Chain Formation and Consumer Welfare on the Retail Pharmacy Market

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Regulation of retail pharmacies

The regulation of the European retail pharmacy market has gone through substantial changes in the past two decades.

- **Entry restrictions** based on demographic and distance criteria
  - **to prevent the excess entry** inherent on markets with high regulated prices and homogeneous products (Mankiw and Whinston, 1986)
  - often **too restrictive** from a social welfare perspective (Schaumans and Verboven, 2008)

- **Ownership of pharmacies** in two dimensions:
  1. **the role of pharmacist**
  2. **chain formation**

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Multiple ownership regulation on the pharmacy market

Table: Pharmacy regulation in a subset of OECD countries

Country	Entry restrictions (1)			Ownership (2)		Pricing (3)	
	General	Population	Distance	Pharmacist	Chains	Margins	Regressive
Austria	Y	Y (5500)	Y (500m)	Y	N	Y	Y
Czech Republic	N	N	N	N	Y	Y	Y
Canada	N	N	N	N	Y	O	O
Denmark	O	N	N	O	O	Y	Y
Finland	Y	O	Y	Y	N	Y	Y
France	Y	Y (2500)	N	Y	Y	Y	Y
Germany	N	N	N	Y	O	Y	Y
Italy	Y	Y (3300)	Y (200m)	N	N	Y	N
Netherlands	O	N	N	N	Y	Y	N
Norway	N	N	N	N	Y	Y	N
Slovak Republic	N	N	N	Y	Y	Y	Y
Spain	Y	Y (2800)	Y (250m)	Y	N	Y	Y
Sweden	N	N	N	N	Y	Y	Y
United Kingdom	N	N	N	N	Y	O	N
USA	N	N	N	N	Y	N	N

Notes: Y - yes/permitted, O - mentioned, but open to interpretation/partially allowed, N - no/not permitted. Source: compiled

Rationale for multiple ownership bans

Statement of Federal Union of German Associations of Pharmacists, 2021

"The ban on third-party and multiple ownership stresses the ***personal responsibility*** *and liability of self-employed pharmacists in the healthcare sector. It* ***separates the pharmaceutical supply from companies' exclusive intention to maximise return****."*

"There is a danger for all patients that ***chain pharmacies may not provide independent advice*** *as their owners (e.g. manufacturers) are driven by commercial interests and only aim at selling certain products. In particular,* ***over-the-counter (OTC) drugs to creating additional demand*** *which may lead to abuse and danger to one's health and life."*

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Empirical evidence on misconduct

- Janssen and Zhang (2020): change in **dispensation policies during the opioid epidemic** in the US
  - **independent pharmacies on dispense 40.9% more opioids** and 61.7% more OxyContin, with a substantial portion of this use being categorized as recreational
  - **independent pharmacies may have a lower cost of misconduct** due to lower levels of oversight,
  - a pharmacy owner is entitled to a **higher share of the profits** and thus may prioritize profitability,
  - **integrated information systems** may raise quality.
- Kuang et al. (2020): **non-prescription sale of antibiotics** and the service quality of community pharmacies in China:
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Rising market concentration and quality concerns

- Vogler et al. (2006): after deregulation in Norway, 80% of pharmacies are part of a chain owned by a wholesaler ⇒ **market power and foreclosure concerns**
- Vogler et al. (2012): **excess new entry may lead to fewer pharmacists per outlet** and thus lower service quality.
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Research agenda and results overview

1. **Do consumers perceive chain pharmacy services as inferior** to independent firms?
   - there is **no** systematic **evidence** for consumers **preferring independent sellers**
2. Is there an **efficiency differential** between chain affiliates and independent firms?
   - chain pharmacies require **significantly lower number of employees** than independent counterparts
3. **Do chains** break-even more easily than independent firms?
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Slovak deregulation process

- From 1998 to 2004 entry levels were constrained and **self-regulated by the Slovak Chamber of Pharmacists**.

- In 2004, Slovakia shifted to a liberalized entry regime: **no geographic restrictions and no ban on multiple ownership**.

- **Chain formation** in two formats:
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Chain market shares

	Freq.	Market share	Virtual chain	Vertical int.	Owner/Manager of network
Plus	444	21.01	Y	Y	Distributor: Unipharma
Dr.Max	276	13.06	N	O	Insurer: Mirakl/PENTA
Partner	235	11.12	Y	Y	Distributor: Phoenix
VASA lekaren	216	10.22	Y	Y	Distributor: Med-Art
Benu	61	2.89	N	Y	Distributor: Phoenix
Druzstvo lekarni	49	2.32	Y	N	Horizontal
Farmakol	48	2.27	N	Y	Distributor: Farmakol
Schneider	44	2.08	N	N	Horizontal
Moja lekaren	28	1.33	Y	Y	Distributor: Pharmos
Apotheke	5	0.24	N	Y	Distributor: Unipharma
Independent	707	33.46	-	-	-

Notes: Y - yes; N - no; O - integration with other health care providers.

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Data

1. **Prescription-level** information:
   - 58,005,693 fulfilled prescriptions of medication in 2017
   - address of the prescribing physician
   - address of the pharmacy fulfilling the prescription
   - quantity of the product purchased (in packages)
   - price paid by the insurer and by the patient
   - diagnosis of the patient

   $\Rightarrow$ total prescription revenue and output per pharmacy

   $\Rightarrow$ location-specific catchment area and potential market size by diagnosis

2. **Pharmacy-level** information ($N = 1956$):
   - chain affiliation
   - location and opening hours data
   - employment: number of pharmacists and pharmacy technicians

Data

3. **Industry-level** information:
   - share of OTC drugs and medical devices in total drug sales (23%)
   - wage costs per pharmacist (€1,744) and per technician (€1,276)
   - regulated pharmacy retail margins for each medication

	Mean	SD	P10	P90
Revenue from prescriptions (€1,000)	509.17	688.40	1,059.13	66,662.73
Sales of prescription medication (1,000 units)	40.87	36.20	10.33	81.99
pharmacists	2.16	1.40	1	4
technicians/assistants	1.03	1.20	0	2
work days open per year	243.26	25.97	233	256
days open per year	274.52	46.77	239	350
Nonstop (open $>$ 50 weekends)	.09	.27	0	0
Distance to closest hospital (km)	6.42	7.24	0.29	17.42

Diagnosis-level demand specification

For a given diagnosis, the **utility of individual** i **of type** c **from purchasing at pharmacy** j in transaction t is:

$$\begin{aligned}\tilde{u}_{ijtc} &= u_{ijtc} + \varepsilon_{ijtc} \\ &= \gamma_c d_{ijt} + \beta_c x_{jt} + \xi_{bc} + \varepsilon_{ijtc}.\end{aligned}$$

d_{ijt} - distance from prescribing physician to pharmacy, x_{jt} - location characteristics and opening hours, ξ_{bc} - chain fixed effects, ε_{ijtc} - extreme value preference shock.

Demand characteristics:

- if consumer type were known $\Rightarrow$ **conditional logit model**
- no outside option $\Rightarrow$ **no market expansion**
- no variation in margins $\Rightarrow$ **utility is scale-free** (or measured in km)

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Consumer types and purchase probability

Preferences for pharmacy characteristics may **vary across individuals with different lifestyles**:

- parameter distribution is not be unimodal,
- distribution of the parameters across latent consumer types $c = 1, \cdots, C$ (Heckman and Singer, 1984).

Likelihood function:

$$\mathcal{L} = \sum_{i}^{N_d} \ln \sum_{c=1}^{C} \pi_c \prod_{t=1}^{T_i} \prod_{j=1}^{J_t} \left(\frac{\exp(x_{ijt}\beta_c + d_{ijt}\gamma_c)}{\sum_{k=1}^{J} \exp(x_{ikt}\beta_c + d_{ikt}\gamma_c)} \right)^{\{\iota_{it}=j\}} \quad (1)$$

π_c - probability that consumer i fall into the latent consumer group c,
$\{\iota_{it} = j\}$ - indicator variable $= 1$ if j is chosen.

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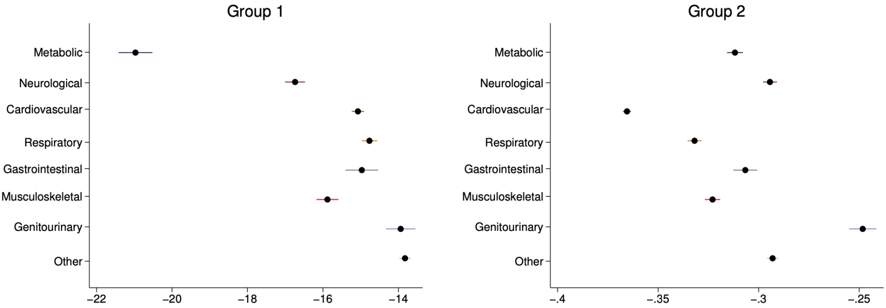
Consumer types and distance sensitivity

- Algorithm converges to **2 groups for all diagnoses**.
- Systematic **differences in distance sensitivity**:
  - Group 1: distance sensitive
  - Group 2: low distance sensitivity, higher response to branding.



Chain utility as distance reduction $(-\xi_{bc}/\gamma_c)$

Large chains

	Group 1		Group 2		Group 1		Group 2	
	Dr. Max (standard chain, $n = 276$)				*Plus (virtual chain, $n = 444$)*			
Metabolic	0.028	(0.001)	1.400	(0.037)	0.004	(0.001)	0.568	(0.034)
Neurological	0.058	(0.001)	0.370	(0.035)	0.019	(0.001)	0.301	(0.032)
Cardiovascular	0.042	(0.001)	1.140	(0.016)	0.003	(0.001)	0.474	(0.015)
Respiratory	0.028	(0.001)	0.568	(0.029)	0.003	(0.001)	0.455	(0.027)
Gastrointestinal	0.043	(0.002)	0.977	(0.056)	0.008	(0.002)	0.310	(0.052)
Musculoskeletal	0.034	(0.001)	1.021	(0.034)	−0.005	(0.001)	0.459	(0.032)
Genitourinary	0.026	(0.002)	0.886	(0.083)	0.008	(0.002)	0.954	(0.078)
Other	0.034	(0.001)	0.440	(0.028)	0.006	(0.001)	0.483	(0.025)
	Partner (virtual chain, $n = 235$)				*Vasa lekaren (virtual chain, $n = 216$)*			
Metabolic	0.003	(0.001)	0.521	(0.040)	−0.002	(0.001)	0.404	(0.042)
Neurological	0.018	(0.001)	−0.040	(0.034)	0.033	(0.001)	−0.169	(0.039)
Cardiovascular	−0.008	(0.001)	0.387	(0.017)	−0.012	(0.001)	0.164	(0.018)
Respiratory	0.008	(0.001)	0.154	(0.032)	−0.004	(0.001)	−0.017	(0.034)
Gastrointestinal	0.008	(0.003)	0.386	(0.060)	0.002	(0.002)	0.046	(0.064)
Musculoskeletal	−0.010	(0.002)	0.390	(0.037)	−0.019	(0.001)	0.262	(0.039)
Genitourinary	−0.005	(0.003)	0.912	(0.088)	0.002	(0.003)	0.377	(0.093)
Other	0.000	(0.001)	0.203	(0.029)	−0.014	(0.001)	0.122	(0.031)

Notes: Standard errors are in parentheses. The variable n measures the number of pharmacies in the chain.

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Small chains

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	Benu (standard chain, $n = 61$)				*Small chain ($n < 50$)*			
Metabolic	−0.052	(0.003)	−1.198	(0.077)	−0.004	(0.001)	−0.366	(0.047)
Neurological	0.011	(0.003)	−1.784	(0.073)	0.018	(0.001)	−0.572	(0.043)
Cardiovascular	−0.026	(0.002)	−1.203	(0.035)	−0.004	(0.001)	−0.565	(0.022)
Respiratory	−0.028	(0.003)	−0.857	(0.049)	−0.004	(0.001)	−0.628	(0.037)
Gastrointestinal	−0.012	(0.007)	−1.126	(0.108)	−0.009	(0.003)	−0.760	(0.074)
Musculoskeletal	−0.007	(0.004)	−1.115	(0.069)	−0.007	(0.002)	−0.434	(0.043)
Genitourinary	−0.010	(0.007)	−0.683	(0.139)	−0.013	(0.003)	−0.459	(0.104)
Other	0.017	(0.003)	−1.171	(0.051)	−0.017	(0.001)	−0.692	(0.034)

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Smaller chains offer lower perceived quality:

- possible **specialization in OTC products**?
- **endogenous outcome** regarding chain size? (chains with low perceived quality may have a higher rate of bankruptcy and thus fail to grow)

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Consumer surplus gains from chain formation

- **Consumer surplus** estimate:

$$CS = \sum_{d=1}^{8} \sum_{c=1}^{C} \pi_c \sum_{i=1}^{N_d} \sum_{t=1}^{T_{id}} -\frac{c_{dist}}{\gamma_c} \ln\left(\sum_{j \in J_t} \exp(u_{idtj})\right) q_{it}$$

- **Value of travel time** in Slovakia is approximately €7.7 per hour (Wardman et al., 2016)
  - If walking speed is 15 minutes per km $\Rightarrow$ cost per kilometer to and back from a pharmacy is €3.85.
- **€29.9 million consumer surplus gains** from chain formation per year ($\approx$ approximately 3% of industry revenue).
  - we assume that all pharmacies would continue to be active on the market as independent firms
  - if chain affiliation results in lower costs, removing the networks may lead to changes in consumer surplus via decreased availability

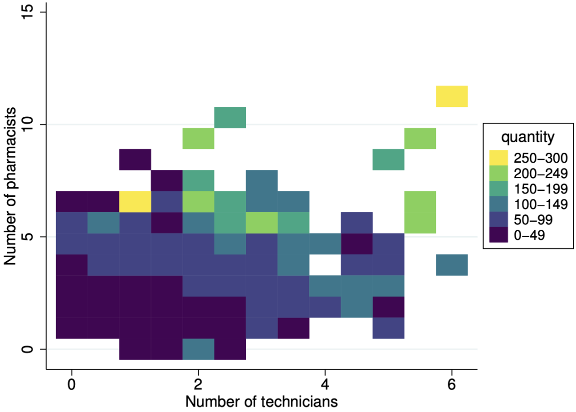
Provision of pharmaceutical services

Employee levels and output

Firms hire **quality-adjusted pharmacists** to satisfy demand:

$$l_j = 40(n_{pj} + \frac{w_t}{w_p} n_{tj})$$

n_{pj} - number of fully qualified pharmacists, n_{tj} - number of technicians



Notes: the median number of transactions fulfilled by pharmacies adjusts with employment levels: similar output goals with varying ratios of each employee type

Production function specification

We assume the production function with **constant returns to scale**:

$$(1 + s_j^{OTC})q_j^M = \exp(\alpha_0 + \alpha_b + \omega_j)l_j$$

q_j^M - total sales of medication, s_j^{OTC} - OTC sales as a fraction of medication sales q_j^{OTC}/q^M, α_0 - productivity of independent pharmacies, α_b - chain fixed effect, ω_j - location-specific shock, l_j number of quality-adjusted pharmacists.

Labor demand:

$$\ln l_j = -\alpha_0 - \alpha_b + \ln(1 + s_j^{OTC}) + \ln q^M$$

$\Rightarrow$ higher OTC sales result in lower estimated productivity ▸ estimates

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Marginal productivity per pharmacist

	MP_b (units)		$MP_0 = MP_b$ (p-value)
Independent	13,124	(443)	-
Dr Max	16,068	(871)	0.003
Small chain	15,769	(873)	0.007
Plus	15,616	(505)	0.000
Partner	14,703	(629)	0.041
Vasa lekaren	14,029	(685)	0.274
Benu	8,092	(1,571)	0.002
N		1,635	

Note: Standard errors in parentheses.

$\Rightarrow$ marginal productivity per pharmacist is on average higher for chains.

$\Rightarrow$ effect is underestimated if OTC sales are higher for chains.

Fixed costs

In the final step of our analysis we aim to quantify the **potential fixed cost savings** available to pharmacies who join a chain

As in Eizenberg (2014), **we infer** these gains following a **revealed preference approach** to estimate the **bounds of fixed costs** across different pharmacy types.

Based on the demand and costs model we can calculate expected variable profits of each pharmacy outlet:

$$\pi_j^V(A) = \hat{r}_j^{net} - w_p \hat{l}_j$$

where A is a set of potential entry locations wich can be divided into two subsets:

1. A^1 contains all locations in which entry occured
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Fixed costs

For each brand b operationg pharmacies in location set $A_b^1 \in A^1$ the expected variable profits are given by sum across branch locations

$$\Pi_V^b(A) \equiv \sum_{j \in A_b^1} \pi_j^V(A).$$

Firms play a two stage game:

1. In the first stage, each firm forms expectations regarding variable profits from entering a location j
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The equilibrium concept implies that for each location in the entry set A_b^1, the expected additional variable profits from entry for chain b must be sufficient to offset the fixed costs of operating:

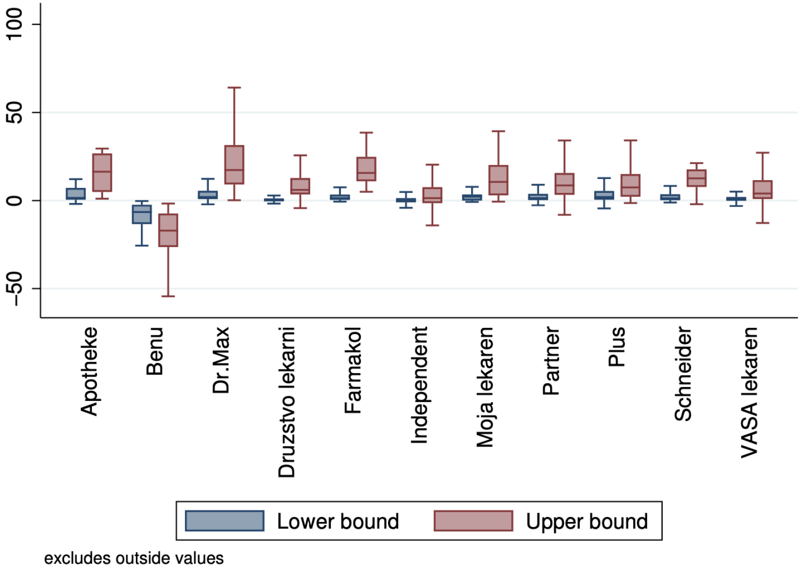
$$\Delta\Pi_V^b(A_b, A_b - 1_j) \equiv \Pi_V^b(A_b) - \Pi_V^b(A_b - 1_j) \geq f_j^b \text{ for } \forall j \in A_b^1$$

while for the entry locations A^0 this is not true:

$$\Delta\Pi_V^b(A_b + 1_j, A_b) \equiv \Pi_V^b(A_b + 1_j) - \Pi_V^b(A_b) < f_j^b \text{ for } \forall j \in A_b^0$$

The above conditions imply bounds for the fixed costs of each brand.

Estimated bounds by chain (in €1,000)



Conclusion and discussion

- Estimated fixed costs margins are **not indicative of extra-normal profits from OTC drugs**
- Productivity levels indicate that chains **result in cost savings for the industry**.
- Pharmacy chains **do not appear to perform worse** than independents **in terms of perceived quality**.

Discussion:

- **foreclosure** at the medication level
- dynamic effects due to **exit of smaller chains**
- **selection issue** for fixed cost estimation
- financial statement data on **overall revenues**
- **regional variation in catchment areas**
- modelling **price rabates**

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Production function estimates

Variable	OLS (1)	GMM (2)	OLS (3)	GMM (4)	MP_b (units)	$MP_0 = MP_b$ (p-value)
Dr Max			-0.196	-0.202	16,068	0.003
			(0.065)	(0.065)	(871)	
Plus			-0.244	-0.174	15,616	0.000
			(0.049)	(0.047)	(505)	
Benu			0.434	0.484	8,092	0.002
			(0.164)	(0.197)	(1,571)	
Vasa lekaren			-0.092	-0.067	14,029	0.274
			(0.063)	(0.060)	(685)	
Partner			-0.183	-0.114	14,703	0.041
			(0.060)	(0.055)	(629)	
Small chain			-0.214	-0.184	15,769	0.007
			(0.069)	(0.066)	(873)	
Constant	-5.822	-5.891	-5.697	-5.793	13,124	-
(Independent)	(0.018)	(0.017)	(0.032)	(0.034)	(443)	
N	1,635	1,635	1,635	1,635	1,635	1635

Notes: Standard errors in parentheses. MP_b measures the chain-specific marginal productivity per "quality-adjusted" pharmacist. MP_0 denotes productivity estimates at unbranded pharmacies. Productivity estimates are based on the GMM model reported in Column (4).

⇒ GMM based on demand instruments from the spatial demand model

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