More Than the Sum of Its Parts?

Markups and the Role of Establishments

Markus Kondziella
University of St. Gallen

Joshua Weiss
University of Bristol and IIES

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Introduction

Size-dependent markups are an important source of misallocation

- Many estimate that firms with larger industry sales shares set higher markups
- In line with oligopolistic competition theory
- Implies misallocation: optimal firm size-dependent policy gives a relative subsidy to large firms

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Previous work studies the relationship between markups and firm sales

But firms' sales are driven by their **number of establishments** and **sales per establishment**

How do markups distort these two margins?

What are the implications for misallocation and policy?

What We Do

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

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

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Theory: firms choose number of establishments (extensive margin) and the price at each

High quality firms are multi-establishment; each successive establishment they open is lower quality

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Theory: firms choose number of establishments (extensive margin) and the price at each

High quality firms are multi-establishment; each successive establishment they open is lower quality

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

Results: extensive margin irrelevant for misallocation, but important for firm size-dependent policy

Responsible for only 9% of misallocation; rises to 50% without fact 2

Policy trade-off: want large firms to produce more at their establishments but not build new ones

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

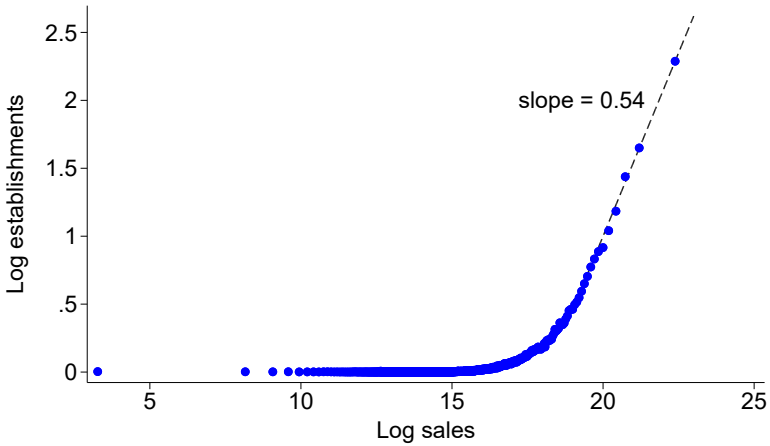
Employment, wage bill, municipality, industry, and firm ID for each establishment (but not sales)

- 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

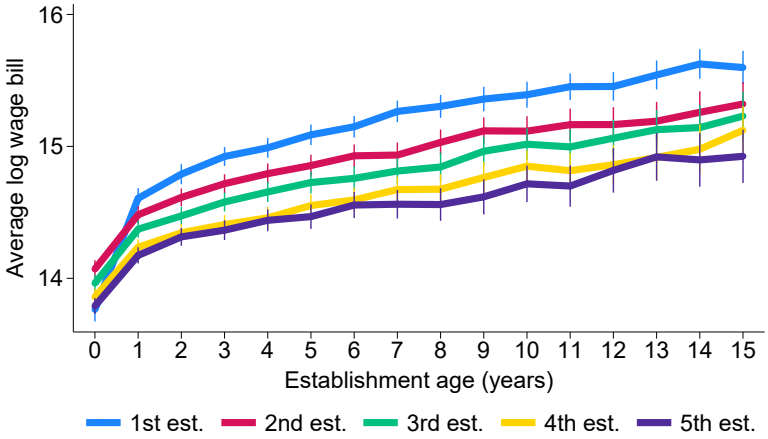
Multi-establishment firms		**Decomposing multi-establishment firm sales**	
Firm share	*Sales share*	*Relative sales per establishment*	*Relative number of establishments per firm*
2.7%	48.7%	4.7	7.2

Fact 1: Importance of the Extensive Margin



Among the largest firms, 54% of cross-sectional sales variation is number of establishments

Fact 2: 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 2: 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 2: 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

Fact 3: Size-Dependent Firm 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 3: Size-Dependent Firm 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: firm fixed effects; including all firms; instrumenting with lagged sales per establishment

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

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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 build 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 $n \in [0, N(i)]$

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Establishment building: uses labor $\frac{\kappa}{\alpha+1}(N(i)^{\alpha+1} - 1)$, where $\kappa > 0$ and $\alpha \in \mathbb{R}$

- The first unit measure of establishments are free, which we interpret as a firm's first establishment

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Production: output at firm i's establishment n is the labor hired, $l(i,n)$

Quality: the good produced at firm i's establishment n has quality $\varphi(i,n) = \bar{\varphi}(i)\max\{1,n\}^{-\rho}$

- $\bar{\varphi}(i)$ is firm i's baseline quality, drawn from a Pareto distribution
- Establishment quality is $\bar{\varphi}(i)$ for $n \in [0,1]$, then declines with elasticity $\rho > 0$ for $n > 1$
- Interpretation: a firm sees a range of establishment opportunities and picks the best ones

Demand

Perfectly competitive final good producers aggregate differentiated establishment goods:

$$\int_0^1 \int_0^{N(i)} \varphi(i,n)\Upsilon\left(\frac{y(i,n)}{Y}\right) dndi = 1$$

- 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 $\Upsilon(x) = x^{\frac{\sigma-1}{\sigma}}$

Demand

Demand for firm i's establishment n is $y(i,n)$, which is given by $p(i,n) = \varphi(i,n)\Upsilon'\left(\frac{y(i,n)}{Y}\right) D$

- D is an aggregate index

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

We use the Klenow and Willis (2016) specification of the aggregator function's derivative $\Upsilon'(\cdot)$

$$\text{Demand elasticity:} \qquad \sigma(i,n) = \left|\frac{p(i,n)}{y(i,n)}\frac{\partial y(i,n)}{\partial p(i,n)}\right| = \left(\frac{y(i,n)}{Y}\right)^{-\epsilon/\bar{\sigma}} \bar{\sigma}$$

$\bar{\sigma}, \epsilon > 0$... larger establishments face less elastic demand (CES is $\epsilon = 0$)

Firm Decisions

Prices: at each establishment, outcomes depend only on the establishment's overall quality $\varphi(i,n)$

$$\text{markup} = \frac{p(i,n)}{W} = \frac{\sigma(i,n)}{\sigma(i,n)-1}, \qquad \text{where} \quad \sigma(i,n) = \left(\frac{y(i,n)}{Y}\right)^{-\epsilon/\bar{\sigma}} \bar{\sigma}$$

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Establishments: firm i opens establishment n if profits $\pi(\varphi(i,n))$ exceed the building cost $W\kappa n^{\alpha}$

Assume α is not too negative, so the building cost does not decline too fast...

If $\bar{\varphi}(i) \leq \varphi^*$, then firm i is single-establishment ($N(i)=1$), where $\pi(\varphi^*) = W\kappa$

Otherwise, firm i is multi-establishment and $N(i)$ is increasing in $\bar{\varphi}(i)$

Aggregate Productivity and Consumption

Household consumption C is our measure of welfare

They consume all final good output:

$$C = Y = Z\left(\bar{L} - \frac{\kappa}{\alpha+1}\int_0^1 \left(N(i)^{\alpha+1} - 1\right) di\right)$$

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

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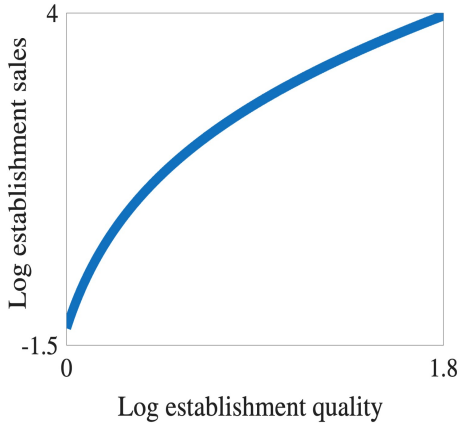
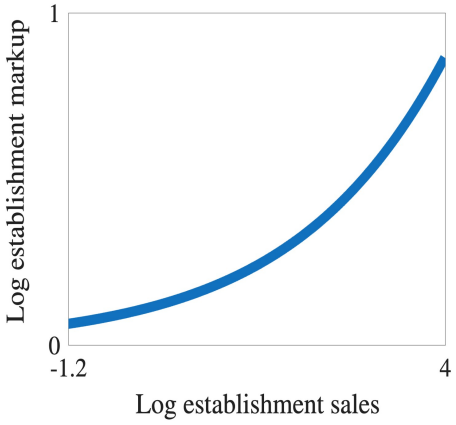
Aggregate productivity Z is implied by firms' equilibrium choices:

$$Z = \left(\int_0^1 \int_0^{N(i)} \frac{y(i,n)}{Y} dn di\right)^{-1}$$

Establishment Sales and Markups

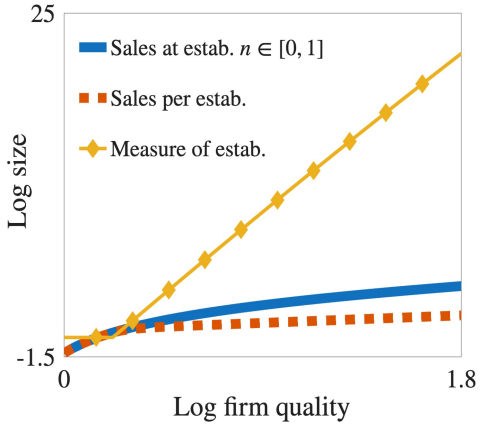


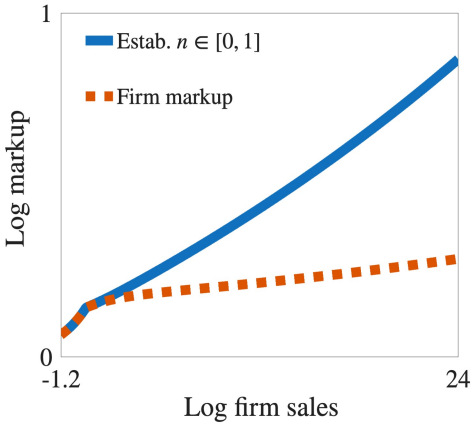


Activity at an establishment is fully determined by its overall quality $\varphi(i, n)$

Higher quality establishments are larger and have higher markups

Firm Sales and Markups





Firm i sales per estab. and markup are averages over establishments with $\varphi(i, n) \in [\bar{\varphi}(i)N(i)^{-\rho}, \bar{\varphi}(i)]$

Larger firms' sales are increasingly driven by measure of establishments

Empirical Results

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Calibration

Set labor supply $\bar{L}$ to get 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 elasticity across successive establishments	-0.20	-0.20
average number of establishments	1.17	1.17

Calibration

Parameter	**Value**
κ (establishment building cost shifter)	0.192
α (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 elasticity)	0.059

$\alpha > 0$ means firms face strictly convex establishment opening costs

$\Rightarrow$ Higher quality firms have higher quality marginal establishments

Untargeted Moments

1) Firm sales distribution; sales share of largest x% of firms within their industries

	Top 5%	*Top 1%*	*Top 0.1%*
Data	67%	45%	27%
Model	52%	45%	35%

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	Top 5%	*Top 1%*	*Top 0.1%*
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2) Regress log sales per establishment on log measure of establishments

- Among multi-establishment firms; controlling for industry-year fixed effects

Data: coefficient of 0.143

Model: coefficient of 0.131

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Misallocation

What is the first best?

1) Reallocate labor across existing establishments to maximize productivity

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

Misallocation

What is the first best? productivity Z and consumption C rise by 1.45% and 1.47%, respectively

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Misallocation

What is the first best? productivity Z and consumption C rise by 1.45% and 1.47%, respectively

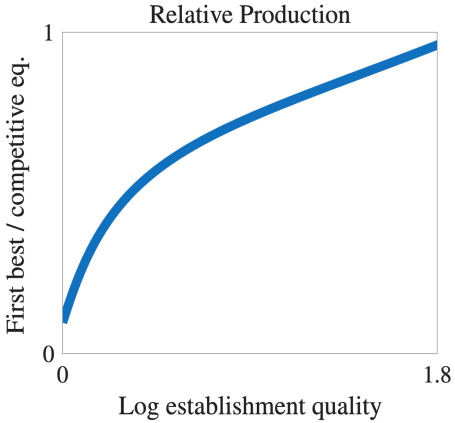
1) Reallocate labor across existing establishments to maximize productivity

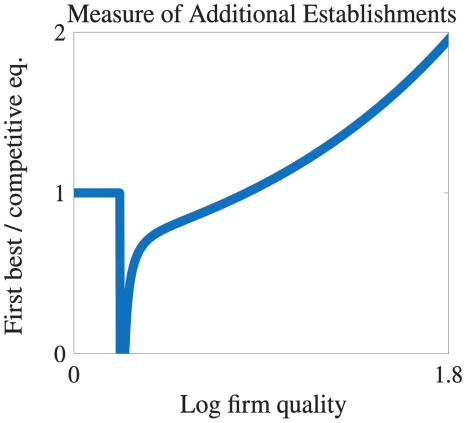
   Increases productivity and consumption by 1.34%

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

91% of losses relative to the first best is misallocation across existing establishments

First Best vs. Competitive Equilibrium





Reallocate production toward larger establishments; and establishments toward larger firms

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

Value of Opening an Establishment

Why is there so little misallocation on the extensive margin (how many establishments to open)?

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

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- Suppose no matter how many establishments the firm opens, this distribution remains the same
- Set establishment opening costs and labor supply to get the same competitive equilibrium

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

- For each firm, take the distribution of quality across their establishments in the competitive eq.
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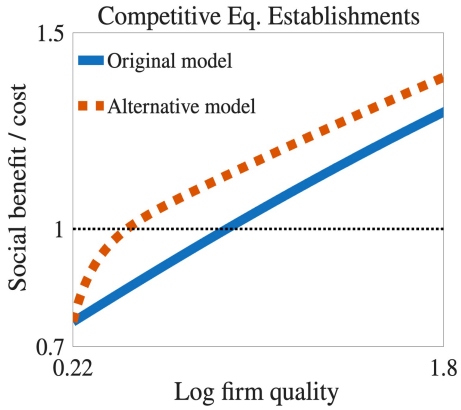
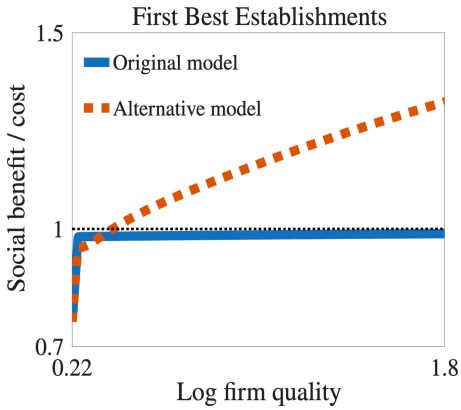
In the alternative model, misallocation of production across existing establishments is the same

But misallocation on the extensive margin increases ten-fold

From 0.13% of output (9% of total misallocation) to 1.33% of output (50% of total misallocation)

Value of Opening an Establishment





Firms overvalue low quality establishments, undervalue high quality establishments

Marginal establishments are lower quality than average establishments, so less undervalued by firms

Falling quality at each firm worsens diminishing returns to changing its set of establishments

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Firm Size-Dependent Policy

Given the low importance of the extensive margin, is firm size-dependent policy effective?

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

- Firm i pays $T(S(i))$ where $S(i)$ is relative sales (revenue over Y)
- At relative sales S, marginal revenue is multiplied by $1 - T'(S)$

Firm Size-Dependent Policy

Given the low importance of the extensive margin, is firm size-dependent policy effective?

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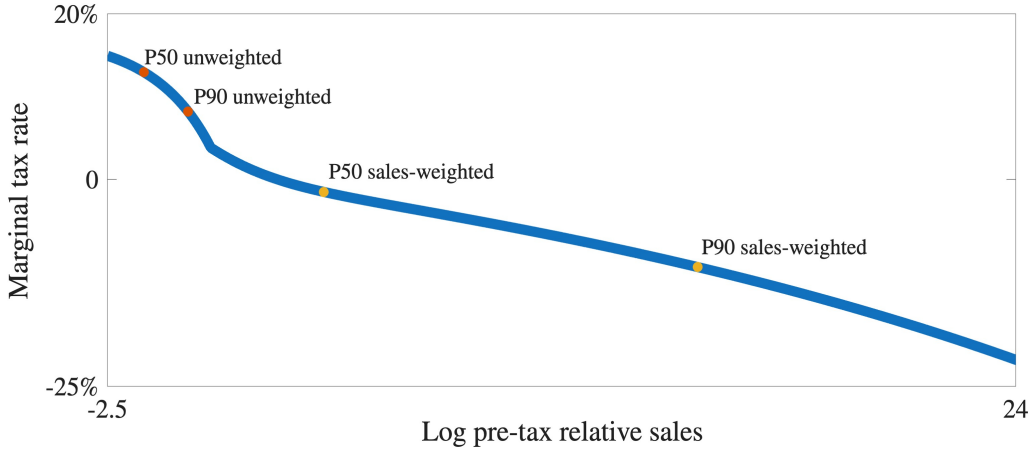
Consider two "optimal" firm size-dependent policies (chosen to maximize consumption):

1) The optimal policy **holding fixed the set of establishments**

2) The optimal policy allowing the set of establishments to respond endogenously

Optimal Policy With Fixed Set of Establishments



The optimal policy has a falling marginal tax rate to shift production from small to large firms

Optimal Policy With Fixed Set of Establishments

Holding fixed the set of establishments, the optimal policy increases consumption by 1.26%

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

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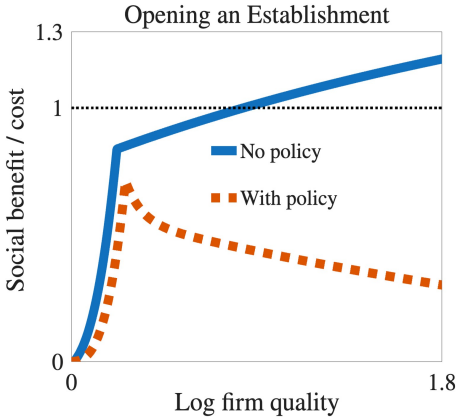
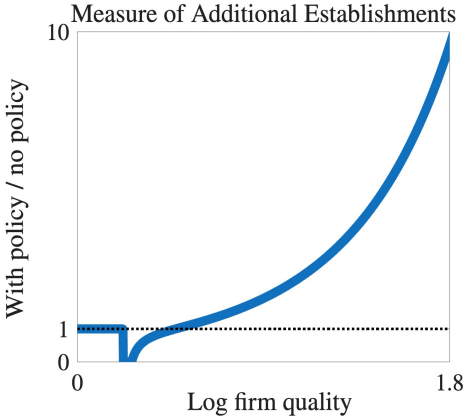
What if we implement this policy and the set of establishments responds endogenously?

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





Large firms respond to their relative subsidy by opening new, lower quality establishments

Firms overvalue low quality establishments... worsened by subsidies that lead to overproduction

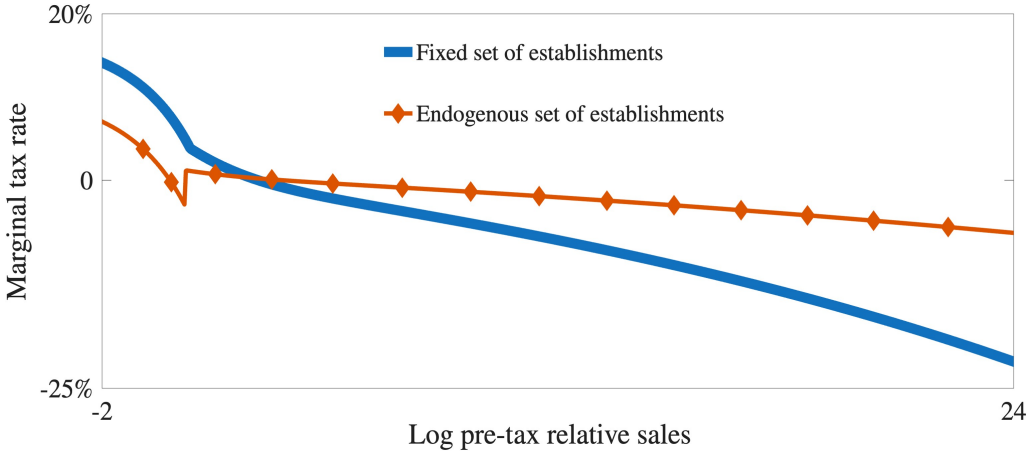
Optimal Policy With Endogenous Set of Establishments

Taking into account the extensive margin, the optimal policy increases consumption by 0.51%

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

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

Optimal Policies



Taking into account the extensive margin, relative taxes and subsidies are smaller

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Optimal Policies in the Alternative Model

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

Holding fixed the set of establishments, optimal firm size-dependent policy is the same as before

...but now if establishments endogenously respond, consumption falls by 0.82% (instead of 1.57%)

Optimal Policies in the Alternative Model

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

Holding fixed the set of establishments, optimal firm size-dependent policy is the same as before

...but now if establishments endogenously respond, consumption falls by 0.82% (instead of 1.57%)

Optimal policy taking into account this response increases consumption by 1.45% (instead of 0.51%)

- 54% of the way to the first best (instead of 35%)
- Better than optimal policy holding fixed the set of establishments (1.26%)

Now, inefficiencies along firms' two margins are better aligned

Entry

Suppose we add a free entry condition

- An infinite mass of potential entrants can pay a fixed labor cost to enter
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Cut the measure of firms by 20%

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Cut the measure of firms by 20%

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

Two novel findings in Swedish data on services firms

- As firms expand, they open smaller establishments
- Size-dependent markups are driven by sales per establishment not number of establishments

Developed a model to match these findings...

Nearly all misallocation is of production across the existing set of establishments

However, the extensive margin is important for the effects of firm size-dependent policy

- We want large firms to produce more at their existing establishments but not build new ones

Declining quality across a firm's successive establishments is a major driver of these results