}$ (demand elasticity at relative output of 1)	8.356
$\epsilon/\bar{\sigma}$ (demand super elasticity)	0.507
ρ (establishment quality rate of decline)	0.059

$\theta > 0$ means each successive establishment at a firm costs more to open

The Set of Open Establishments

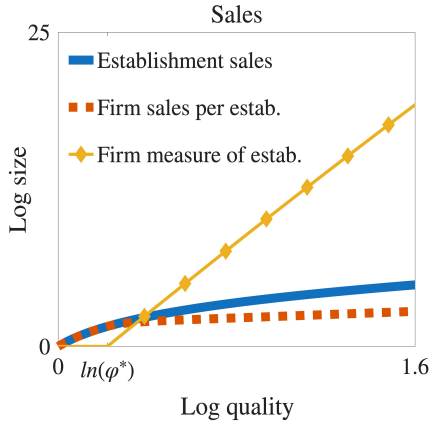


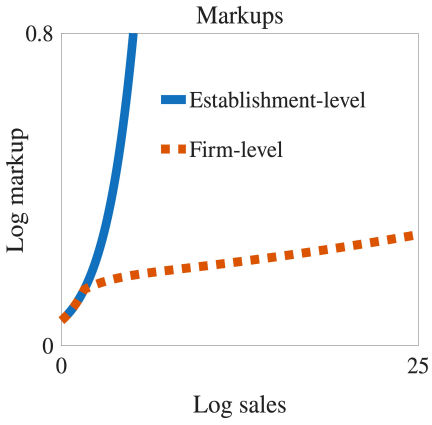


A firm is multi-establishment if their baseline quality $\bar{\varphi}(i)$ is above a common threshold φ^*

Higher quality firms have more establishments and higher quality (larger) marginal establishments

Sales and Markups





Higher quality establishments are larger and set higher markups

Higher quality firms have higher sales per establishment but mostly more establishments

...this flattens sales per establishment and the sales-markup relationship

Model Validation: Untargeted Moments

1) Regress log sales per establishment on log measure of establishments

- Among multi-establishment firms; controlling for industry-year fixed effects
- Do firms with many establishments have high sales per establishment (and so underproduce)?

Model: coefficient of 0.131

Data: coefficient of 0.143

Model Validation: Untargeted Moments

2) Concentration at the top; sales and establishments share of largest x% of firms

	Top 5%	*Top 1%*	*Top 0.1%*
Sales share			
Model	52%	45%	35%
Data	77%	58%	33%
Establishments share			
Model	18.8%	14.6%	10.5%
Data	16.6%	10.1%	4.1%

The model misses large firms with one or few establishments

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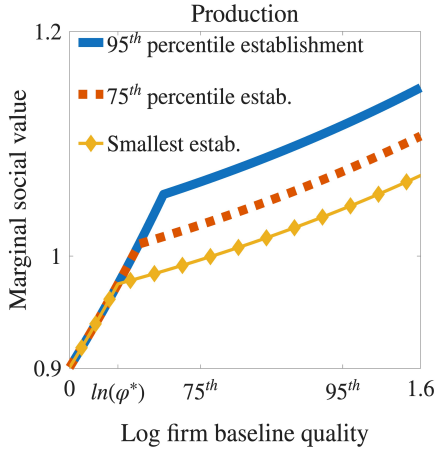
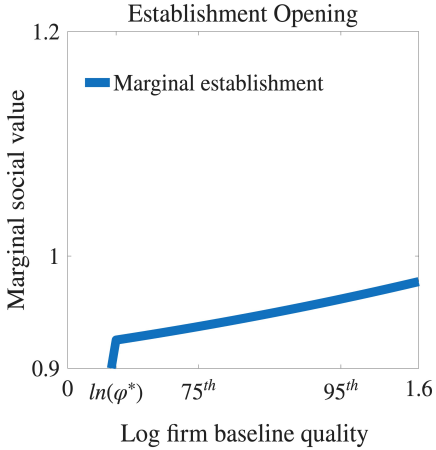
Inefficient Distortions in the Competitive Equilibrium





Substantial variation in value of production across firms (large firms underproduce), some within firms

Firms overvalue marginal establishments even relative to production at much smaller firms

Misallocation

What are the gains from implementing the first best?

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We can decompose these gains into misallocation along each margin:

1) Reallocate labor across existing establishments to maximize productivity

2) Also choose each firm's measure of establishments to maximize consumption

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What are the gains from implementing the first best? consumption rises by 1.47%

This understates the effects of misallocation because we ignore capital and input-output

We can decompose these gains into misallocation along each margin:

1) Reallocate labor across existing establishments to maximize productivity

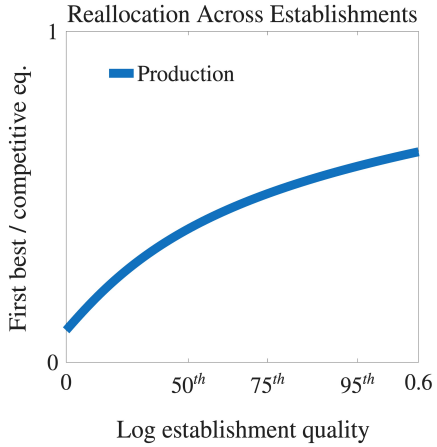
Increases consumption by 1.34%

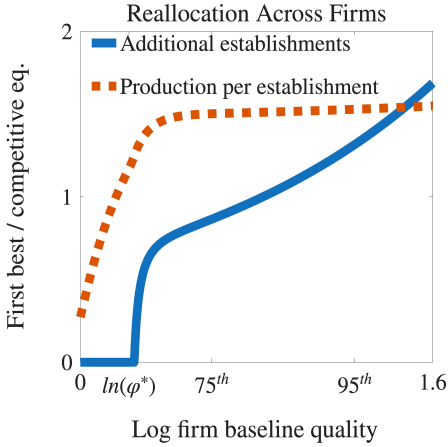
...only reallocating *within firms* increases consumption by 0.06%

2) Also choose each firm's measure of establishments to maximize consumption

91% of total misallocation is across existing establishments and mostly across firms not within firms

First Best vs. Competitive Equilibrium





Reallocate production toward larger establishments; production and establishments toward larger firms

Reduce additional establishments by 11%, but save only 0.3% of labor used to open establishments

Why So Little Extensive Margin Misallocation?

There are small gains from changing the set of establishments

Even though there are large marginal gains in the competitive equilibrium

And in a similar model (customers instead of establishments), Afrouzi et al. (2023) find large gains

...the main difference in our models is they assume all a firm's customers are the same

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Compare to an alternative model without declining quality across a firm's successive establishments

- With **exact same** joint distribution of establishments, firms, markups in competitive equilibrium
- Misallocation of production across competitive equilibrium set of establishments is unchanged

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Extensive margin misallocation increases 10x from 0.13% of output to 1.33% (total rises to 2.67%)

Why? Declining quality means sharply diminishing returns to changing the set of establishments

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Nearly all misallocation is of production across firms' existing establishments (across firms not within)

So is *firm* size-dependent policy effective (as it is for size-dependent *firm* markups)?

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So is *firm* size-dependent policy effective (as it is for size-dependent *firm* markups)?

Consider a tax/subsidy scheme $T(\cdot)$ based only on firm sales

- If a firm has total revenue S, it pays $T(S)$, so it faces marginal tax rate $T'(S)$

Firm Size-Dependent Policy

Nearly all misallocation is of production across firms' existing establishments (across firms not within)

So is *firm* size-dependent policy effective (as it is for size-dependent *firm* markups)?

Consider a tax/subsidy scheme $T(\cdot)$ based only on firm sales

- If a firm has total revenue S, it pays $T(S)$, so it faces marginal tax rate $T'(S)$

Consider two "optimal" firm size-dependent policies (chosen to maximize consumption):

$T_{fixed}(\cdot)$: optimal policy holding fixed the set of establishments

$T_{endog}(\cdot)$: optimal policy allowing the set of establishments to respond endogenously

Optimal Policy With Fixed Set of Establishments

Holding fixed the set of establishments, optimal policy $T_{fixed}(\cdot)$ increases consumption by 1.26%

...86% of the way to the first best (95% of misallocation across existing establishments)

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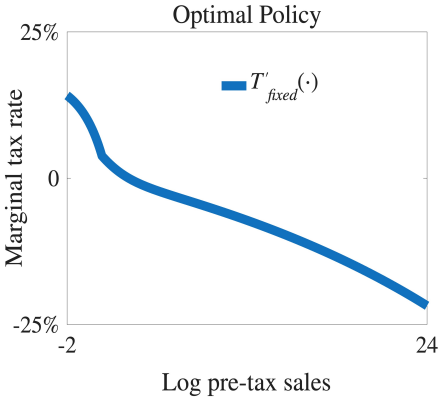
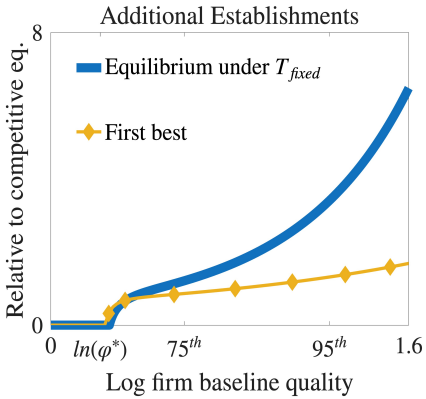
What if we implement this policy and the set of establishments responds endogenously?

Consumption falls by 1.57% relative to no policy

It's critical to account for the extensive margin when designing firm size-dependent policy

Policy Trade-off





There is disagreement between how we want to incentivize firms on the intensive vs. extensive margins

Subsidize large firms to produce more at existing establishments

...But then they open way too many establishments

Optimal Policy With Endogenous Set of Establishments

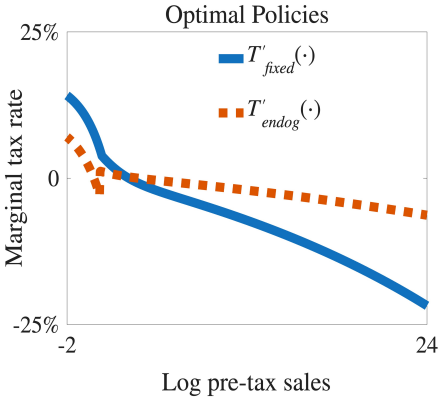
Taking into account the extensive margin, optimal policy $T_{endog}(\cdot)$ increases consumption by 0.51%

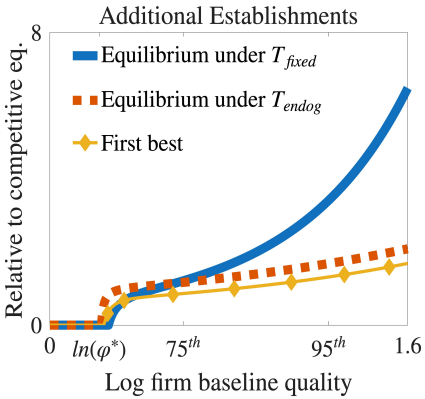
...only 35% of the way to the first best

...worse than optimal policy with a fixed set of establishments (increased consumption by 1.26%)

Firm size-dependent policy is limited by the extensive margin response

Optimal Policies





Taking into account firms' extensive margin responses, $T_{endog}(\cdot)$ is less extreme than $T_{fixed}(\cdot)$

Large firms still open too many establishments, but not nearly as much with $T_{endog}(\cdot)$ as with $T_{fixed}(\cdot)$

Empirical Results

Model

Misallocation

Firm Size-Dependent Policy

Extensions

Optimal Policies in the Alternative Model

Consider firm size-dependent policy without declining quality across successive establishments

...in the alternative model

Optimal policy taking into account full responses increases consumption by 1.45% (instead of 0.51%)

...54% of the way to the first best (instead of 35%)

...better than optimal policy with a fixed set of establishments (increased consumption by 1.26%)

Now, inefficiencies along firms' two margins are better aligned

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Cut the measure of firms by 20%

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86% of labor savings go to production

In the alternative model, going to the first best increases consumption by 4.93% (instead of 2.67%)

Cut the measure of firms by 73%

Reduce production labor by 3.8%

Conclusion

In Swedish data on services firms:

- Number of establishments is an important margin, especially for large firms
- Size-dependent *firm* markups are just a symptom of size-dependent *establishment* markups
- Each successive establishment at a firm is relatively smaller

Developed a model to match these findings:

Characterized inefficient distortions implied by size-dependent *establishment* markups

The extensive margin is not important for misallocation, but is for firm size-dependent policy

...makes it much less valuable to shift sales toward large firms