

Essays in Empirical Industrial Organization

Moritz Schwarz

Supervisors:

Philipp Schmidt-Dengler and Christine Zulehner

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 - We are worried that our estimators could be inconsistent
 - We want to answer questions that standard models cannot, e.g., simulate counterfactual that affect information or dynamics

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- 2 Collusion in the Austro-Hungarian Sugar Industry 1889-1914**
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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”?

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- Evaluate different policy options in counterfactual scenarios where frictions are removed

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- **Smart defaults and other policies targeting inertia:** Gravert (2024), Handel and Kolstad (2015), CMA, BEREC

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- Survey¹

¹The survey is joint work with a FWF/DFG funded research group led by Christine Zulehner and Heiko Karle.

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- Plan prices and characteristics 2019Q2-2024Q1 [Full list](#)

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Screenshot of Survey

Willkommen zu einer anonymen Umfrage der Universität Wien, Innsbruck, und Frankfurt School of Finance & Management.

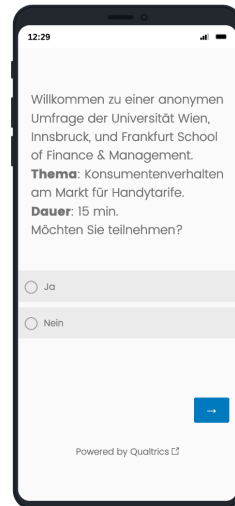
Thema: Konsumentenverhalten am Markt für Handytarife.

Dauer: 15 min.

Möchten Sie teilnehmen?

☐ Ja

☐ Nein



- Following Abaluck and Adams-Prassl (2021), I combine a conditional logit with consideration sets

Utility

$$\begin{aligned}u_{ijt} &= \mathbf{x}'_{jt}\beta + \zeta \cdot \text{Switch}_{ijt} + \xi_j + \varepsilon_{ijt} \\ &= \delta_{ijt} + \varepsilon_{ijt}\end{aligned}$$

Attention

$$\mu_{it} = \text{Pr}(\text{shop around}) := \Lambda(\mathbf{x}_0, \mathbf{z}_i, \xi_j)$$

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- where ε_{ijt} is distributed i.i.d. type 1 extreme value, ξ_j is a brand fixed effect, and $\phi_{i0t} = 1$

- Choice probabilities s_j^* depend on consideration – consumer only chooses from products in consideration set C

$$s_j^*(\mathbf{x}_t \mid C) = \begin{cases} \frac{\exp(\delta_j)}{\sum_{k \in C} \exp(\delta_k)} & \text{if } j \in C \\ 0 & \text{otherwise} \end{cases}$$

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- For every consumer and time period, consideration set probabilities π_C sum up to 1

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$$s_j(\cdot) = \mu(\cdot) \sum_{C \in \mathcal{P}(j)} \pi_C(\cdot) s_j^*(\cdot \mid C) \quad \text{for } j \neq 0,$$

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- If a consumer does not shop around, $\mu = 0$, she chooses her previous plan $s_0 = 1$

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- Given identification of $\frac{\partial s_j}{\partial p_{j'}}$, π_C , s_j^* , identification of mean preferences is standard (how choice shares vary with characteristics)

- 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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 - aggregation over plans by user types (low, medium, high, power user)

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 - Full consideration: $\phi = 1$
 - Differences in switching rates reveal relative importance of frictions

Chapter 2

Collusion in the Austro-Hungarian Sugar Industry 1889-1914

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

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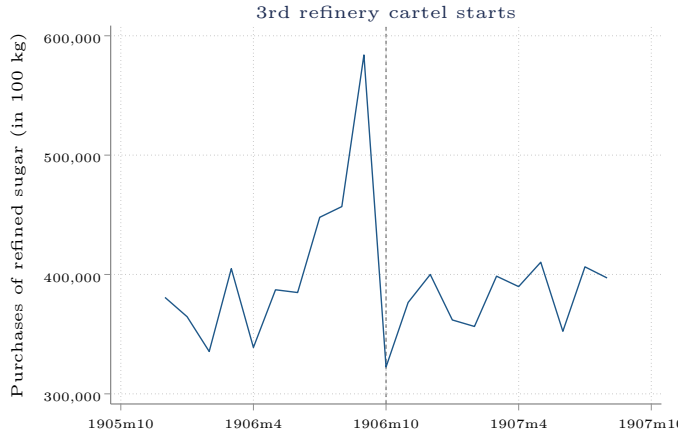
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 - Did integrated cartels obtain higher markups than downstream-only cartels?

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- **Factors determining cartel success:** Levenstein and Suslow (2006)
→ *We estimate conduct taking into account stockpiling dynamics (monthly data)*

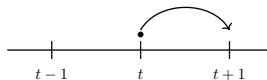


Data source: Centralverein der Rübenzuckerindustrie

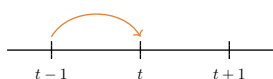
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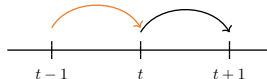
NN



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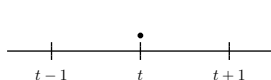


CN

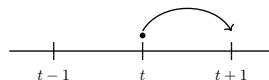


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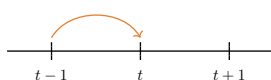
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- 4 states, where state C (“cheap”) occurs in period t if $p_t \leq p_{t+1}$ [More on assumptions](#)



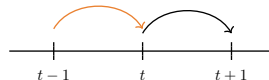
NN



NC

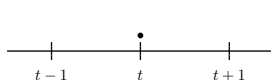


CN

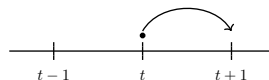


CC

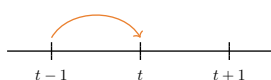
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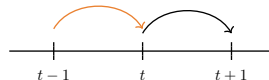
NN



NC



CN



CC

- **Instruments:** price of raw sugar (global market), tax on refined sugar, cartel dates

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

$$\text{FOC: } P(Q) + P'(Q) \underbrace{\theta}_{\text{as if } \theta := \frac{dQ}{dq_j}} q_j = MC(W, ST)$$

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 - Collusive price in absence of stockpiling

Elasticity in absence of stockpiling

Chapter 3

Revisiting demand estimation in storable goods markets

- Demand for storable goods can feature stockpiling dynamics

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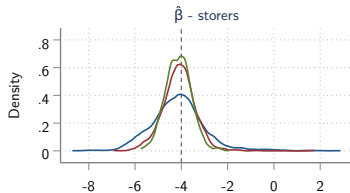
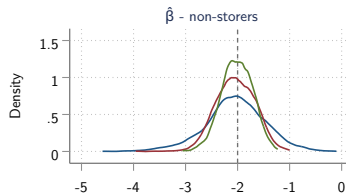
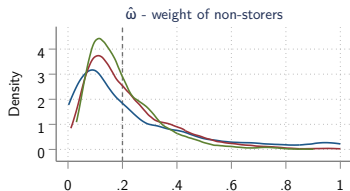
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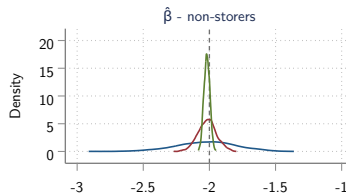
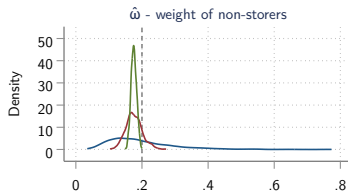
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- Research questions (data):
 - Can we ignore non-additively separable shocks if they are present? (simulated data)
 - Should we include them in our model in the first place? (scanner data)

Small Sample



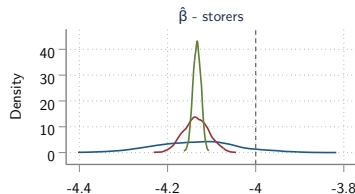
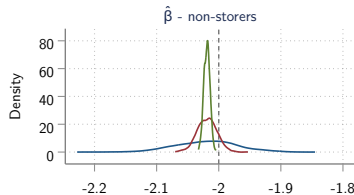
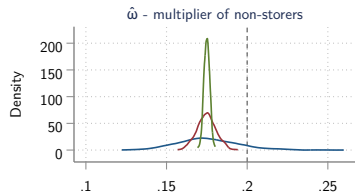
Repetitions = 1000
Sample Sizes: 100, 200, 300

Large Sample



Repetitions = 1000
Sample Sizes: 500, 5000, 50000

Huge Sample



Repetitions = 1000
Sample Sizes: 10000, 100000, 1000000

Discussion

- Distributions center to the left of true values
- $\hat{\beta}^s$ performs worse than $\hat{\beta}^n$
- In sum, estimator that ignores shocks is inconsistent

- Code up the full original estimator (panel setting)

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 - 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 Appendix

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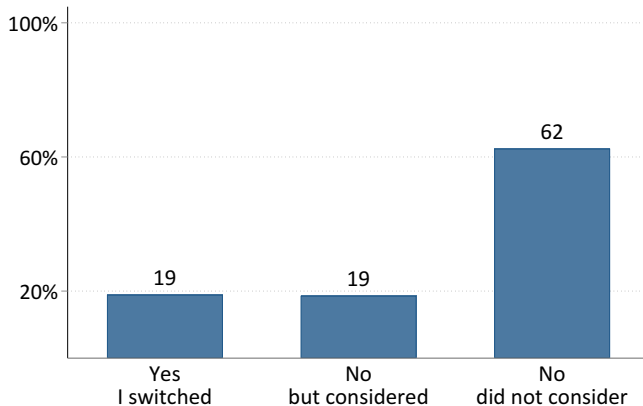
2 Collusion in the Austro-Hungarian Sugar Industry 1889-1914 [Appendix](#)

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

- 1 **Inertia in the market for mobile telephony** Appendix
- 2 **Collusion in the Austro-Hungarian Sugar Industry 1889-1914** Appendix
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- 3 **Revisiting demand estimation in storable goods markets** Appendix

Appendix 1

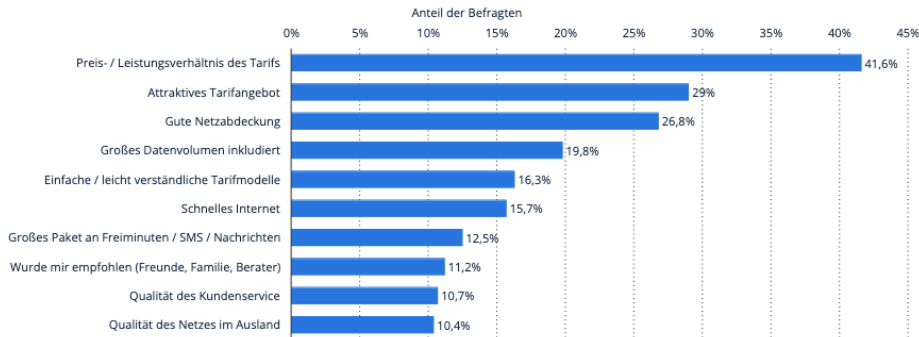
Did you switch provider in 2019-2021?



Data source: RTR (2021) [Back](#)

Aus welchen Gründen haben Sie sich für Ihren aktuellen Mobilfunkanbieter entschieden?

Gründe für die Wahl des aktuellen Mobilfunkanbieters in Österreich 2021



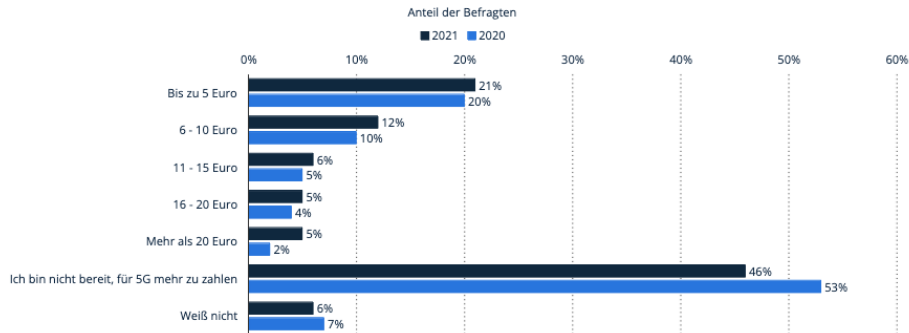
18

Beschreibung: Bei einer Meinungsumfrage in Österreich aus dem Jahr 2021 über die Gründe bei der Wahl des Mobilfunkanbieters, gaben 41,6 Prozent der Befragten an, sich vor allem wegen des Preis-Leistungsverhältnisses des Tarifs für einen bestimmten Anbieter entschieden zu haben. 26,8 Prozent der befragten Teilnehmer gaben eine gute Netzabdeckung als Grund an. Empfehlungen durch Freunde, Familie oder Berater waren nur für 11,2 Prozent der Befragten entscheidend. [Mehr](#)
Hinweise(s): Österreich; 6. Mai 2021 bis 6. Mai 2021; 39.791 Befragte; ab 14 Jahre; Repräsentativ für die österreichische Bevölkerung; Top 10
Quelle(n): Marktagent

statista

Wenn 5G zehnfach schnelleres Internet bereitstellt, wie viel sind Sie bereit, mehr zu zahlen?

Zahlungsbereitschaft für 5G in Österreich 2021



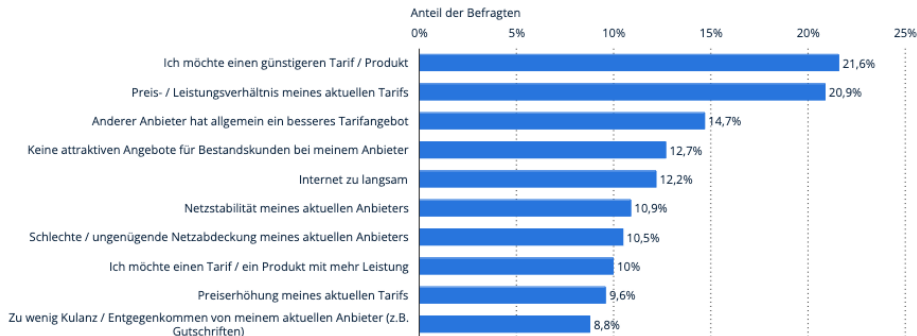
35

Beschreibung: Laut einer Umfrage von Deloitte im Jahr 2021 waren 46 Prozent der Befragten in Österreich nicht bereit, für eine 5G-Verfügbarkeit, die ein zehnfach schnelleres Internet bereitstellt, mehr Geld zu zahlen. Im Jahr 2020 waren es mit 53 Prozent noch etwas mehr. Mais
Hinweis: Österreich; Sommer 2021; 1000 Befragte
Quelle(n): Deloitte

statista

Aus welchen Gründen haben Sie vor Ihren aktuellen Mobilfunkanbieter zu wechseln?

Gründe für einen Anbieterwechsel in Österreich im Jahr 2021



21

Beschreibung: Bei einer Meinungsumfrage in Österreich aus dem Jahr 2021 zu den Gründen für einen gewünschten Mobilfunkanbieterwechsel gaben mit 21,6 Prozent die meisten der Befragten an, einen günstigeren Tarif haben zu wollen. 20,9 Prozent der befragten Österreicher nannten als Grund dafür, warum sie (jeder) den Anbieter wechseln würden, das Preis- / Leistungsverhältnis ihres aktuellen Tarifs. [Mehr](#)
Hinweis: Österreich, 5. Mai 2020 bis 5. Mai 2021; 7.328 Befragte*; ab 14 Jahre; repräsentativ für die österreichische Bevölkerung; Top 10; * Basis: Entscheidungsträger bzgl. der Wahl eines Mobilfunkanbieters würden (jeder) den Mobilfunk-Anbieter (...) [Wählen](#)
Quelle(n): Marktagent

statista

The survey filters for consumers that fulfil the following criteria:

- At least 18 years old in 2022

Criteria must be fulfilled for both current and previous plan [Back](#)

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Criteria must be fulfilled for both current and previous plan [Back](#)

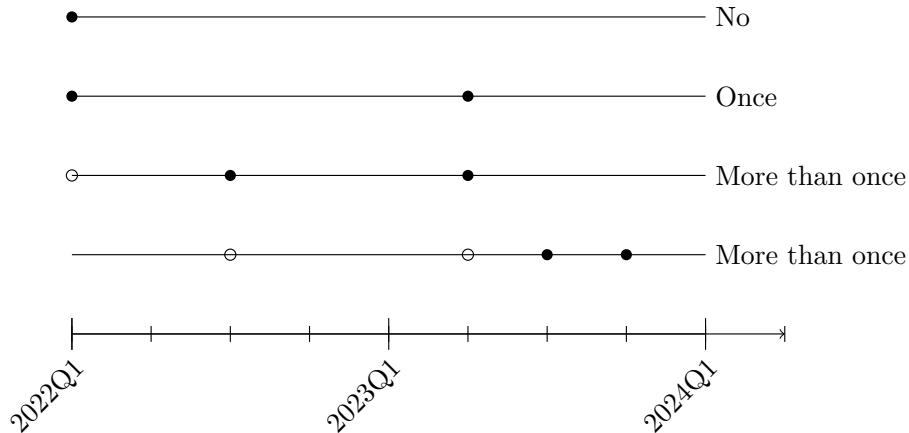
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- The plan is for retail customers
- They pay for the plan themselves
- They chose the plan

Criteria must be fulfilled for both current and previous plan [Back](#)

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

Back



Attention

$$\mu_{it} = \frac{\exp(\mathbf{x}'_{0_{it}}\lambda + \mathbf{z}'_i\kappa + \xi_{\psi(0_i)}^{in})}{1 + \exp(\mathbf{x}'_{0_{it}}\lambda + \mathbf{z}'_i\kappa + \xi_{\psi(0_i)}^{in})}$$

Consideration

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

Choice

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

Sociodemographics

Gender [Back](#)

Age

Region

Income Bracket

Education

Marital Status

Household Size

Children

Employment Status

User Type

Has searched in price comparison websites

Has searched in local shops

Plan Characteristics

Monthly fee

Annual fee

SMS

Minutes

Gigabyte

5G

Download Speed

Commitment period

EU Roaming

Non-EU Roaming

Bundle (plan+wifi, plan+fixed line)

Family rebate

- provider specific

- provider specific
 - brick and mortar shops by region

- provider specific
 - brick and mortar shops by region
 - network quality by region

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 - advertising expenditure over time

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 - proxy for ad exposure like media exposure

- Prices

- Prices

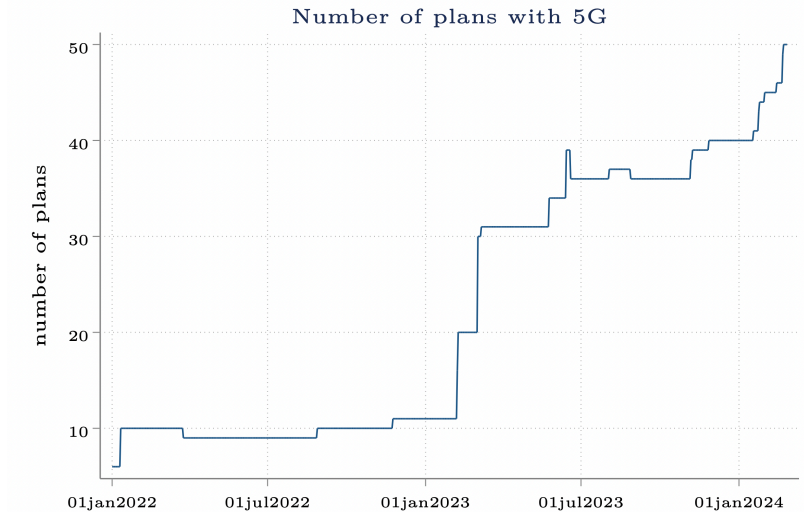
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- price comparison websites offer reminders
- can include potential savings (with some caveats) rather than price



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

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- RTR definitions for usage (gigabyte etc) available

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- 5 Even if customer service varies over time, prices do not vary much → would customer service then be correlated with price?

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These are cost components, but more fixed cost rather than marginal cost.

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- time period is market: lagged/future prices?
- broadband prices? (not all firms offer broadband too, are the omitted product characteristics different)

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- (Churn data can also help)

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- All cross-derivative asymmetries are due to imperfect consideration

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Conditions

- partial derivative of latent choice probability wrt to all other goods prices (compounded) exists, is non-negative and continuous
- cross-price derivatives of latent choice probabilities are symmetric
- no nominal illusion (latent choice probabilities are invariant to price shifts across the board)

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- Empirical question if they work if consumers have limited consideration

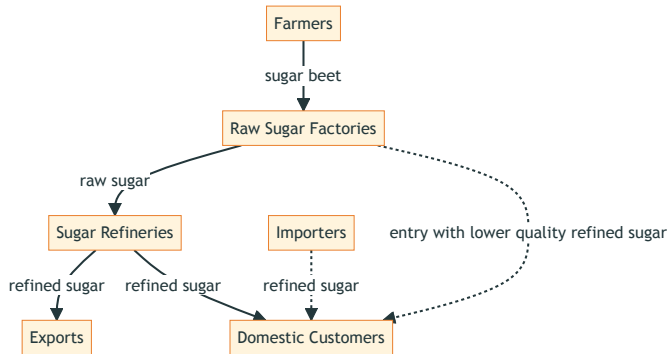
§ 135 (7)

Anbieter nach Abs. 1 haben Endnutzern, in den Fällen einer automatischen Verlängerung nach einer Befristung, zumindest einmal jährlich, jedenfalls aber zum Zeitpunkt einer Information nach Abs. 6, über den anhand ihres Nutzungsverhaltens im vergangenen Jahr bestmöglichen Tarif in Bezug auf ihre Dienste zu informieren.

Article 105(3)

Where a contract or national law provides for automatic prolongation of a fixed duration contract for electronic communications services other than number-independent interpersonal communications services and other than transmission services used for the provision of machine-to-machine services, Member States shall ensure that, after such prolongation, end-users are entitled to terminate the contract at any time with a maximum one-month notice period, as determined by Member States, and without incurring any costs except the charges for receiving the service during the notice period. Before the contract is automatically prolonged, providers shall inform end-users, in a prominent and timely manner and on a durable medium, of the end of the contractual commitment and of the means by which to terminate the contract. In addition, and at the same time, providers shall give end-users best tariff advice relating to their services. Providers shall provide end-users with best tariff information at least annually.

Appendix 2



Cartel	Duration	Reason for Breakdown
1st refinery cartel	1891m10-1894m9	Entry from new refineries
2nd refinery cartel	1895m11-1897m10	Start of 1st integrated cartel
1st integrated cartel	1897m11-1903m8	International trade agreement
3rd refinery cartel	1906m10- 1911m9	Start of 2nd integrated cartel
2nd integrated cartel	1911m10 -1914m8	World War I

- There are two types of consumers: storers and non-storers

These assumptions can be relaxed to some extent [Back](#)

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- Storage is free for one month, but infinitely costly afterwards, no discounting
- Therefore, consumers store at most for one month
- Consumers have perfect foresight of prices in next month
- If prices today are the same as tomorrow, storers purchase today

These assumptions can be relaxed to some extent [Back](#)

Aggregate purchases X_t are given by

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

■ Estimating Equation

$$\log X_t = \alpha + \log \tilde{X}_t + u_t$$

$$\text{where } \tilde{X}_t = \omega e^{\beta^n p_t + \varepsilon_t} + (1 - \omega)(\mathbb{1}_{\text{buy for } t} e^{\beta^s p_t + \varepsilon_t} + \mathbb{1}_{\text{buy for } t+1} e^{\beta^s p_t + \varepsilon_{t+1}})$$

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- Estimation by GMM if shocks are ignored or if shocks $\varepsilon_t, \varepsilon_{t+1}$ are included by MSM
- MSM is needed because without simulation of $\varepsilon_t, \varepsilon_{t+1}$, we cannot evaluate the sample analog of the moment condition

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

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Appendix 3

- We initialise the NLLS estimation routine with the true parameter vector

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