Preemption in spatial competition: Evidence from the retail pharmacy market

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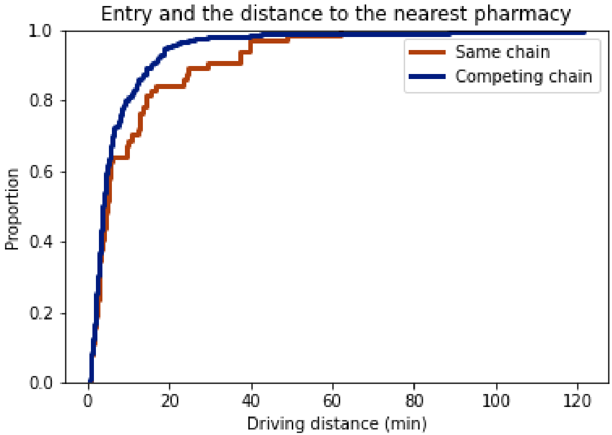
Motivation

- Urbanization and urban-rural inequality put spatial policies on the forefront of the political debate
- Economic theory points at multiple forces that can render firm location configurations inefficient in spatially differentiated markets
- These issues can lead to unrealized gains for consumers and firms
- Empirical study of preemptive entry among pharmacy chains in Norway

Market deregulation and entry behaviour

- Rapid growth in the number of pharmacies after deregulation in 2001
- Multi-store firm: tradeoff between cannibalisation and business-stealing motives



Summary

- Puzzling patterns in which firms favor the presence of own outlets in a market
- Preemptive motives play a key role
- Private information about local market demand
- Spatially disaggregated demand model with overlapping markets
- Event study and linear probability model are consistent with private information hypothesis
- Outline a model of dynamic entry competition

Preemption in spatial competition

- Lack of empirical work studying preemption in spatial competition
- The definition of preemptive entry hinges on how much the likelihood of one firm entering a particular location today is impacted by the likelihood of its opponent entering the same location in the future (Zheng 2016)
- Igami and Yang (2016) showed the role of market shocks commonly observed by firms in preemptive entries
- We show a role of private information in preemptive entries
- Flexible configuration of local markets is able to capture rich substitution patterns

Institutional setting

- Focus on the market of prescription drugs (about 70% of turnover)
- Sales of prescription drugs in Norway is highly regulated and only permitted at licensed pharmacies
- Market regulation:
  - Price ceilings (reference price regulation)
  - No price competition
  - Reimbursement through National Insurance Scheme

Data

- Individual level purchases of prescription drugs from 2004 to 2011,
- Geocoded data on pharmacy locations,
- Pharmacy characteristics: affiliation, size, standing alone or in a shopping mall,
- Pharmacies openings between 2004 and 2011,
- Gender and age population distribution by basic units (similar to census blocks in the US),
- Route information between basic units (areas where people live) and pharmacies.

Demand Model Overview

Spatially disaggregated discrete-choice model:

$$R_{gjt}(\theta) = \sum_{l=1}^{L} Q_{glt}(\theta) Pr_{glt}(j|\theta),$$

where
l is location (BU), t is period, g is demographic group, and j is pharmacy,
R_{gjt} is revenue of pharmacy j in demographic group g at time t,
Q_{glt} is aggregate demand of group g in location l, function of groups and time,
$Pr_{glt}(j|\theta)$ is market share of pharmacy j in group g in location l, assumed to be logit, determined by distance, pharmacy characteristics, and market structure.

Market definition

Consumer Random Utility

Consumer belonging to group g residing in location l going to pharmacy j in period t:

$$
\begin{aligned}
u_{igtj} &= v_{igtj} + \varepsilon_{igtj}, \varepsilon_{igtj} \sim \mathrm{IID\,EV\,I}, \\
v_{igtj} &= \gamma_g d_{igj} + \nu_g d_{igj} \times pop.density_{igt} + \kappa_g cost_{igj} + \delta_{gj} x_{jt}
\end{aligned}
$$

where
d_{igl} is distance between pharmacy j and location l,
$pop.density_{igt}$ is population density at location l at time t,
$cost_{igj}$ is cost of travelling between pharmacy j and location l,
x_{jt} is a vector of pharmacy characteristics at time t (mall location, nearby wine monopoly, etc.).

Full Demand Model

$$R_{gjt}(\theta) = \sum_{l=1}^{L} Q_{glt}(\theta) Pr_{glt}(j|\theta)$$

$$Q_{glt}(\theta) = (\beta_g + \tau_g t + \sum_{s=1}^{11} \mu_g^m \mathbf{1}\{month(t) = m\} + \xi_{g\ell t}) N_{glt}$$

$$Pr_{glt}(j|\theta) = \frac{\exp(v_{gltj}(\theta))}{\sum_{k \in \mathcal{J}_t} \exp(v_{gltk}(\theta))}$$

where
N_{glt} is number of individuals in group g living in location l at time t, $\xi_{g\ell t}$ is a location specific demand unobservable that determines the value of being present in the local market (play an important role later).

Econometric Approach

Method of simulated moments to match the observed sales in each demographics group at a pharmacy j in period t to the predicted ones in our model:

$$\hat{\theta} = arg\min_{\theta} \sum_{j=1}^{J} \sum_{g=1}^{G} \sum_{t=1}^{T} [R_{gjt} - \hat{R}_{gjt}(\theta)]^2$$

Estimation Results (male)

	M0-24	M25-45	M46-59	M60-74	M75-89	M90+
Distance	-0.033***	-0.39***	0.300	-0.309***	-0.449***	-11.410
	(0.001)	(0.004)	(0.257)	(0.004)	(0.01)	(10.85)
Travel cost	0.002***	-0.057***	-1.588***	-0.024***	-0.065***	-35.73
	(0.000)	(0.002)	(0.544)	(0.001)	(0.004)	(34.04)
Distance x pop.density	0.000***	0.000***	-0.971***	-0.000***	-0.000***	-0.581
	(0.000)	(0.000)	(0.335)	(0.000)	(0.000)	(0.550)
Pharmacy size (m^2)	0.001***	0.001***	0.216***	0.001***	0.002***	1.317
	(0.000)	(0.000)	(0.074)	(0.000)	(0.000)	(1.246)
Center	-0.169***	-0.076***	0.006	-0.132***	-0.076***	-3.366
	(0.006)	(0.009)	(0.879)	(0.008)	(0.015)	(4.445)
Mall	-0.127***	-0.366***	0.059	-0.233***	-0.312***	2.712
	(0.010)	(0.013)	(2.497)	(0.010)	(0.017)	(8.180)
Large mall	0.282***	0.231***	-0.091	-0.080***	-0.362***	3.244
	(0.008)	(0.009)	(1.162)	(0.009)	(0.017)	(6.830)
Wine monopoly	0.114***	-0.217***	-0.078	0.084***	0.239***	-2.560
	(0.021)	(0.029)	(1.586)	(0.026)	(0.047)	(105.5)
Wine monopoly x large mall	0.400***	0.155***	-0.153	0.138***	-0.201***	-5.944
	(0.006)	(0.008)	(0.608)	(0.007)	(0.012)	(6.717)

Note: Standard errors are in parentheses. Significance levels are * - $p < 0.1$, ** - $p < 0.05$, *** - $p < 0.01$.
Number of pharmacies - 724. Number of pharmacy-month pairs - 55285.
Number of pharmacy-month-BUs - 31569626. Number of parameters per group - 29.

Estimation Results (female)

	F0-24	F25-45	F46-59	F60-74	F75-89	F90+
Distance	-0.352***	-0.287***	-0.280***	-0.311***	-0.722***	-1.208
	(0.003)	(0.003)	(0.002)	(0.004)	(0.011)	(2.266)
Travel cost	-0.025***	-0.018***	-0.015***	-0.018***	-0.004*	0.824
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(1.582)
Distance x pop.density	0.000***	0.000***	0.000***	-0.000***	0.000***	-0.341
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.634)
Pharmacy size m^2	0.001***	0.001***	0.001***	0.001***	0.003***	2.091
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(3.885)
Center	0.008	-0.077***	-0.072***	-0.080***	0.189***	-0.965
	(0.009)	(0.007)	(0.007)	(0.008)	(0.021)	(10.02)
Mall	-0.269***	-0.269***	-0.164***	-0.186***	-0.426***	0.140
	(0.013)	(0.011)	(0.009)	(0.010)	(0.022)	(19.65)
Large mall	0.563***	0.407***	0.220***	0.078***	-0.485***	0.018
	(0.009)	(0.007)	(0.008)	(0.009)	(0.023)	(8.932)
Wine monopoly	0.094***	-0.084***	0.193***	0.193***	0.442***	-0.077
	(0.027)	(0.023)	(0.021)	(0.025)	(0.064)	(19.35)
Wine monopoly x large mall	0.554***	0.319***	0.291***	0.253***	-0.473***	-1.046
	(0.007)	(0.006)	(0.006)	(0.007)	(0.017)	(9.024)

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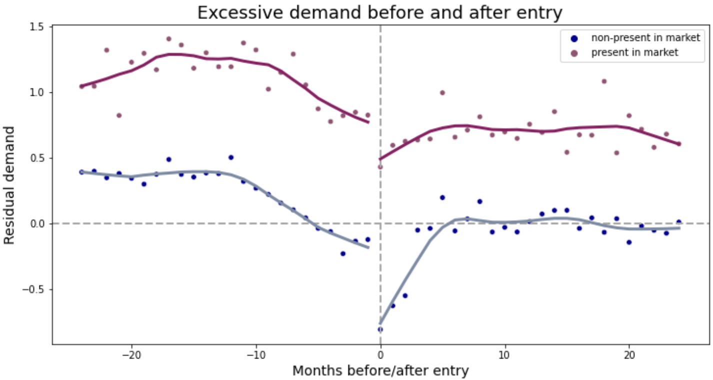
Role of private information

- Incumbents have an easier time learning about local market demand by observing their own sales in the market
- Demand model allows us to estimate residual demand ξ_{glt} for each location l
- Are there any difference between residual demand for incumbents and new players?
- Event study:
  - focus on monopoly to duopoly transitions,
  - we classified entries based on whether the entering chain was incumbent,
  - computed average residual demand before and after entry.

Event study



Each dot is aggregated residual (excessive) local demand averaged over markets where entries occurred

Linear probability model

To control for differences in observable characteristics relating to the events, we use a linear regression specification:

$$\mathbf{1}\{\text{same chain}\}_e = \alpha \hat{\xi}_e + x_e \beta + \text{error}_e,$$

where e denotes entry events, and $\hat{\xi}_e$ is the predicted demand residual averaged over the 3, 6, or 12 months prior to the entry, and where x_e is a vector of characteristics of the entry event, including chain dummies, characteristics of the store, and the market size.

Linear probability model: results

	Dep. Var.: Same/competing chain entry			
	I	II	III	IV
Center	0.12	0.11	0.12	0.15
	(0.14)	(0.13)	(0.13)	(0.15)
Small mall	0.33	0.41*	0.60**	0.72**
	(0.24)	(0.22)	(0.26)	(0.27)
Wine mon. in small mall	-0.25	-0.19	-0.20	-0.28
	(0.25)	(0.22)	(0.22)	(0.27)
Large mall	0.15	0.08	-0.03	0.06
	(0.15)	(0.14)	(0.14)	(0.15)
Wine mon. large mall	0.04	-0.00	-0.02	0.05
	(0.16)	(0.15)	(0.15)	(0.16)
Market size	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Residuals prior 3 months		0.13***		
		(0.03)		
Residuals prior 6 months			0.12***	
			(0.04)	
Residuals prior 12 months				0.13**
				(0.06)
Obs.	53	53	53	53

Sketch of Entry Model

- Three competitors - pharmacy chains
- State space is defined by a discrete set of locations $\mathcal{J}$ (the set of pharmacies present in the final year of our data)
- At each location at a point in time, there can be one of the three pharmacy chains or no pharmacy currently present: $s_{jt} \in \{0, 1, 2, 3\}$
- In each period each firm chooses a location j in space $\mathcal{J}$. The choice set for a firm is the set of locations where no other chain has yet opened a pharmacy

Sketch of Entry Model

- Flow profit from a pharmacy at location j:

$$\pi_{jt} = R_{jt} - VC_{jt}$$

  where R_{jt} is the total revenue earned at pharmacy j in period t, and VC_{jt} is total variable costs

- Revenue depends on the composition of sales

$$R_{jt} = \sum_{g} \sum_{l} Q_{glt}(\theta) Pr_{glt}(j|\theta),$$

  and Q_{glt} is aggregate demand of group g in location l, $Pr_{glt}(j|\theta)$ is market share of pharmacy j in group g in location l

Dynamic Problem

The dynamic problem takes the form:

$$\max_{d_1,\ldots,d_T} \sum_{t=1}^{T} \delta^t \mathbb{E}[\Pi_{ct}(S_t, d_t)],$$

where the chain-level profit is

$$\Pi_{ct}(S_t, d_t) = \sum_{j\in\mathcal{J}} \left[\mathbf{1}\{s_{jt} = c\}\pi_{jt}\right] - FC(d_t) + \omega_{ct}(d_t),$$

where $FC(d)$ is the entry cost of opening a pharmacy in the chosen location, d, and ω_{ct} is a vector of independent and identically distributed private cost shocks

Information structure and timing

- When a firm has the right to move, it immediately observes current market configuration, demand shifters and idiosyncratic shocks to all currently available locations $\{\omega_{ct}(d)\}_{d \in \mathcal{D}(S_t)}$
- State of local demand $\xi_{\ell t}$ at a consumer location $\ell \in \mathcal{L}$ is a crucial variable for entry decision. We may decompose it into two parts:

$$\xi_{\ell t} = \rho \xi^1_{\ell t} + (1 - \rho)\xi^2_{\ell t}, \quad \rho \in [0; 1],$$

  where $\xi^1_{\ell t}$ is commonly observed by all firms and $\xi^2_{\ell t}$ is privately observed by the incumbent firm
- We define the incumbent chain c at location ℓ to be the firm that operates the pharmacy closest to ℓ
- The parameter ρ controls the extent to which market-level residual demand is common ($\rho \to 1$) or private ($\rho \to 0$) information

Conclusion

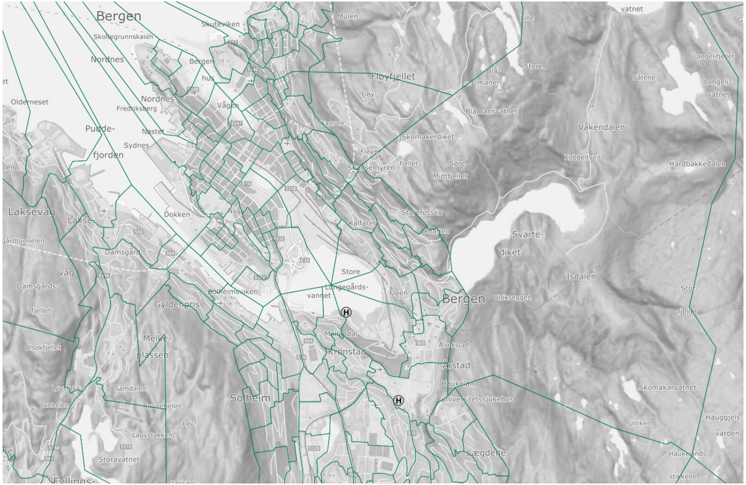
- We study the entry decisions of retail pharmacy chains in Norway following a deregulation of entry
- We document repeated entries by already present incumbent chains
- We formulate and estimate a rich model of demand with overlapping markets
- We propose that private information about local market conditions may play a role
- Next steps:
  - Test the hypothesis about private information using the dynamic structural model
  - Simulation counterfactual scenarios to evaluate the role of private information
  - Welfare analysis and policy implications

Market segmentation

- There is a surprisingly large amount of heterogeneity across consumer segments in terms of preferences for store characteristics
- If market segmentation was a primary driver, we would expect to see incumbents entering with significantly different characteristics

		Closest pharmacy to entrant	
	Total	Same chain	Competing chain
Distance to neighbor (driving min.)	8.0	10.5	7.2
Center	47.6%(107)	56.4%(31)	44.7%(76)
Shopping mall	32.0%(72)	29.1%(16)	32.9%(56)
Wine monopoly	7.6%(17)	3.6%(2)	8.8%(15)
Number of entries	225	55	170

Bergen division on basic units



Localized competition - market definition

- Overlapping markets: all pharmacies that individual can reach within one-hour drive

Back to demand model

Summary statistics

Transactions	
Observations (million transactions)	144.6
Total amount (NOK)	485
No. packages	1.25
Gender composition	
Male	0.436
Female	0.564
Age composition	
0-24	0.064
25-45	0.103
46-59	0.182
60-74	0.297
75-89	0.280
90+	0.074

References I

Igami, Mitsuru and Nathan Yang (2016). “Unobserved heterogeneity in dynamic games: Cannibalization and preemptive entry of hamburger chains in Canada”. In: *Quantitative Economics* 7.2, pp. 483–521.

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