Essays in Empirical Industrial Organization

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Supervisors:
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- What do we miss?
  - We cannot evaluate counterfactuals that affect information or dynamics

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3. **Revisiting demand estimation in storable goods markets**

Chapter 1

Inertia in the market for mobile telephony

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  - What is the optimal regulatory response?
  - Should consumers be "forced to make a choice"?
- I estimate a structural model of demand incl. switching cost, inattention, and limited consideration to simulate "forced choice".

Literature

- **Demand estimation for telecom services.** Train, McFadden, and Ben-Akiva (1987), Viard (2007), Grubb and Osborne (2015), Bourreau, Sun, and Verboven (2021), Weiergraeber (2022)

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→ *I add a study in another market: mobile telephony*

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I construct a data set on individual-time-product level by matching two data sources:

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[1] Funding for the survey is provided by the FWF/DFG, PIs Christine Zulehner and Heiko Karle.

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  - Plan prices and characteristics 2019Q2-2024Q1

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Model

Utility

$$u_{ijt} = \mathbf{x}'_{jt}\beta + \zeta \cdot \mathbb{1}_{y_{it} \neq y_{it-1}} + \xi_{\psi(j)} + \epsilon_{ijt}$$
$$= \delta_{ijt} + \epsilon_{ijt}$$

Attention

$$\mu_{it} = \Lambda(\mathbf{x}_0, \mathbf{z}_i, \xi_{\psi(j)})$$

Consideration

$$\phi_{ijt} = \Lambda(\mathbf{x}_{jt}, \mathbf{z}_i, \xi_{\psi(j)})$$

Model

$$s_0(\cdot) = \mu \sum_{C \in \mathbb{P}(j)} \pi_C(\cdot) s_j^\star(\cdot \mid C) + (1 - \mu),$$

$$s_j(\cdot) = \mu \sum_{C \in \mathbb{P}(j)} \pi_C(\cdot) s_j^\star(\cdot \mid C),$$

$$\pi_C = \prod_{j \in C} \phi_j \prod_{j' \notin C} (1 - \phi_{j'}),$$

$$s_{ijt}^\star(\mathbf{x}_t \mid C) = \begin{cases} \frac{\exp(\delta_{ijt})}{\sum_{k \in \mathbb{P}_{it}(C)} \exp(\delta_{ikt})} & \text{if } j \in C \\ 0 & \text{otherwise} \end{cases}$$

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- Latent choice probabilities $s^\star(\quad | C)$ are identified from absence of nominal illusion

Estimation

- I estimate the model by maximum likelihood.

$$\log \mathcal{L}(y_{it}; X, \theta) = \sum_{i=1}^{N} \sum_{t=1}^{T} \sum_{j \in \mathcal{J}_{it}} \mathbb{1}_{y_{it}=j} \log s_{itj}(\mathbf{x}_t, \mathbf{z}_i; \theta).$$

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- Computational challenge: large number of consideration sets ($2^{\#\text{products}}$)

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  - Differences in switching rates reveals relative importance of frictions

Chapter 2

Collusion in the Austro-Hungarian Sugar Industry 1889-1914

with Nikolaus Fink, Philipp Schmidt-Dengler, and Christine Zulehner

Motivation

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  - Did integrated cartels obtain higher mark-ups than downstream-only cartels?

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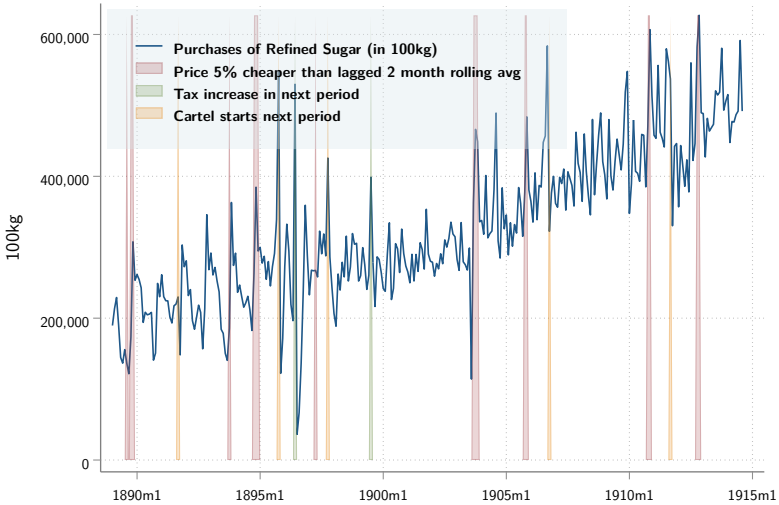
- **Estimation of conduct in homogeneous good industry:** Porter (1983)

  → *We estimate conduct taking into account stockpiling* dynamics

- **Factors determining cartel success:** Levenstein and Suslow (2006)

Hints of stockpiling



Methodology: Demand

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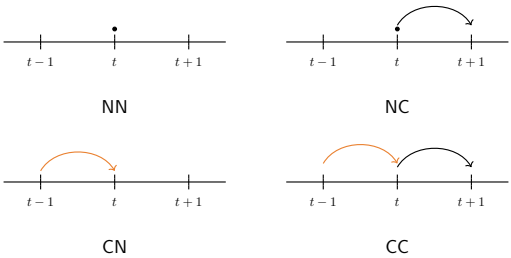

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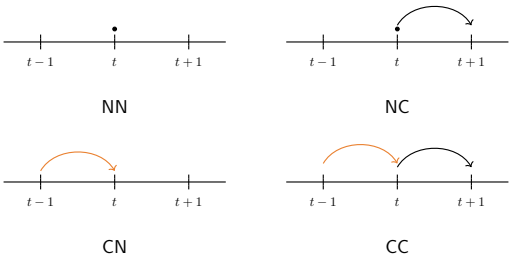

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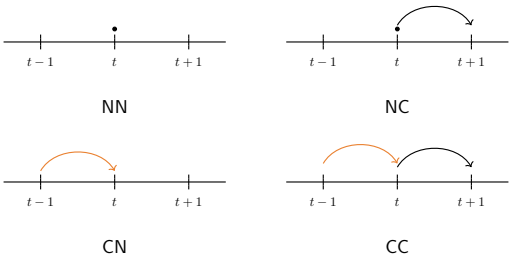

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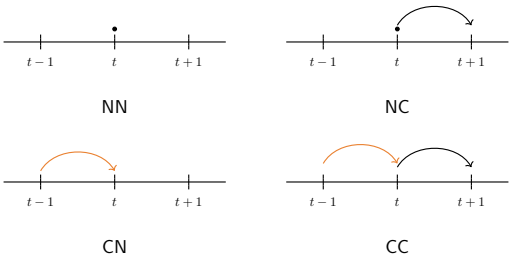

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- Supply: generalization of static and symmetric Cournot (for now)

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Chapter 3

Revisiting demand estimation in storable goods markets

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- Research questions:
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  - Should we include them in our model in the first place?

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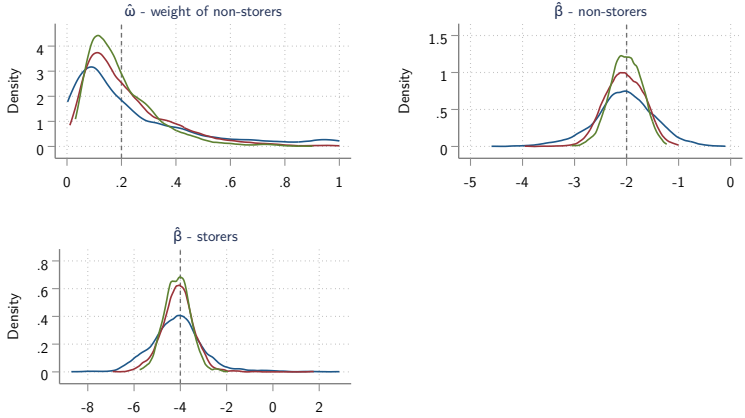
  - Oberservational data (scanner data)

- **Dynamic models of demand.** Hendel and Nevo (2013), Wang, Rojas, and Colantuoni (2017)

  $\rightarrow$ *I examine the empirical relevance of non-additively separable shocks for matching purchasing patterns in a storeable goods market*

Preliminary Monte Carlo Results

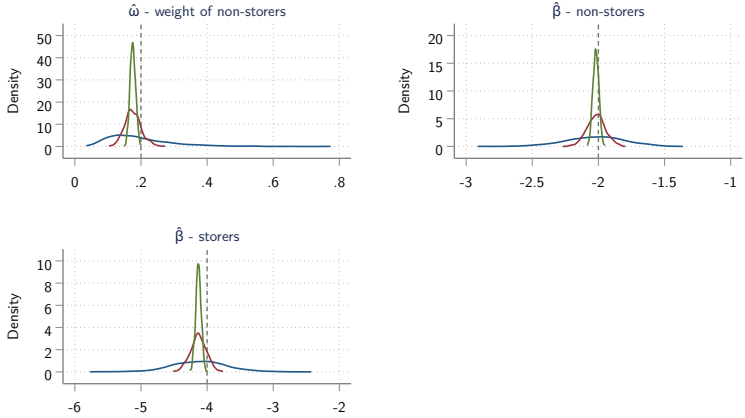
Small Sample



Repetitions = 1000
Sample Sizes: 100, 200, 300

Preliminary Monte Carlo Results

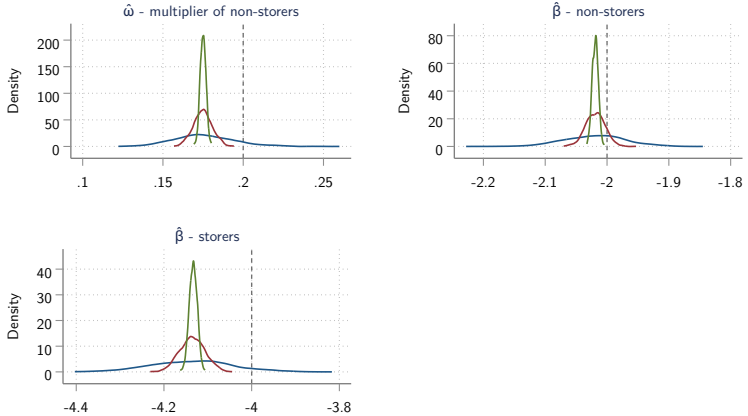
Large Sample



Repetitions = 1000
Sample Sizes: 500, 5000, 50000

Preliminary Monte Carlo Results

Large Sample Properties



Repetitions = 1000
Sample Sizes: 10000, 100000, 1000000

Next Steps

- Code up the full original estimator (panel setting)

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  - Stores

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  - Three differentiated products (Pepsi, Coca-Cola, store brand)

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- Code up the full original estimator (panel setting)
  - Stores
  - Three differentiated products (Pepsi, Coca-Cola, store brand)
- Estimate model with and without non-separable shocks on observational data

1 **Inertia in the market for mobile telephony**

Research Proposal

1. **Inertia in the market for mobile telephony**
2. **Collusion in the Austro-Hungarian Sugar Industry 1889-1914**

   with Nikolaus Fink, Philipp Schmidt-Dengler, and Christine Zulehner

1. **Inertia in the market for mobile telephony**
2. **Collusion in the Austro-Hungarian Sugar Industry 1889-1914**

   with Nikolaus Fink, Philipp Schmidt-Dengler, and Christine Zulehner
3. **Revisiting demand estimation in storable goods markets**

Appendix 1

Screenshot of Survey

Willkommen zu einer anonymen Umfrage der Universität Wien, Innsbruck, und Frankfurt School of Finance & Management.
Thema: Konsumentenverhalten am Markt für Handytarife.
Dauer: 15 min.
Möchten Sie teilnehmen?

- ○ Ja
- ○ Nein

→

Sampling

The survey filters for consumers that fullfill the following criteria:

- At least 18 years old in 2022

Criteria must be fullfilled for both current and previous plan

Sampling

The survey filters for consumers that fullfill the following criteria:

- At least 18 years old in 2022
- They have and know about their Austrian (domestic) plan

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Sampling

The survey filters for consumers that fullfill the following criteria:

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- The plan is for retail customers

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Sampling

The survey filters for consumers that fullfill the following criteria:

- At least 18 years old in 2022
- They have and know about their Austrian (domestic) plan
- The plan is for retail customers
- They pay for the plan themselves

Criteria must be fullfilled for both current and previous plan

Sampling

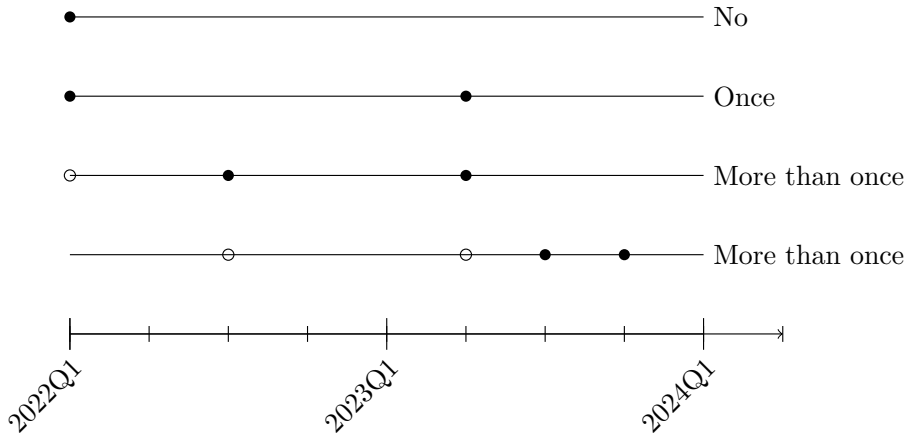
The survey filters for consumers that fullfill the following criteria:

- At least 18 years old in 2022
- They have and know about their Austrian (domestic) plan
- The plan is for retail customers
- They pay for the plan themselves
- They chose the plan

Criteria must be fullfilled for both current and previous plan

Possibilities of single wave

Did you switch mobile telephony plan in 2022/2023/2024?



Specification

Attention

$$\mu_{it} = \frac{\exp(\mathbf{x}'_{0_i t}\lambda + \mathbf{z}'_i\kappa + \xi^{in}_{\psi(0_i)})}{1 + \exp(\mathbf{x}'_{0_i t}\lambda + \mathbf{z}'_i\kappa + \xi^{in}_{\psi(0_i)})}$$

Consideration

$$\phi_{ijt} = \frac{\exp(\mathbf{x}'_{jt}\gamma + \mathbf{z}'_i\rho + \xi^{c}_{\psi(j)})}{1 + \exp(\mathbf{x}'_{jt}\gamma + \mathbf{z}'_i\rho + \xi^{c}_{\psi(j)})}$$

Choice

$$\begin{aligned} u_{ijt} &= \mathbf{x}'_{jt}\beta + \zeta_1 \cdot \mathbb{1}_{y_{it} \neq y_{it-1}} + \zeta_2 \cdot \mathbb{1}_{\psi(y_{it}) \neq \psi(y_{it-1})} + \xi^{u}_{\psi(j)} + \epsilon_{ijt} \\ &= \delta_{ijt} + \epsilon_{ijt} \end{aligned}$$

Variables $(\mathbf{z}_i, \mathbf{x}_t)$

Sociodemographics	Plan Characteristics
Gender	Monthly fee
Age	Annual fee
Region	SMS
Income Bracket	Minutes
Education	Gigabyte
Marital Status	5G
Household Size	Download Speed
Children	Commitment period
Employment Status	EU Roaming
User Type	Non-EU Roaming
	Part of bundle (plan+wifi, plan+fixed line)
	Family rebate

Frequency of bundles

RTR Graph

What is a plan?

- Can reduce number of plans by grouping them into four categories: low (prepaid), mid, high, power

What is a plan?

- Can reduce number of plans by grouping them into four categories: low (prepaid), mid, high, power
- RTR definitions for usage (gigabyte etc) available

Appendix 2

Reasons for cartel breakdowns

Cartel	Duration	Reason for Breakdown
1st refinery cartel	1891m10-1894m9	Entry from new refineries
2nd refinery cartel	1895m11-1897m10	Entry from raw sugar factories with crystal
1st integrated cartel	1897m11-1903m8	International trade agreement
3rd refinery cartel	1906m10-1911m9	Integreated was better
2nd integreated cartel	1911m10-1914m8	World War I

Demand Specification

$$
\begin{aligned}
X_t &= x_t^n + x_t^s \\
&= q_t^n + (\mathbb{1}_{\text{buy for t}}\, q_t + \mathbb{1}_{\text{buy for t+1}}\, q_{t+1}) \\
&= \omega e^{\alpha+\beta^n p_t+\varepsilon_t} + (1-\omega)(\mathbb{1}_{\text{buy for t}}\, e^{\alpha+\beta^s p_t+\varepsilon_t} + \mathbb{1}_{\text{buy for t+1}}\, e^{\alpha+\beta^s p_t+\varepsilon_{t+1}}).
\end{aligned}
$$

- We simulate shocks $\varepsilon_t, \varepsilon_{t+1}$ because otherwise we cannot evaluate the sample analog of the moment condition

Elasticity in absence of dynamics

$$
\begin{aligned}
\eta := \frac{\partial Q}{\partial P}\frac{P}{Q} &= \frac{\frac{\partial}{\partial P}[\omega e^{\alpha+\beta^n P} + (1-\omega)e^{\alpha+\beta^s P}]}{Q}P \\
&= \frac{\beta^n \omega e^{\alpha+\beta^n P} + \beta^s(1-\omega)e^{\alpha+\beta^s P}}{\omega e^{\alpha+\beta^n P} + (1-\omega)e^{\alpha+\beta^s P}}P \\
&= [\beta^n \frac{\omega e^{\alpha+\beta^n P}}{\omega e^{\alpha+\beta^n P} + (1-\omega)e^{\alpha+\beta^s P}} + \beta^s \frac{(1-\omega)e^{\alpha+\beta^s P}}{\omega e^{\alpha+\beta^n P} + (1-\omega)e^{\alpha+\beta^s P}}]P \\
&= [\beta^n Qshare^n + \beta^s Qshare^s]P
\end{aligned}
$$

Apendix 3

Set up

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