Competition or Collusion? Entry Decisions in the Swedish Pharmaceutical Market

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Motivation

Motivation

- To counter (regulation-induced) low price sensitivity, pharmaceutical markets with generic competition are subject to price regulation in many countries.
- Over time those regulations have induced more intensive competition and lowered expenditure / dose (Kortelainen et al. 2023).
- Pharmaceutical firms are finding ways to lessen competition: Cartels (e.g. Clark et al. 2022; Starc and Wollmann 2025), anecdotal evidence, Sweden: descriptive.

Motivation - Example Market

Table: Descriptive Statistics by Package Size, Market 1

Package Size	No. of Firms	Average Price per Pill	Pill Share	Revenue Share
30	3.53	0.60	5%	2%
100	3.75	0.55	60%	28%
250	1	2.53	12%	**25%**
500	1	2.69	22%	**45%**

Notes: Monthly data 9/2011-12/2017.

- Out of 1 328 markets, 292 (22%) at least some of the time potentially collusive. These markets generate 34% of sales.
- $\Rightarrow$ Reasonable doubt that **spheres of influence** (Bernheim and Whinston 1990) or **market allocation** (Stigler 1964) may be practiced.

Research Questions

1. Are the observed entry patterns (monopoly package sizes) the result of
   - intense (post-entry price) competition or
   - potentially, of (tacit) collusion?
   - Current literature on Swedish pharmaceutical market (Janssen, 2022; Granlund and Rudholm, 2023) and multimarket collusion (Ciliberto and Williams, 2014; Miller, 2010) focuses on prices, not entry decisions (Sullivan, 2020a,b).

2. Would increasing substitution across package sizes help?

Rest of the Talk

1. Setting
2. Data, choice of 2 markets
3. Model tailored to the Swedish pharmaceutical market
4. Non-cooperative or collusive entry configuration?
5. Counterfactual analysis
6. Conclusions

Setting

Setting

- **Market**: active ingredient - dosage form - strength.
- A market is divided into POTM substitution groups: Active ingredient - dosage form - strength - **package size**.
- **Product of the Month** (POTM): a monthly auction within each substitution group.
- Physicians' decision: POTM group (package size).
- Regular pharmacies: Recommend POTM (cheapest) $\rightarrow$ POTM = Large sales. No substitution between package sizes.
- Consumers' choice set: products with the same package size.
- Dose pharmacies: can substitute between package sizes (more details later).

Setting

Dose pharmacies

- Bundle multiple prescriptions into a daily dose (for 3% of population, mainly in elderly care).
- Can substitute between package sizes but prefer large jar products.
- Same markups as regular pharmacies, no incentives to dispense the cheapest across package sizes.
- Proposal for forcing dose pharmacies to dispense the cheapest across package sizes (not implemented).

Data

Data sources

- Prices: TLV; Sales: IQVIA
- Dataset coverage: $>$ 300 active ingredients (ATC5), 1 328 markets.
- Time period: 12/2009-12/2017

Sample construction

- From the 2 therapeutic subgroups with the highest potentially collusive revenue, we choose 2 markets.
- Potentially collusive: at least 2 different firms having monopoly in different package sizes.
- These markets have
  1. 2 monopoly groups (Market 1 for 72 months, Market 2 for 8 months).
  2. same firms as monopolists.

Model & Estimation

Demand - Challenge

- **Challenge**: Two key features of the data in competitive package size groups (more than 1 bidder):
  1. Winner changes 60%
  2. Winner's market share close to 60%.
- Hard to reconcile with regular (discrete choice) demand models. Also, adding a dummy for being the winner:
  - Endogenous variable
  - A product market share's depends on whether it wins **and who wins**.
- **Solution**: Nested Logit demand model with incomplete information and a fixed extra market share for the winning product in each nest (package size group). Model

Estimation

- Nested logit demand model with an extra share for the winning product in each nest. Demand estimation in 2 steps. Demand
- MC estimation following Dubois and Lasio (2018), Fan and Zhang (2022). MC
- Monthly FC bound estimation following Eizenberg (2014), Wollmann (2018). FC

Is the observed entry configuration a static non-cooperative NE? Market 1

Table: Static Game Payoff Matrix ATC4_1

Fixed Cost: 127 SEK ≈ 12*EUR*						
A / B	**Competitive**		**Competitive+500**		**Competitive+250+500**	
Competitive	48674	-23	38529	660188	35289	854604
Competitive+250	340350	-23	272802	603659	**120728**	**605292**
Competitive+250+500	827434	-23	**277614**	**41071**	38326	8751

Outcome data source: TLV, IQVIA MIDAS Quarterly Sales and IQVIA MIDAS (2009–2017).

- **Competitive** = firm only enters the competitive package(s) it is observed in.
- The observed entry outcome.
- **The non-cooperative static Nash equilibria.**
- The observed entry outcome **not sustained** as a static non-cooperative NE.
- IC constraint: more profitable to collude with the observed entry outcome.

Is the observed entry configuration a static non-cooperative NE? Market 2

Table: Static Game Payoff Matrix ATC4_2

Fixed Cost: 3612 SEK ≈ 334*EUR*						
A / B	**Competitive**		**Competitive+250**		**Competitive+14+250**	
Competitive	19310	18805	**13257**	**40931**	12822	39187
Competitive+14	18679	18152	12117	39952	10909	40009
Competitive+14+250	39777	12442	9946	24578	23088	22565

Outcome data source: TLV, IQVIA MIDAS Quarterly Sales and IQVIA MIDAS (2009–2017).

- The observed entry outcome.
- **The non-cooperative static Nash equilibrium.**
- After the collusive period of 8 months, firms A and B move to the static non-cooperative NE.

Counterfactual

Counterfactual

- Key issue seems to be to allow substitution across package sizes not only for the physician and dose pharmacies, but also for patients and regular pharmacies.

- Counterfactual: Allow for across-package-size substitution using Iaria and Wang (2021) Product-Overlap Nested Logit model.
  1. Calculate expected profits in different entry configurations.
     EntryCounterfactual
  2. Check whether the 2 firms still want to stay in the "monopoly" package sizes.

Counterfactual, Market 1

- 250-pill → 30-pill
- 500-pill → 100-pill
- Firm A & B still stays in the "monopoly packages" in NE.

Original			
Package Size	Shares in pills (%)	Average Price per Pill	
30	5.20	0.60	
100	56.91	0.55	
250	11.64	**2.53**	
500	21.25	**2.69**	
Total	**95.00**	**1.27**	
Counterfactual			
Package Size	Shares in pills (%)	Average Price per Pill	% Change in price
30	8.38	0.65	8.47
100	54.59	0.53	-4.26
250	10.72	**0.97**	**-61.64**
500	21.77	**0.54**	**-79.79**
Total	**95.46**	**0.59**	**-53.58**

Outcome data source: TLV, IQVIA MIDAS Quarterly Sales and IQVIA MIDAS (2009–2017).

Counterfactual, Market 2

- 14-pill → 28/30-pill
- 250-pill → 98/100-pill
- Firm A & B exits the "monopoly" packages in NE.

Original			
Package Size	Shares in pills (%)	Average Price per Pill	
14	0.01	1.06	
28/30	2.09	1.12	
56	6.46	0.39	
98/100	77.17	0.62	
250	9.26	0.55	
Total	**95.00**	**0.61**	
Counterfactual			
Package Size	Shares in pills (%)	Average Price per Pill	% Change in price
14			
28/30	2.94	1.52	36.18
56	3.89	0.95	141.99
98/100	**82.94**	0.61	**-1.97**
250			
Total	**89.77**	**0.65**	**7.22**

Outcome data source: TLV, IQVIA MIDAS Quarterly Sales and IQVIA MIDAS (2009–2017).
Average price is sales-weighted.

Conclusions

Conclusions

- A non-negligible share of Swedish pharmaceutical sales occurs in markets where there is potentially tacit collusion through **spheres of influence** or **market allocation**, i.e., firms being monopolies in different package sizes.
- Studying two such markets in detail, we find that
  1. Observing two different firms being monopolists in different groups in a given market need not, but may, imply (tacit) collusion.
  2. Counterfactual results suggest that allowing substitution between package sizes in a collusive market would decrease expenditure per pill by 53%, but would increase expenditure per pill in a non-collusive market.

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Demand - Solution

- Standard indirect utility function:

$$v_{ij} = \alpha - \beta P_j + \gamma X_j + \xi_j + \epsilon_{ij} = \delta_j + \epsilon_{ij}$$

- This yields the standard market share expression for losing products:

$$s_j = s_{j|g} \times s_g = \frac{exp(\frac{\delta_j}{\sigma})}{exp(V_g)} \times \frac{exp(\sigma V_g)}{1 + \sum_g exp(\sigma V_g)}$$

- Winning product in nest g appears also as a separate product, yielding

$$v_{iwg} = \delta_{wg} + \epsilon_{iwg}.$$

- The market share of the winning product is then

$$D_j = s_w + s_j = s_{w|g} \times s_g + s_{j|g} \times s_g =$$

$$[\frac{exp(\frac{\delta_{wg}}{\sigma})}{exp(V_g)} + \frac{exp(\frac{\delta_j}{\sigma})}{exp(V_g)}] \times \frac{exp(\sigma V_g)}{1 + \sum_g exp(\sigma V_g)}.$$

Demand - Solution

- Firms choose and commit to δ_j.
- Uncertainty: ξ_j, ξ_{-j} unknown.
- **Assumption**: $-(\gamma X_j + \xi)/\sigma$ distributed EV Type I.
- Allows us to simplify the profit function and FOCs.
- After drawing ξ_j, price P_j^* is set according to

$$\delta_j^* = \alpha - \beta P_j^* + \gamma X_j + \xi_j$$

- Probability of winning based on:

$$P_j \leq P_k$$

- ... and can be expressed as

$$W_{j|g} = \frac{exp(\frac{\delta_j}{\sigma})}{\sum_k exp(\frac{\delta_k}{\sigma})}$$

- Equilibrium existence using the aggregative game approach (Nocke and Schutz, 2018; Garrido, 2024)

Demand Estimation

Table: Demand Estimation

	ATC4_1	ATC4_2
Price	-1.041***	-0.758***
	(0.088)	(0.091)
Log(within *MS*)	0.985***	0.163**
	(0.092)	(0.079)
Branded	3.228***	3.321***
	(0.241)	(0.250)
Parallel Import	5.219***	0.349
	(0.694)	(0.267)
Jar	1.004***	
	(0.086)	
Dose pharmacies only	-0.201	2.583***
	(0.162)	(0.109)
Month/Year	Yes	Yes
Market	Yes	Yes
Observations	7352	10738
1st-stage F-test	50.962	57.833

Notes: *MS* = market share. The base category is Generic. Robust SEs in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Outcome data source: TLV, IQVIA MIDAS Quarterly Sales and IQVIA MIDAS (2009–2017).

Implications of Demand and Supply

Table: Price and Marginal Cost Estimates

Market 1						
Package	Price Ceiling	Price per pill	Marginal Cost per pill	Price-Cost Margin %	No. of Firms	No. of Obs
30-pill	1.02	0.714	0.707	1	3.61	268
100-pill	1.08	0.66	0.59	10	3.93	285
250-pill	2.60	2.53	0.44	83	1	76
500-pill	2.69	2.69	0.37	86	1	76
Market 2						
Package	Price Ceiling	Price per pill	Marginal Cost per pill	Price-Cost Margin %	No. of Firms	No. of Obs
14-pill	1.25	1.06	0.83	22	1	8
28/30-pill	1.70	1.47	0.85	42	3.90	29
56-pill	1.72	0.51	0.36	29	5.47	43
98/100-pill	1.63	0.69	0.25	63	9.09	70
250-pill	0.55	0.55	0.15	72	1	8

Notes: Prices with standard deviations in parentheses and marginal costs with standard errors in parentheses. No. of obs is the number of product-month observations. Outcome data source: TLV, IQVIA MIDAS Quarterly Sales and IQVIA MIDAS (2009–2017).

Entry and Fixed Costs

- Entry condition for product j:

$$\Pi^f_{N^f} - \Pi^f_{N^f - j} - K^f \geq 0 \tag{1}$$

- where K^f is the (firm-specific) monthly fixed cost of entry into a nest.
- We assume that firms observe each others' entry decisions and entry cost K^f.
- We further assume that all firms play the same equilibrium.
- Eizenberg (2014); Wollmann (2018) use entry and exit to estimate upper and lower bounds of fixed cost.
- **Challenge**: Monopoly markets would not yield reliable estimates of fixed cost if monopoly a result of collusion.
- **Solution**: Use the upper bound fixed cost estimates from **competitive nests** - we estimate K^f only for firms in the monopoly nests.

Entry and Fixed Costs

Table: Fixed Cost Bounds

Profit (SEK)					
Market 1			Market 2		
Package	Lower Bound	Upper Bound	Package	Lower Bound	Upper Bound
500-pill	4703	612168	**250-pill**	1533	26979
250-pill	1868	231754	98/100-pill		16144
100-pill		127	56-pill		3612
30-pill		-5	28/30-pill		4362
			14-pill	3406	4585
Profit Ratio					
Market 1			Market 2		
Package	Lower Bound	Upper Bound	Package	Lower Bound	Upper Bound
500-pill	37.09	4828.03	**250-pill**	0.42	7.47
250-pill	14.73	1827.79	98/100-pill		4.47
100-pill		1.00	56-pill		1.00
30-pill		-0.04	28/30-pill		1.21
			14-pill	0.94	1.27

Outcome data source: TLV, IQVIA MIDAS Quarterly Sales and IQVIA MIDAS (2009–2017).

Estimation

Counterfactual

Table: Static Game Payoff Matrix - Market 1 - Counterfactual

Fixed Cost: 127 SEK				
B \ **A**	**Competitive**		**Competitive+500**	
Competitive	43820	775	31262	46192
Competitive+250	144178	713	**106158**	**44612**

Outcome data source: TLV, IQVIA MIDAS Quarterly Sales and IQVIA MIDAS (2009–2017).

Table: Static Game Payoff Matrix - Market 2 - Counterfactual

Fixed Cost: 3 612 SEK				
B \ **A**	**Competitive**		**Competitive+250**	
Competitive	**16437**	**12625**	14693	8411
Competitive+14	15486	9851	13166	5444

Outcome data source: TLV, IQVIA MIDAS Quarterly Sales and IQVIA MIDAS (2009–2017).