Free Entry and Social Inefficiency in Regulated Pharmacy Markets

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Introduction

- The whole production chain from pharmaceutical innovation to drug dispense is heavily regulated in most countries.

- Reasons for regulation:
  - → Safety of products.
  - → Providing incentives to innovate.
  - → Guarding against (excessive) market power.
  - → Ensuring safe and equitable access to all consumers.

- Regarding pharmacies, the following regulations widely in use:
  - → Entry and location regulation.
  - → Price / markup regulation.
  - → Ownership regulation.
  - → Educational restrictions.

Objectives

- We study the effects of relaxing entry (& location) regulation in the Finnish pharmacy market, keeping other regulations in place.
  - $\rightarrow$ Wholesale price & pharmacy markup regulation.
  - $\rightarrow$ Current pharmacy taxation.
  - $\rightarrow$ Ownership regulation = no chains.
- We do this by:
  1. Estimating a spatial model of pharmacy choice.
  2. Modeling the costs of operating a pharmacy.
  3. Simulating a counterfactual where entry restrictions are relaxed.

Contributions

- We provide
  1. demand parameter estimates;
  2. production function estimates;
  3. a new entry algorithm which is considerably faster than existing ones; and
  4. counterfactual results on number of pharmacies, welfare, and its distribution.

Rest of the talk

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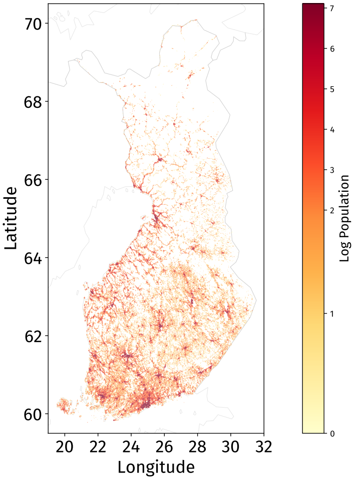
- Institutional background.
- Data
- Demand.
- Supply.
- Counterfactual.
- Conclusions.

Institutional Background

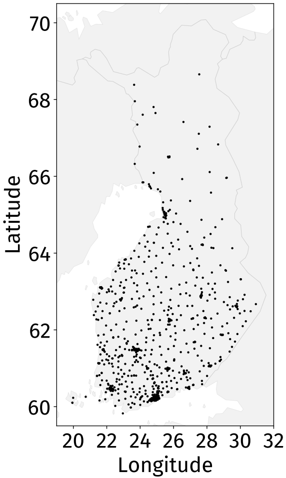
Relevant Regulation and Institutional Setup

- Finnish Medicines Agency (Fimea) dictates the number of pharmacies and their (detailed) locations.
  - → The objective is to ensure the availability of pharmacy services in all areas.
  - → Exact determinants not known.
- Pharmacy-markups are set in legislation.
  - → A national wholesale price for each product.
  - → Pharmacy-markup is a function of the wholesale price.
  - → Hence, no price differences across pharmacies.
  - → But no restrictions for non-pharmaceutical products (7% of turnover).
- Pharmacies are subject to a revenue-based progressive *pharmacy tax*.
- Online pharmacies were and are not a big thing.

Existing Pharmacy Network



Population density



Pharmacy network

Data

Data

- Pharmacy accounting data (Fimea).
  - → Data on pharmacies' sales and costs for year 2021.
- Grid database (Statistics Finland).
  - → Finland divided into 250m x 250m cells with data on population.
- Pharmaceutical expenditure data (the Finnish Social Insurance Institution (Kela)).
  - → Expenditure on pharmaceuticals in each postal code area.
- Other publicly available data.
  - → Locations of pharmacies, grocery stores, malls, etc.

Demand

Structural Model for Pharmacy Choice

- We estimate a discrete choice model for pharmacy choice, closely following Ellickson, Grieco and Khvastunov (2020).
- Basic intuition:
  - → Each cell has a representative consumer living in the cell centroid.
  - → Consumer chooses how much expenditure it allocates to pharmacies in its choice set.
  - → Aggregating the expenditures, we get predicted revenues for each pharmacy.
  - → We estimate the model parameters by minimizing the difference between observed and predicted revenue using non-linear least squares.

Structural Model for Pharmacy Choice (cont'd)

- We expand the model by:
  - → Adding random coefficients for the distance parameter.
  - → Using travel time by car as our measurement for distance (convert to €s using avg. wage).
  - → Including demographic variation in our measurement for market potential.
- We estimate four models differing in how they treat substitution to the outside good and unobserved distance heterogeneity.

Main Demand Results

Utility specification	Logit	NL	RC	RCNL
β Intercept	10.6436 ***		5.1818 ***	
	(2.6244)		(1.0359)	
β Distance	-0.2008 ***	-0.0288 ***	-0.2689 ***	-0.0341 ***
	(0.0165)	(0.0062)	(0.0268)	(0.0082)
β Dist. $\times$ Urban	-0.0310	-0.0032	-0.0224	-0.0003
	(0.0369)	(0.0052)	(0.0440)	(0.0056)
β Urban	-9.4842 ***	-0.4733 ***	-5.1704 ***	-0.5888 ***
	(2.6645)	(0.1170)	(0.9579)	(0.1245)
σ Distance			0.1381 ***	0.0149 **
			(0.0306)	(0.0049)
ρ		0.8651 ***		0.8706 ***
		(0.0296)		(0.0312)
α	1.0106 ***	2.0839 ***	1.1220 ***	2.1538 ***
	(0.0184)	(0.0371)	(0.0430)	(0.0450)
MSE	5.10e12	5.08e12	5.05e12	5.03e12

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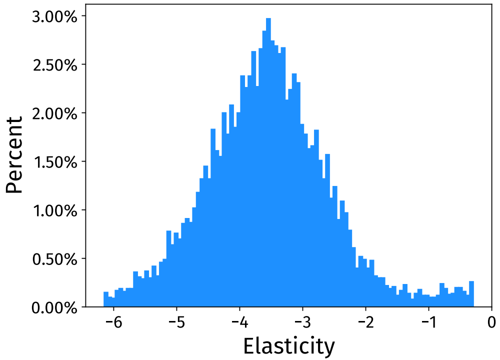
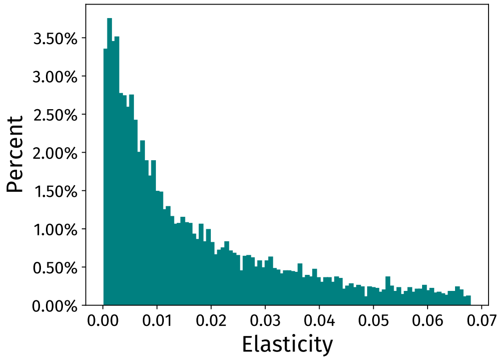
Elasticities

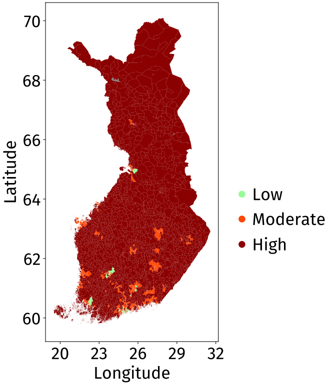


Own-Elasticities



Cross-Elasticities

HHIs with the Current Pharmacy Network



Herfindahl–Hirschman index (HHI) Categories

Supply

Production Function for Variable Costs

- We estimate a production function for variable costs.
  - → We measure inputs in terms of expenditure.
- We treat labor and material as variable inputs.
  - → Material costs consist of wholesale purchases of pharmaceuticals.
- We assume a Leontief production function.
  - → Pharmacies cannot substitute labor for material, or vice versa.
  - → We allow economies of scale for labor input.

Production Function Estimates

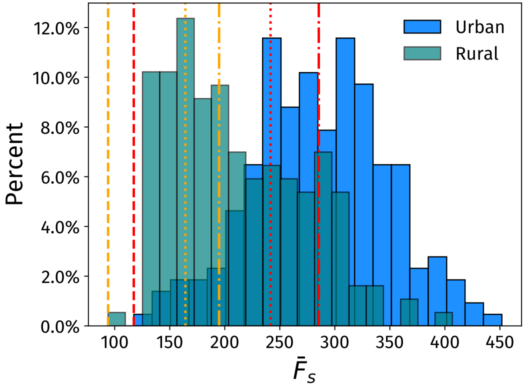
Estimator:	OLS		IV	
Model:	(1)	(2)	(3)	(4)
Dependent Variable:	$\ln(L)$	M	$\ln(L)$	M
$\ln(R)$ or R	0.88***	0.72***	0.94***	0.72***
	(0.03)	(0.00)	(0.03)	(0.00)
Intercept	-0.35		-1.17***	
	(0.47)		(0.45)	
Observations	402	402	402	402
R^2	0.82	0.99	-	-
F-statistic	-	-	728.45	2857.56
Return to scale (κ)	1.14		1.07	
Productivity (A or B)	0.39	1.39	1.25	1.39

Fixed Costs ▸ Fixed Costs Algorithm

- Problem: we do not observe fixed costs of operating a pharmacy.
- To circumvent this, we follow Eizenberg (2014).
- The idea: for a pharmacy to remain in the market, their gross profits (net of variable inputs) must be at least as high as their fixed costs.
- How: simulate gross profits for all existing pharmacies by taking values from the joint distribution of the structural shocks (demand, labor & materials).
- This gives us an **upper bound** of fixed costs.

Fixed Costs

- We get an upper bound of the fixed costs for each pharmacy.
- We divide the pharmacies into rural and urban pharmacies and use the minimum of each.
- The fixed cost estimates are:
  - → €93,988 for rural
  - → €117,321 for urban



Counterfactual Analysis

Entry Algorithm

- We simulate endogenous entry (exit) to the pharmacy market.
- Solving a full information entry game is not feasible.
- Therefore, we impose several assumptions for computational purposes:
  1. Entrants are fully myopic;
  2. entrants are identical; and
  3. entry is restricted to locations with a grocery store.
- Even with these restrictions we have more entry locations than in the existing literature: ≈ 4000.

Entry Algorithm

- Sequential myopic entry (SME) algorithm from Seim and Waldfogel (2013) and Verboven and Yontcheva (2024):
  1. Begin from an empty board
  2. Take a candidate entrant
     2.1 Find the location with the highest profit
     2.2 Enter if profitable
  3. Remove all pharmacies that turn unprofitable
  4. Repeat until no new entries or exits.
- The SME algorithm does not guarantee a Nash equilibrium.

Entry Algorithm – A Speed Improvement

- However, the existing algorithm is computationally expensive.
- Our contribution: the Backward sequential myopic entry (BSME) algorithm
    1. Fill the board with pharmacies
    2. Take the pharmacy with the highest loss
        2.1 If unprofitable, remove from the board
    3. Repeat until all remaining pharmacies are profitable
    4. Initiate the SME entry algorithm.
- BSME satisfies the same conditions as the SME algorithm
- BSME not guarantee a Nash equilibrium.

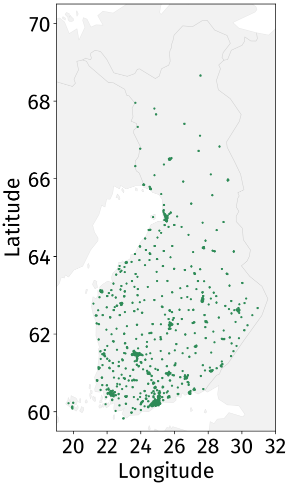
Entry Algorithm – A Speed Improvement

- The backward step quickly reaches the aggregate number of pharmacies that is close to the final number.
- Why is it faster?
  1. Set of existing stores is smaller than the set of possible entry locations
  2. We need to update fewer choice probabilities
  3. Each iteration is cheaper than the one before, unlike for the SME
- For large problems, BSME is at least an order of magnitude faster.
  → In our application, 90min vs. 3 900min, a reduction of 98%.
- BSME does not produce an order of entry.

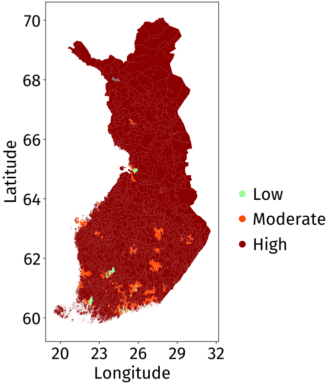
Counterfactual Results

Counterfactual Results

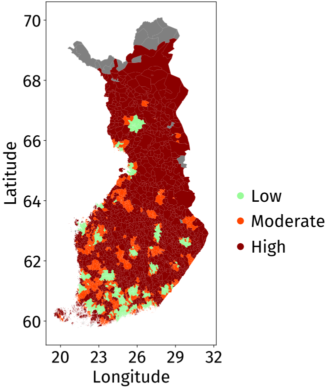
- We end up with 2276 pharmacies, an increase of 180% from initial 818
- Most of new pharmacies are located in urban areas. Two factors drive this result:
    1. More population (market potential) in catchment areas
    2. Stronger under-service
- Not quite a Nash equilibrium: 1.4% of pharmacies want to switch locations



Pre- and Post-deregulation HHIs Categories

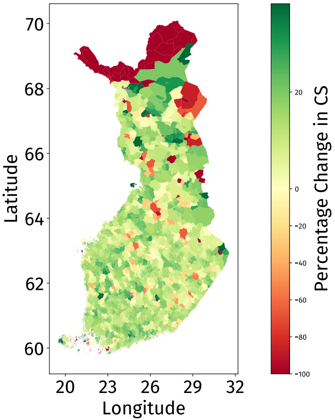


Pre



Post

Post Deregulation Δ CS



consumer surplus (CS) changes

Aggregate Entry Results

Variable	Absolute	Relative
	Panel A: Consumers	
Δ Consumer surplus (CS)	67.94	14%
	Panel B: Pharmacies	
Δ Number of pharmacies	1459	178%
Δ Revenue	197.55	8%
Δ Labor costs	57.54	20%
Δ Fixed costs	162.07	188%
Δ Gross profits	120.25	51%
Δ Net profits	-41.73	-28%

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Aggregate Entry Results

Variable	Absolute	Relative
Panel C: Government and Total Surplus		
Δ Pharmacy tax	-122.38	-71%
Δ Value-added tax	19.76	8%
Δ Total surplus	-76.41	-7%

Aggregate Entry Results

Variable	Absolute	Relative
Panel C: Government and Total Surplus		
Δ Pharmacy tax	-122.38	-71%
Δ Value-added tax	19.76	8%
Δ Total surplus	-76.41	-7%

Aggregate Entry Results

Variable	Absolute	Relative
Panel C: Government and Total Surplus		
Δ Pharmacy tax	-122.38	-71%
Δ Value-added tax	19.76	8%
Δ Total surplus	-76.41	-7%

Descriptives for Moving Pharmacies

Variable	Mean	Std. Dev.	P10	P50	P90	N
Δ Profit	6067	6895	456	2904	14144	32
City area	0.03	0.18	0.00	0.00	0.00	32
Distance (minutes)	8.34	8.81	0.38	6.72	22.02	32
Distance (km)	8.98	10.61	0.14	4.42	26.85	32
Δ Closest rival (minutes)	-4.83	7.32	-16.68	-0.39	0.46	32
Δ Closest rival (km)	-5.89	8.81	-17.26	-0.39	0.37	32

Notes: This table presents descriptive statistics of the pharmacies that wish to change location. A total of 32 (1.4%) pharmacies wished to move. Their share of total profits is 1.50%.

Conclusions

- In the counterfactual with entry deregulation without other regulatory changes:
  - $\rightarrow$ (Almost all) Consumers gain through shorter distances and more options.
  - $\rightarrow$ Increased # pharmacies $\Rightarrow$ lost economies of scale.
  - $\rightarrow$ Even more important: Aggregate fixed costs increase substantially.
  - $\rightarrow$ $\Rightarrow$ aggregate pharmacy profits decrease.
  - $\rightarrow$ Government loses tax revenue as it is tied to pharmacy revenue.
- $\Rightarrow$ entry is excessive from a welfare point of view
- Current entry regulation ”compensates” for the inefficiencies caused by other regulatory measures (e.g. fixed markups, pharmacy taxation).
- Deregulation of entry should not be pursued without considering other regulatory changes at the same time.

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Appendix

Markups

Wholesale price (WP)	Retail price (2003)	Retail price (2014)	Retail price (2023)
0–9.25 / 0–7.49	1.5 × WP + 0.50 €	1.45 × WP	1.42 × WP
9.26–46.25 / 7.50–39.99	1.4 × WP + 1.43 €	1.35 × WP + 0.92 €	1.35 × WP + 0.52 €
46.26–100.91 / 40.00–99.99	1.3 × WP + 6.05 €	1.25 × WP + 5.54 €	1.24 × WP + 4.92 €
100.92–420.47 / 100.00–399.99	1.2 × WP + 16.15 €	1.15 × WP + 15.63 €	1.15 × WP + 13.92 €
over 420.47 / 400.00–1499.99	1.125 × WP + 47.68 €	1.1 × WP + 36.65 €	1.10 × WP + 33.92 €
over 1 500			1 × WP + 183.92 €

Variable	Mean	Std. Dev.	P10	P50	P90	N
Pharmaceutical sales (€M)	3.32	3.21	0.72	2.45	6.61	818
Inner city (1/0)	0.35	0.48	0.00	0.00	1.00	818
Outer city (1/0)	0.13	0.33	0.00	0.00	1.00	818
Rural center (1/0)	0.08	0.27	0.00	0.00	0.00	818
Supermarket nearby (1/0)	0.59	0.49	0.00	1.00	1.00	818
Mall nearby (1/0)	0.21	0.41	0.00	0.00	1.00	818
Healthcare nearby (1/0)	0.26	0.44	0.00	0.00	1.00	818
Public transport nearby (1/0)	0.07	0.25	0.00	0.00	0.00	818
Population density (pop. in cell)	2.14	2.70	0.28	0.99	6.12	818
Jobs density (jobs in cell)	1.82	4.24	0.11	0.53	4.23	818
Main pharmacy (1/0)	0.79	0.41	0.00	1.00	1.00	818
YA (1/0)	0.02	0.15	0.00	0.00	0.00	818