Downstream Competition and Exclusive Dealing

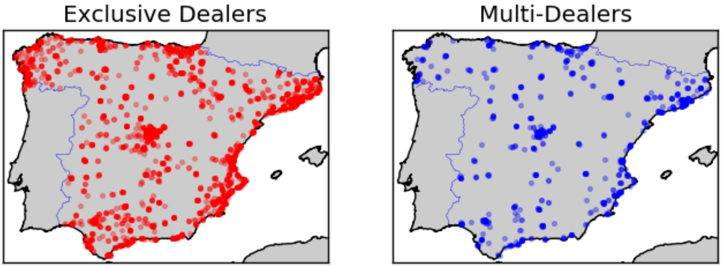
Franco Esteban Cattaneo

Graduate School of Economics and Social Sciences
University of Mannheim

Barcelona GSE Summer Forum - Applied Industrial Organization
June 12, 2019

Motivation - An empirical pattern

- Prevalence of exclusive dealing car dealerships in the European Market
  - Regulatory attempts to encourage dealers to sell multiple brands
  - Spain: around a 78% of exclusive dealing.



- Exclusive contracts in car retail, beer distribution, mobile phones sales, computer components.

Motives for Exclusive Dealing

⋆ Longstanding debate in the theory literature and regulatory policy

1. Preserve returns from promotional investment
   - Besanko and Perry (1993), Segal and Whinston (2000a), De Meza and Selvaggi (2007), Fumagalli, Motta and Rønde (2012)
2. Differentiate from competing retailers
   - Besanko and Perry (1994)
3. Manufacturers may use ED to raise retailers' costs to offer other brands.
   - Exclusionary motives: Aghion and Bolton (1987), Rasmussen et al. (1991), Bernheim and Whinston (1998), Segal and Whinston (2000b), Calzolari and Denicolò (2015)

→ Combined analysis of these aspects useful for competition authorities

Introduction (3 of 4)

Research Question

Exclusive dealing (**ED**) in the car retail sector arises as...

Competitive motives

- a consequence from retailers' genuine desire to differentiate from their local competitors.

Anticompetitive motives

- a result of manufacturers deterring competition within dealers by increasing the costs of selling multiple brands?

- **Relevant Question:** Anticompetitive dealer can exclude smaller manufacturers, reduce product variety and availability, and reduce consumer welfare.

Preview of the results

- Downstream competition plays a major role for the adoption of ED.
- No evidence of increased costs for multi-dealers (No foreclosure).

Introduction (4 of 4)

This paper

1. Novel dataset on car sales registry and retailers from Spain.
2. Estimate a model of car retailing
   - Manufacturers compete for dealers.
   - Dealers' choice on offerings are endogenous (Brand, ED).
   - Spatial demand for cars.
3. Identify the channels through which exclusive dealing affects competition.
   - **Demand side** (Nurski & Verboven, 2016): Consumers might value exclusivity.
   - **Supply side** (Asker, 2016): Exclusivity might raise rivals costs of distribution.
   - **Market structure**: Choice of ED is affected by local retail network structure. Interaction between how dense is the local market and incentives to differentiate from competitors.
4. New identification strategy for fixed costs.

Overview of the data

1. **Car sales:** Spanish Directorate-General of Traffic Summary Statistics
2. **Car characteristics:** Specialized magazines Summary Statistics
3. **Dealer locations and brands:** Collected from manufacturer's websites.
4. **Demographics:** income, geographical data. Various government agencies.

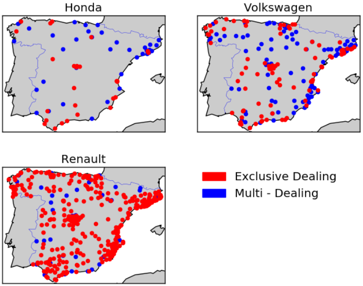
Pattern #1: Hidden multi-dealers and classification

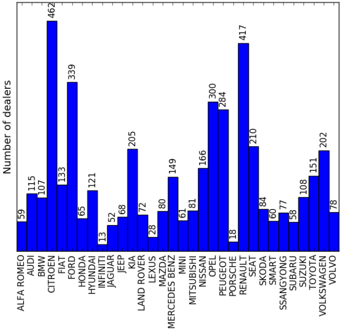
Figure 1: Avanti Motor Group, Armilla, Granada

Figure 2: Quadis Retail Group, Sant Boi de Llobregat, Barcelona

Data (2 of 3)

Patterns #2 and #3: Differences in dealer capilarity, and geographic distribution across manufacturers.

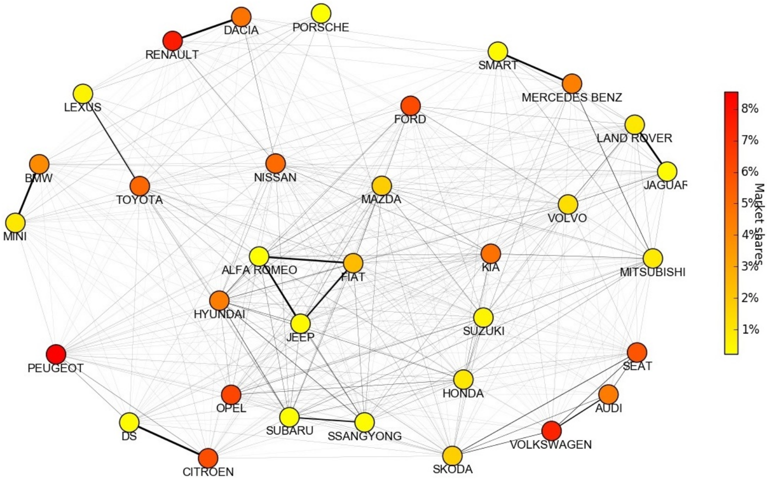




- 32 Brands, 3345 Dealers.
- 21.57% are multi-dealers. 41.40% of points of sale are multi-dealers.
- Smaller brands have a higher % multi-dealers.

Data (3 of 3)

Pattern #4: Differences intra-dealer competition across manufacturers.



Model

Timing of the model

Static game with four stages

1. Potential dealer $d \in E$ in a location l_d decides:
   - Whether to open a dealership at all, and if so, whether to...

   $\rightarrow$ Become an exclusive dealer of one brand.

   $\rightarrow$ Become a multidealer and sell products from several brands.
2. Manufacturers see their dealer networks and set wholesale prices.
3. Everyone sees wholesale prices and manufacturers set list prices so as to maximize the joint profits of their retail networks.
4. Consumers decide what car and from which retailer to buy it.

Incentives for exclusive dealing

- Demand effects (Additional promotion by manufacturer).
- Lower fixed costs.
- Dealer differentiation vs. offering more products.

Demand

Random Coefficients Logit

Notation: Market m, Product j, Consumer i, Dealer d

$$u_{ijdm} = \delta_{jm} + \mu_{ijm} + \gamma_{idm} + \epsilon_{ijdm}$$

- δ_{jm}: base utility for product j in market m

  $\delta_{jm} = x'_{jm}\beta + \alpha p_j + \xi_{jm}$

- μ_{ijm}:individual heterogeneity for consumer i

  $\mu_{ijm} = \sigma y_{im} p_j$

- γ_{idm}: individual-dealer heterogeneity for consumer i buying from dealer d

  $\gamma_{idm} = \gamma_1 \mathrm{ED}_d + \gamma_2 \mathrm{dist}(i, d)$

- Points of purchase are not observed
  - Take many simulated consumer locations and assume them to have their closest dealer from each brand in their choice set.
  - $\mathrm{dist}(i, d)$: distance from simulated consumer location to dealer.
  - ED_d: exclusivity status from dealer

Dealer Profits and Prices

Profits for a dealership d

$$\pi_d = \sum_{m \in M} \sum_{b \in a_d} \sum_{j \in b} \left(p_j - p_j^w\right) \mathcal{M}_m s_{jdm}(\theta, p, a) - F_d(a_d),$$

- $d \in D \subseteq E$: a dealership in the set of all dealerships D
- $b \in B$: a brand in the set of all brands.
- $a_d \in A_d \subseteq \mathcal{P}(B)$: combination of brands sold by dealer d.
- $F_d(a_d)$: fixed costs.
- $\mathcal{M}_m$: market size of market m.
- p_j and p_j^w: list and wholesale prices, respectively.
  - Manufacturers set list prices conditional on their realized dealership networks and these are binding.
  - They set list prices in order to max. the total profits of its entire network.

Entry Game

Simultaneous Entry Game

- Potential dealer $d \in E$ in location l_d chooses a strategy $a_d \in A_d \subseteq \mathcal{P}(B)$ to maximize profits.

$$\max_{a_d \in A_d} \mathbb{E}[\pi_d(a_d, a_{-d})|\mathcal{I}_d] = \mathbb{E}\left[\sum_{m \in M} \sum_{b \in a_d} \sum_{j \in b} \mathcal{M}_m s_{jdm}(\theta, a)(p_j - p_j^w)\right] - F_d(a_d).$$

Fixed Costs

$$F_d(a_d) = \sum_{b \in a_d} (F_b + \nu_d^b) + \mathbb{I}\{|a_d| > 1\} \cdot C_{MD} + \nu_d^l$$

- Fixed component F_b per brand
- C_{MD} cost of multi-dealing
- ν_d^b, ν_d^l dealer specific disturbances - unobserved by the e'trician

Estimation

Estimation in **three separated stages**

1. Demand estimation (Random Coefficients Logit)
    - Identification assumption: choice set are models available $< 80km$
    - Instruments: BLP instruments + demographics instruments.
    - Selection of ξ_{jm} on entry? Unobserved ξ_{jm} in Entry Stage.

2. Inferring marginal costs through first order conditions.
    - $p^w = p - \left(\sum_{d \in D} \Delta_d\right)^{-1} q$, where $\Delta_d = \sum_{m \in M} \mathcal{M}_m \frac{\partial s_{jdm}}{\partial p_k}$

3. Fixed Costs Estimation (Moment Inequalities)
    - Simulate expected variable profits $\mathbb{E}_{\xi,\epsilon}[\mathrm{VP}_d(a)]$
    - Selection of entry on ν_d^l and ν_d^b?.

Demand estimates

Table 1: Estimates for the demand model

	(1) Logit	(2) RC Logit	(3) RC Logit	(4) RC Logit
Price	-2.232**	-1.130**	-1.163**	-2.291**
	(0.220)	(0.118)	(0.115)	(0.618)
Fuel Cons.	-0.344**	-0.342**	-0.332**	-0.214**
	(0.041)	(0.048)	(0.048)	(0.067)
HP / Weight	-0.113**	-0.028	-0.020	0.070
	(0.037)	(0.039)	(0.039)	(0.074)
Size	1.276**	1.291**	1.325**	2.066**
	(0.118)	(0.132)	(0.130)	(0.429)
Cons.	-15.200**	-13.548**	-13.914**	-17.706**
	(0.978)	(1.074)	(1.051)	(2.461)
Distance		-0.556**	-0.546**	-0.353**
		(0.060)	(0.060)	(0.110)
ED			0.200**	-0.021
			(0.100)	(0.154)
Price				0.073**
$\times$ Income				(0.023)
Origin f.e.	Yes	Yes	Yes	Yes
Province f.e.	Yes	Yes	Yes	Yes

Distribution of Elasticities | Top 5 Elasticities | Dealer Margins

Demand estimates

Table 1: Estimates for the demand model

	(1) Logit	(2) RC Logit	(3) RC Logit	(4) RC Logit
Price	-2.232**	-1.130**	-1.163**	-2.291**
	(0.220)	(0.118)	(0.115)	(0.618)
Fuel Cons.	-0.344**	-0.342**	-0.332**	-0.214**
	(0.041)	(0.048)	(0.048)	(0.067)
HP / Weight	-0.113**	-0.028	-0.020	0.070
	(0.037)	(0.039)	(0.039)	(0.074)
Size	1.276**	1.291**	1.325**	2.066**
	(0.118)	(0.132)	(0.130)	(0.429)
Cons.	-15.200**	-13.548**	-13.914**	-17.706**
	(0.978)	(1.074)	(1.051)	(2.461)
Distance		-0.556**	-0.546**	-0.353**
		(0.060)	(0.060)	(0.110)
ED			0.200**	-0.021
			(0.100)	(0.154)
Price				0.073**
$\times$ Income				(0.023)
Origin f.e.	Yes	Yes	Yes	Yes
Province f.e.	Yes	Yes	Yes	Yes

Distribution of Elasticities | Top 5 Elasticities | Dealer Margins

Main Takeaways

- Price 1,000 € $\uparrow$ = Dist. 6.07 km $\uparrow$

Demand estimates

Table 1: Estimates for the demand model

	(1) Logit	(2) RC Logit	(3) RC Logit	(4) RC Logit
Price	-2.232**	-1.130**	-1.163**	-2.291**
	(0.220)	(0.118)	(0.115)	(0.618)
Fuel Cons.	-0.344**	-0.342**	-0.332**	-0.214**
	(0.041)	(0.048)	(0.048)	(0.067)
HP / Weight	-0.113**	-0.028	-0.020	0.070
	(0.037)	(0.039)	(0.039)	(0.074)
Size	1.276**	1.291**	1.325**	2.066**
	(0.118)	(0.132)	(0.130)	(0.429)
Cons.	-15.200**	-13.548**	-13.914**	-17.706**
	(0.978)	(1.074)	(1.051)	(2.461)
Distance		-0.556**	-0.546**	-0.353**
		(0.060)	(0.060)	(0.110)
ED			0.200**	-0.021
			(0.100)	(0.154)
Price × Income				0.073**
				(0.023)
Origin f.e.	Yes	Yes	Yes	Yes
Province f.e.	Yes	Yes	Yes	Yes

Distribution of Elasticities | Top 5 Elasticities | Dealer Margins

Main Takeaways

- Price 1,000 € ↑ = Dist. 6.07 km ↑
- ED not significant

Demand estimates

Table 1: Estimates for the demand model

	(1) Logit	(2) RC Logit	(3) RC Logit	(4) RC Logit
Price	-2.232**	-1.130**	-1.163**	-2.291**
	(0.220)	(0.118)	(0.115)	(0.618)
Fuel Cons.	-0.344**	-0.342**	-0.332**	-0.214**
	(0.041)	(0.048)	(0.048)	(0.067)
HP / Weight	-0.113**	-0.028	-0.020	0.070
	(0.037)	(0.039)	(0.039)	(0.074)
Size	1.276**	1.291**	1.325**	2.066**
	(0.118)	(0.132)	(0.130)	(0.429)
Cons.	-15.200**	-13.548**	-13.914**	-17.706**
	(0.978)	(1.074)	(1.051)	(2.461)
Distance		-0.556**	-0.546**	-0.353**
		(0.060)	(0.060)	(0.110)
ED			0.200**	-0.021
			(0.100)	(0.154)
Price $\times$ Income				0.073**
				(0.023)
Origin f.e.	Yes	Yes	Yes	Yes
Province f.e.	Yes	Yes	Yes	Yes

Main Takeaways

- Price 1,000 € ↑ = Dist. 6.07 km ↑
- ED not significant

Distribution of Elasticities | Top 5 Elasticities | Dealer Margins

Moment Inequalities

Equilibrium play implies that keeping the location and all other players fixed, a dealership d offering a_d would have lower $\mathbb{E}(\pi_d|\cdot)$ if ...

- it removed a brand that is observed to offer (Upper bound).
- it added a brand that it is not observed to offer (Lower bound).

Selection

- No dealer can add and remove the same brand.
- No observation defines an upper and a lower bound.
- $\Delta\nu_d^l = 0$, but $\mathbb{E}[\Delta\nu_d^b | b \in a_d] \leq 0 \rightarrow$ selection problem

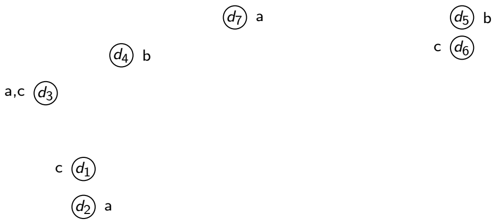
  E.g. Upper bounds for fixed costs estimated with observations with low realized fixed costs.

$\rightarrow$ Construct reasonable upper bounds simulating $\mathbb{E}(\pi_d|\cdot)$ under alternative competition.

Fixed Cost Estimation (2 of 7)

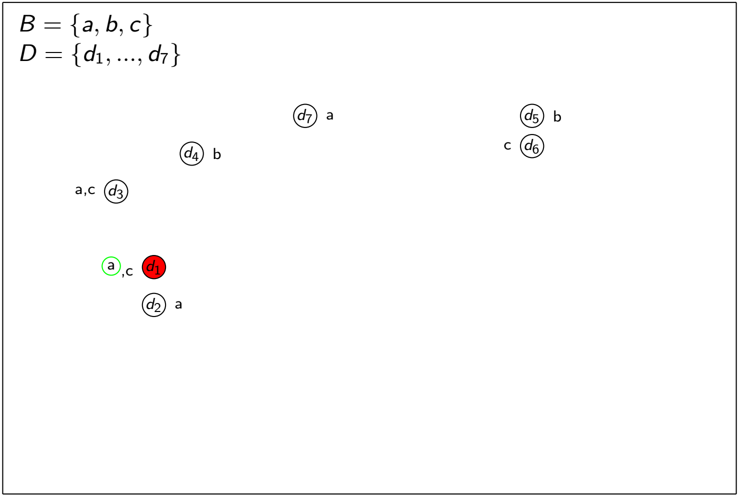
Figure 3: Illustration of the approach

$B = \{a, b, c\}$
$D = \{d_1, ..., d_7\}$



Fixed Cost Estimation (2 of 7)

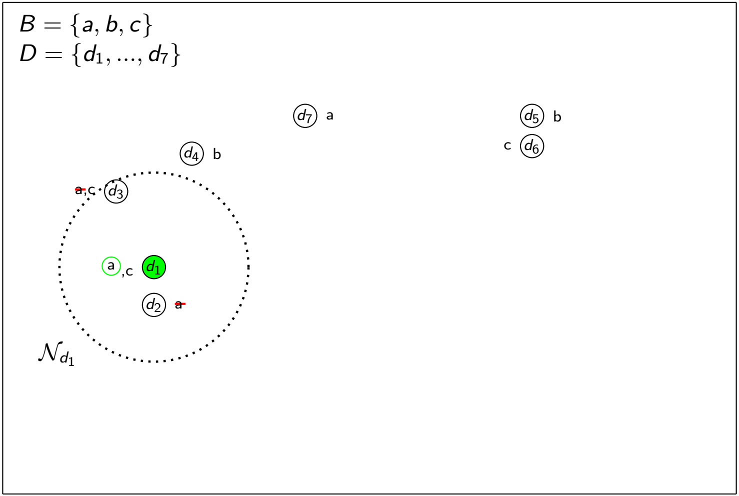
Figure 3: Illustration of the approach



Assumption Moment Inequalities

Fixed Cost Estimation (2 of 7)

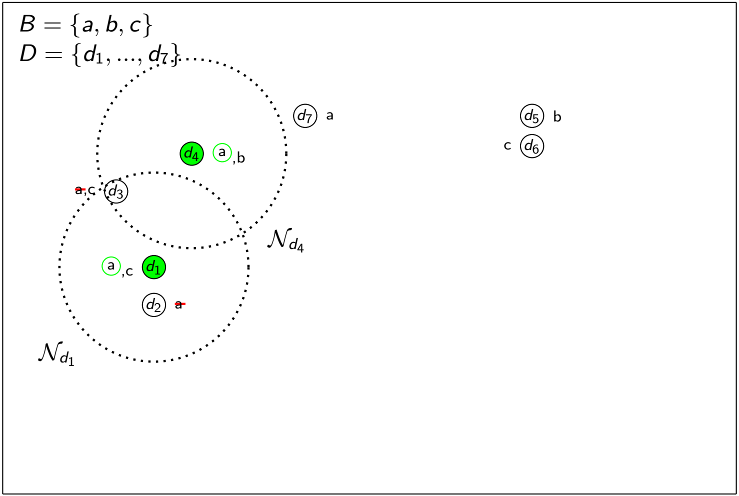
Figure 3: Illustration of the approach



Assumption Moment Inequalities

Fixed Cost Estimation (2 of 7)

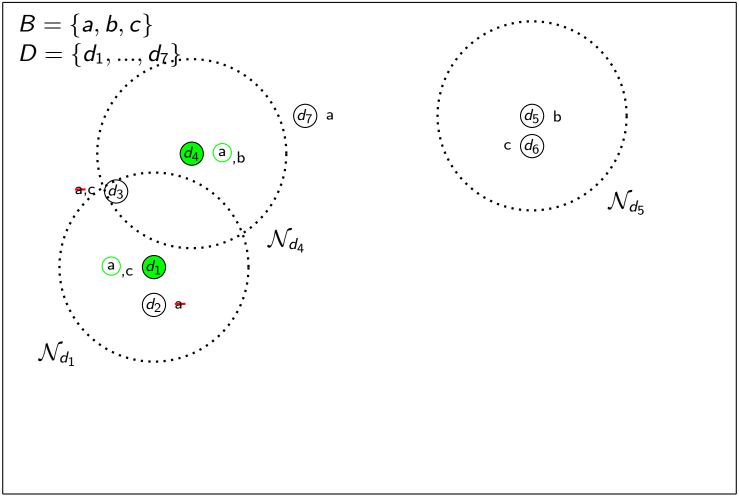
Figure 3: Illustration of the approach



Assumption Moment Inequalities

Fixed Cost Estimation (2 of 7)

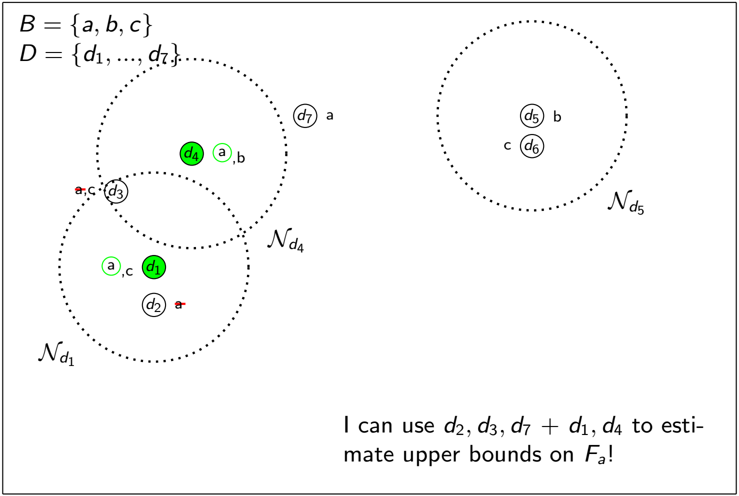
Figure 3: Illustration of the approach



Assumption Moment Inequalities

Fixed Cost Estimation (2 of 7)

Figure 3: Illustration of the approach



Assumption Moment Inequalities

Moment Inequalities

I define functions...

"Subtract the brand whenever possible, if not add the brand to the counterfactual monopolist"

$$\Delta r_b^u(a_d, a_d^{b-}, a_{-d}) = \begin{cases} \mathbb{E}\left[\Delta \mathrm{VP}_d(a_d, a_d^{b-}; a_{-d})\right] - F_b - \mathbb{I}\left\{|a_d| \neq 2\right\} \cdot C_{MD}, & \text{if } b \in a_d, \\ \mathbb{E}\left[\Delta \mathrm{VP}_d(a_d^{b+}, a_d; a'_{-d})\right] - F_b - \mathbb{I}\{|a_d^{b+}| \neq 2\} \cdot C_{MD}, & \text{if } b \notin a_d, \end{cases}$$

"Add the brand whenever possible, if not subtract the brand in the counterfactual competitive market"

$$\Delta r_b^l(a_d, a_d^{b+}, a_{-d}) = \begin{cases} \mathbb{E}\left[\Delta \mathrm{VP}_d(a_d^{b-}, a_d; a'_{-d})\right] + F_b + \mathbb{I}\{|a_d^{b-}| > 1\} \cdot C_{MD}, & \text{if } b \in a_d, \\ \mathbb{E}\left[\Delta \mathrm{VP}_d(a_d, a_d^{b+}; a_{-d})\right] + F_b + \mathbb{I}\{|a_d| > 1\} \cdot C_{MD}, & \text{if } b \notin a_d, \end{cases}$$

Moment Inequalities (continued)

... and select those observations that fulfill the requirements in the illustration (and assumption)...

"Select the observations for which $\Delta r_b^u \geq 0$"

$$
\begin{aligned}
g_d^1(b, a_d, a_{-d}) = \quad & \mathbb{I}\{b \in a_d\} \cdot \mathbb{I}\{|a_d| \neq 2\} + \mathbb{I}\{b \notin a_d\} \cdot \mathbb{I}\{d \in \mathcal{N}_b^L\} \cdot \mathbb{I}\{|a_d^{b+}| \neq 2\}, \quad \text{and} \\
g_d^2(b, a_d, a_{-d}) = \quad & \mathbb{I}\{b \in a_d\} \cdot \mathbb{I}\{|a_d| = 2\} + \mathbb{I}\{b \notin a_d\} \cdot \mathbb{I}\{d \in \mathcal{N}_b^L\} \cdot \mathbb{I}\{|a_d^{b+}| = 2\}.
\end{aligned}
$$

"Select the observations for which $\Delta r_b^l \geq 0$"

$$
\begin{aligned}
g_d^3(b, a_d, a_{-d}) = \quad & \mathbb{I}\{b \in a_d\} \cdot \mathbb{I}\{d \notin \mathcal{N}_b^L\} \cdot \mathbb{I}\{|a_d^{b-}| > 1\} + \mathbb{I}\{b \notin a_d\} \cdot \mathbb{I}\{|a_d| > 1\}, \quad \text{and} \\
g_d^4(b, a_d, a_{-d}) = \quad & \mathbb{I}\{b \in a_d\} \cdot \mathbb{I}\{d \notin \mathcal{N}_b^L\} \cdot \mathbb{I}\{|a_d^{b-}| = 1\} + \mathbb{I}\{b \notin a_d\} \cdot \mathbb{I}\{|a_d| = 1\}.
\end{aligned}
$$

where $\mathcal{N}_b^L$ denotes the neighboring areas defined as in the illustration.

Moment Inequalities (continued)

... to create the following moment conditions that satisfy inequalities...

MI for Upper Bounds

$$m_b^1 = \quad |D|^{-1} \sum_{d \in D} g_d^1(b, a_d, a_{-d}) \Delta r_b^u \left(a_d, a_d^{b-}, a_{-d} \right) \geq 0, \quad \text{and}$$
$$m_b^2 = \quad |D|^{-1} \sum_{d \in D} g_d^2(b, a_d, a_{-d}) \Delta r_b^u \left(a_d, a_d^{b-}, a_{-d} \right) \geq 0,$$

MI for Lower Bounds

$$m_b^3 = \quad |D|^{-1} \sum_{d \in D} g_d^3(b, a_d, a_{-d}) \Delta r_b^l(a_d, a_d^{b-}, a_{-d}) \geq 0, \quad \text{and}$$
$$m_b^4 = \quad |D|^{-1} \sum_{d \in D} g_d^4(b, a_d, a_{-d}) \Delta r_b^l(a_d, a_d^{b-}, a_{-d}) \geq 0.$$

- Provided that $|D|^{-1} \sum_{d \in D} g_d^i \cdot \nu_d^b \longrightarrow 0$ for $i \in \{1, 2, 3, 4\}$
- This is true if ν_d^b are i.i.d

Fixed Cost Estimation (6 of 7)

And Yet More Moment Inequalities

Based on Ho and Pakes (2014) match couples of dealers

$$\Delta w(d_1, d_2, b) = \Delta r_b^u(a_{d_1}, a_{d_1}^{b_-}, a_{-d_1}) + \Delta r_b^l(a_{d_2}, a_{d_2}^{b_+}, a_{-d_2}).$$

Moment conditions

$$m^5 = \quad NM^{-1} \sum_{b \in B} \sum_{d_1 \in D} \sum_{d_2 \neq d_1} g_{d_1}^2(b, a_{d_1}, a_{-d_1}) g_{d_2}^3(b, a_{d_2}, a_{-d_2}) \Delta w(d_1, d_2, b) \geq 0, \quad \text{and}$$

$$m^6 = \quad NM^{-1} \sum_{b \in B} \sum_{d_1 \in D} \sum_{d_2 \neq d_1} g_{d_1}^1(b, a_{d_1}, a_{-d_1}) g_{d_2}^4(b, a_{d_2}, a_{-d_2}) \Delta w(d_1, d_2, b) \geq 0,$$

Objective function: $\left[m(F)_- \right]' \Sigma(F)^{-1} \left[m(F)_- \right]$

Fixed Cost Estimates (7 of 7)

Table 2: Fixed Cost Estimates (in 10,000 €)

	Lower	Upper		Lower	Upper
Alfa Romeo	10.3750	112.3477	Mini	31.0048	233.3680
Audi	248.9550	967.3268	Mitsubishi	57.6487	253.7285
BMW	240.7112	1427.9737	Nissan	105.1268	453.3960
Citroen	158.1234	409.9916	Opel	112.3373	473.0761
Fiat	31.8118	199.4893	Peugeot	232.2222	982.2118
Ford	109.0567	382.4699	Porsche	1049.9087	5929.1565
Honda	35.2027	221.0466	Renault	314.3647	950.5661
Hyundai	110.0356	515.8113	Seat	243.6576	840.3873
Infiniti	43.2850	299.4948	Skoda	63.6640	367.2605
Jaguar	90.1613	601.0930	Smart	-9.9428	60.6519
Jeep	37.5273	266.4081	SsangYong	17.8420	118.3771
KIA	114.6440	580.4779	Subaru	1.9487	78.3876
Land Rover	116.1576	623.2758	Suzuki	15.3060	98.6510
Lexus	20.3505	35.8169	Toyota	117.6452	443.0447
Mazda	86.8278	440.2257	Volkswagen	213.7001	746.6376
Mercedes	248.3775	906.8245	Volvo	92.0989	499.0274
			Multi-Dealing	-62.5631	1.1340

Concluding Remarks

- New dataset + model of retail with endogenous branding.
- Presented demand and supply estimates.
  - Competition downstream pushes dealers to differentiate from each other $\rightarrow$ ED for different brands
  - No evidence of demand effects from ED.
  - Slight tendency towards cost benefits from ED.
- Implications for competition policy: ED in the car market follows competitive motives.
- How to deal practically with selection in geographical markets.

Current Work: Counterfactuals

- Effects of relaxing geographic competition through territorial restrictions.

Downstream Competition and Exclusive Dealing

Franco Esteban Cattaneo

Graduate School of Economics and Social Sciences
University of Mannheim

Barcelona GSE Summer Forum - Applied Industrial Organization
June 12, 2019

Car registry data

Microdata - Spanish Directorate-General of Traffic (DGT)

- Daily admin data about all car registries (Jul 2016 - Aug 2017).
- Merged with data from car magazines to complete car characteristics.

Table 3: Descriptive Statistics

	Brand	Sales	Shares
1	Peugeot	73785	7.86%
2	Renault	73429	7.82%
3	Volkswagen	66719	7.11%
4	Seat	65021	6.93%
5	Opel	57174	6.09%

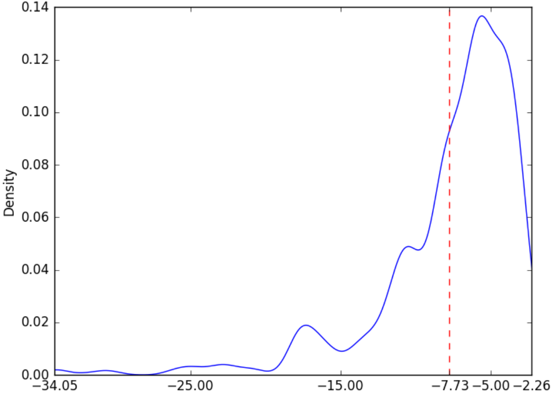
	Model	Sales	Shares
1	Sandero	24227	2.58%
2	Ibiza	21757	2.32%
3	Golf GTI	20933	2.23%
4	Qashqai	20586	2.19%
5	Tucson	17815	1.90%

	μ	σ	Min	Max	Obs
Model					
Horsepower	144.34	60.23	60	422	234
Weight (100 Kg.)	14.55	3.35	8.05	24.65	234
Size (m^2)	8.03	1.06	4.48	10.36	234
Fuel Cons. (l/km)	5.08	1.19	3.3	10.61	234
Price (10,000 €)	3.43	2.16	1.02	14.86	234
Markets					
Municipalities					6608
Provinces					43

Back

Elasticities (1 of 2)

Figure 4: Distribution of Price elasticities



Back

Elasticities (2 of 2)

Table 4: Top 5 Highest and Lowest Elasticities

Brand	Model	Elasticity
Highest 5 Elasticities		
Land Rover	Range Rover	-33.78
Porsche	Panamera	-30.70
BMW	Serie 6	-25.75
Mercedes Benz	Clase S	-24.62
BMW	Serie 7	-23.05
Median		
Volkswagen	Beetle	-6.39
Mini	Paceman	-6.30
Lowest 5 Elasticities		
Dacia	Dokker	-2.56
Ford	Ka	-2.48
Dacia	Logan	-2.33
Dacia	Sandero	-2.30
Skoda	Citigo	-2.30

Back

Inferred margins

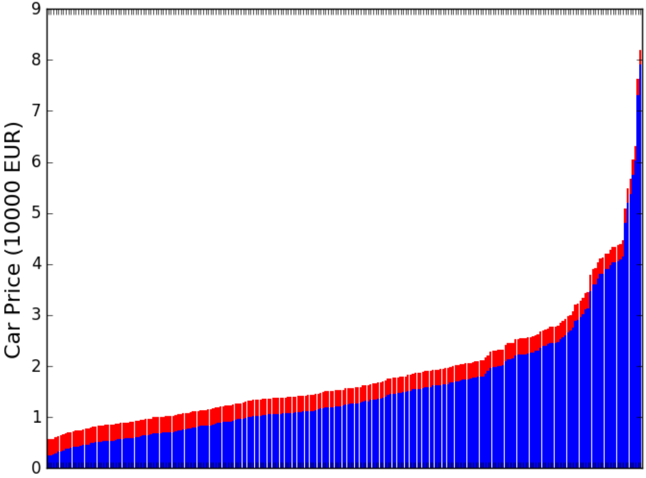


Figure 5: Distribution of Dealers' expected margin by car

Back

Overcoming Selection: Eventual Profitability

Overcoming Selection

- If $b \notin a_d$, d prefers a_d over a_d^{b+} given a_{-d}
- In areas with high demand for $j \in b$, there is some a'_{-d} for which d would have incentives to deal for a_d^{b+} over a_d
- Let a'_{-d} subtract all b locally, so that d would be a local monopolist retailer for b, then I assume $\mathbb{E}[\Delta\pi_d(a_d, a_d^{b+}; a_{-d})|\mathcal{I}_d] \leq 0$

Assumption: Eventual (Un)Profitability

Let $d, \tilde{d}$ be two observed dealerships with a_d and $a_{\tilde{d}}$ respectively, and suppose $b \in a_{\tilde{d}}$. Then, if $\text{dist}(d, \tilde{d}) < L$ there exists at least one $i_d \in \{0,1\}^{|-d|}$ with $a'_{-d} = i_d \cdot a_{-d} + (1 - i_d) \cdot a_{-d}^{b-}$ such that

$$\mathbb{E}[\pi_d(a_d^{b+}, a'_{-d})|\mathcal{I}_d] \geq \mathbb{E}[\pi_d(a_d, a'_{-d})|\mathcal{I}_d].$$

Conversely, let $b \in a_d$, then there exists at least one $i_d \in \{0,1\}^{|-d|}$ with $a'_{-d} = i_d \cdot a_{-d} + (1 - i_d) \cdot a_{-d}^{b+}$ such that

$$\mathbb{E}[\pi_d(a_d^{b-}, a'_{-d})|\mathcal{I}_d] \geq \mathbb{E}[\pi_d(a_d, a'_{-d})|\mathcal{I}_d].$$

Back

Moment Inequalities

I define functions...

"Subtract the brand whenever possible, if not add the brand to the counterfactual monopolist"

$$\Delta r_b^u(a_d, a_d^{b-}, a_{-d}) = \begin{cases} \mathbb{E}\left[\Delta \mathrm{VP}_d(a_d, a_d^{b-}; a_{-d})\right] - F_b - \mathbb{I}\left\{|a_d| \neq 2\right\} \cdot C_{MD}, & \text{if } b \in a_d, \\ \mathbb{E}\left[\Delta \mathrm{VP}_d(a_d^{b+}, a_d; a'_{-d})\right] - F_b - \mathbb{I}\{|a_d^{b+}| \neq 2\} \cdot C_{MD}, & \text{if } b \notin a_d, \end{cases}$$

"Add the brand whenever possible, if not subtract the brand in the counterfactual competitive market"

$$\Delta r_b^l(a_d, a_d^{b+}, a_{-d}) = \begin{cases} \mathbb{E}\left[\Delta \mathrm{VP}_d(a_d^{b-}, a_d; a'_{-d})\right] + F_b + \mathbb{I}\{|a_d^{b-}| > 1\} \cdot C_{MD}, & \text{if } b \in a_d, \\ \mathbb{E}\left[\Delta \mathrm{VP}_d(a_d, a_d^{b+}; a_{-d})\right] + F_b + \mathbb{I}\{|a_d| > 1\} \cdot C_{MD}, & \text{if } b \notin a_d, \end{cases}$$

Moment Inequalities (continued)

... and select those observations that fulfill the requirements in the illustration (and assumption)...

"Select the observations for which $\Delta r_b^u \geq 0$"

$$g_d^1(b, a_d, a_{-d}) = \mathbb{I}\{b \in a_d\} \cdot \mathbb{I}\{|a_d| \neq 2\} + \mathbb{I}\{b \notin a_d\} \cdot \mathbb{I}\{d \in \mathcal{N}_b^L\} \cdot \mathbb{I}\{|a_d^{b+}| \neq 2\}, \quad \text{and}$$
$$g_d^2(b, a_d, a_{-d}) = \mathbb{I}\{b \in a_d\} \cdot \mathbb{I}\{|a_d| = 2\} + \mathbb{I}\{b \notin a_d\} \cdot \mathbb{I}\{d \in \mathcal{N}_b^L\} \cdot \mathbb{I}\{|a_d^{b+}| = 2\}.$$

"Select the observations for which $\Delta r_b^l \geq 0$"

$$g_d^3(b, a_d, a_{-d}) = \mathbb{I}\{b \in a_d\} \cdot \mathbb{I}\{d \notin \mathcal{N}_b^L\} \cdot \mathbb{I}\{|a_d^{b-}| > 1\} + \mathbb{I}\{b \notin a_d\} \cdot \mathbb{I}\{|a_d| > 1\}, \quad \text{and}$$
$$g_d^4(b, a_d, a_{-d}) = \mathbb{I}\{b \in a_d\} \cdot \mathbb{I}\{d \notin \mathcal{N}_b^L\} \cdot \mathbb{I}\{|a_d^{b-}| = 1\} + \mathbb{I}\{b \notin a_d\} \cdot \mathbb{I}\{|a_d| = 1\}.$$

where $\mathcal{N}_b^L$ denotes the neighboring areas defined as in the illustration.

Moment Inequalities (continued)

... to create the following moment conditions that satisfy inequalities...

MI for Upper Bounds

$$m_b^1 = \quad |D|^{-1} \sum_{d \in D} g_d^1(b, a_d, a_{-d}) \Delta r_b^u \left(a_d, a_d^{b-}, a_{-d} \right) \geq 0, \quad \text{and}$$
$$m_b^2 = \quad |D|^{-1} \sum_{d \in D} g_d^2(b, a_d, a_{-d}) \Delta r_b^u \left(a_d, a_d^{b-}, a_{-d} \right) \geq 0,$$

MI for Lower Bounds

$$m_b^3 = \quad |D|^{-1} \sum_{d \in D} g_d^3(b, a_d, a_{-d}) \Delta r_b^l (a_d, a_d^{b-}, a_{-d}) \geq 0, \quad \text{and}$$
$$m_b^4 = \quad |D|^{-1} \sum_{d \in D} g_d^4(b, a_d, a_{-d}) \Delta r_b^l (a_d, a_d^{b-}, a_{-d}) \geq 0.$$

- Provided that $|D|^{-1} \sum_{d \in D} g_d^i \cdot \nu_d^b \longrightarrow 0$ for $i \in \{1, 2, 3, 4\}$
- This is true if ν_d^b are i.i.d

And Yet More Moment Inequalities

Based on Ho and Pakes (2014) match couples of dealers

$$\Delta w(d_1, d_2, b) = \Delta r_b^u(a_{d_1}, a_{d_1}^{b-}, a_{-d_1}) + \Delta r_b^l(a_{d_2}, a_{d_2}^{b+}, a_{-d_2}).$$

Moment conditions

$$m^5 = \quad NM^{-1} \sum_{b \in B} \sum_{d_1 \in D} \sum_{d_2 \neq d_1} g_{d_1}^2(b, a_{d_1}, a_{-d_1}) g_{d_2}^3(b, a_{d_2}, a_{-d_2}) \Delta w(d_1, d_2, b) \geq 0, \quad \text{and}$$
$$m^6 = \quad NM^{-1} \sum_{b \in B} \sum_{d_1 \in D} \sum_{d_2 \neq d_1} g_{d_1}^1(b, a_{d_1}, a_{-d_1}) g_{d_2}^4(b, a_{d_2}, a_{-d_2}) \Delta w(d_1, d_2, b) \geq 0,$$

Objective function: $\left[m(F)_{\_}\right]' \Sigma(F)^{-1} \left[m(F)_{\_}\right]$

Back