Essays in Empirical Industrial Organization

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- Why should we drop the standard assumptions?
  - We are worried that standard estimators are inconsistent
  - We want to answer questions that standard models cannot answer, e.g., simulate counterfactuals related to information or dynamics

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

Chapter 1

Inertia in the market for mobile telephony

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  - Should consumers be "forced to make a choice"?

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

Related Literature

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

- **Quantification of frictions.** Shcherbakov (2016), Heiss et al. (2021), Abaluck and Adams (2021), Dressler and Weiergraeber (2023)

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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

→

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Utility $$u_{ijt} = \mathbf{x}'_{jt}\beta + \zeta \cdot Switch_{ijt} + \xi_j + \varepsilon_{ijt} = \delta_{ijt} + \varepsilon_{ijt}$$

Attention $$\mu_{it} = Pr(\text{shop around}) := \Lambda(\mathbf{x}_0, \mathbf{z}_i, \xi_0)$$

Consideration $$\phi_{ijt} = Pr(\text{consider product } j) := \Lambda(\mathbf{x}_{jt}, \mathbf{z}_i, \xi_j)$$

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

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

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$$s_j(\cdot) = \mu(\cdot) \sum_{C \in \mathbb{P}(j)} \pi_C(\cdot) s_j^\star(\cdot \mid C) \quad \text{for } j \neq 0,$$
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- where $\mathbb{P}(j)$ is the set of consideration sets which include product j (and the previous plan)
- If a consumer does not shop around, $\mu = 0$, she chooses her previous plan, $s_0 = 1$

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- Latent choice probabilities $s^\star(\cdot \mid C)$ are identified from absence of nominal illusion
- Given identification of $\frac{\partial s_j}{\partial x_{j'}}, \pi_C, s_j^\star$, identification of mean preferences is standard (how choice shares vary with own characteristics)

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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  - But many fringe firms, largest 5 providers capture ~97% market share
  - Can, e.g., aggregate over plans by user types (low, medium, high, power user)

Next Steps

- Run pre-test and final survey (expected: 2024Q2)
- Expand model to account for heterogeneities
- Code up estimator and estimate model
- Simulate counterfactuals and compare switching rates $\frac{1}{N}\sum_{i=1}^{N}(1 - s_{i0})$:
  - Forced attention/choice: $\mu = 1$
  - Remove switching cost: $\xi = 0$
  - 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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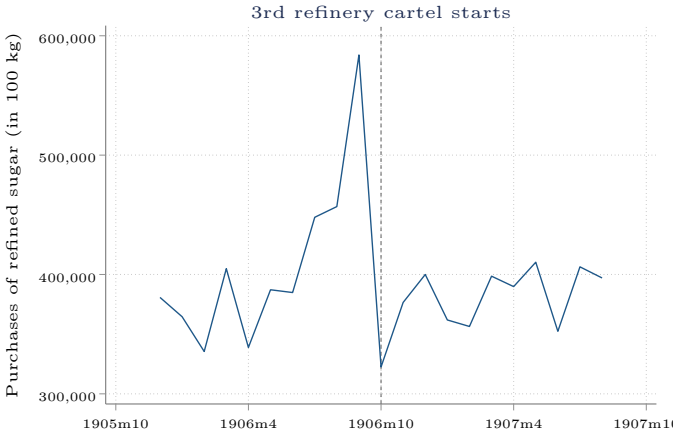
  - Did storing behaviour reduce the welfare costs of cartelisation?
  - Did integrated cartels obtain higher markups than downstream-only cartels?

Related Literature

- **Estimation of conduct in homogeneous good industries:** Porter (1983)
- **In particular, in the sugar industry:** Genesove and Mullin (1998)
- **Factors determining cartel success:** Levenstein and Suslow (2006)

  $\rightarrow$ *We estimate conduct taking into account stockpiling dynamics* (monthly data)

Hints of stockpiling



Data source: Centralverein der Rübenzuckerindustrie

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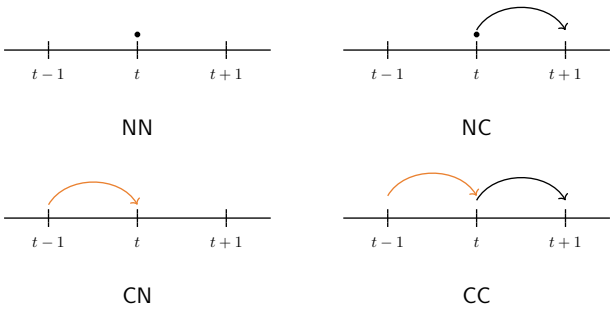

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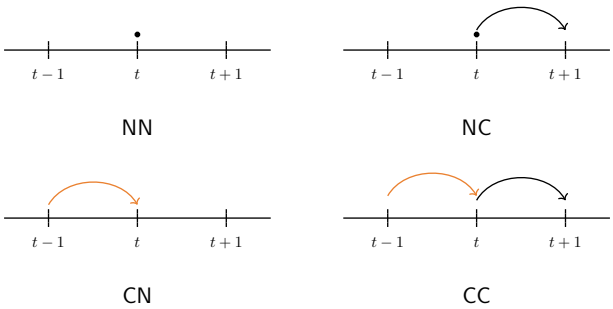

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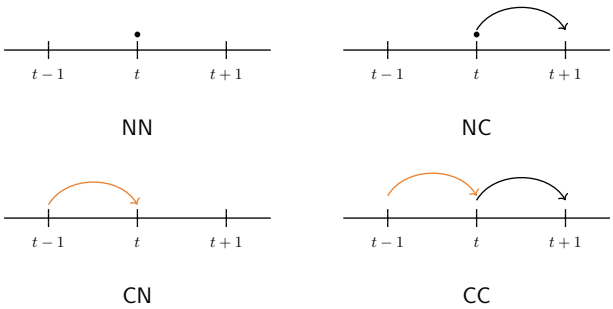

- Instruments: price of raw sugar (global market), tax on refined sugar, cartel dates

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  - Raw sugar was turned into refined sugar in fixed proportion (1.11:1)

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  - MC did not vary with quantity (according to Genesove and Mullin 1998)
  - Raw sugar was turned into refined sugar in fixed proportion (1.11:1)
- Conduct parameter θ (elasticity adjusted price-cost markup):

Methodology: Supply

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

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- Conduct parameter θ (elasticity adjusted price-cost markup):

$$\frac{\theta}{N} = \frac{\frac{P-MC}{P}}{\frac{1}{\eta}}$$

Next Steps

- Finish coding up estimator
- Expand specification for supply side
- (Digitalise more data)
- Estimate demand, supply, and conduct
- Simulate counterfactuals
  - Price under Cournot competition: $\frac{\theta}{N} = \frac{1}{N}$
  - Collusive price in absence of stockpiling

Elasticity in absence of stockpiling

Chapter 3

Revisiting demand estimation in storable goods markets

Outline

- Demand for storable goods can feature stockpiling dynamics

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  - What is the cost of abstracting from non-additively separable shocks if they are present? (simulated data) Simulation Setup

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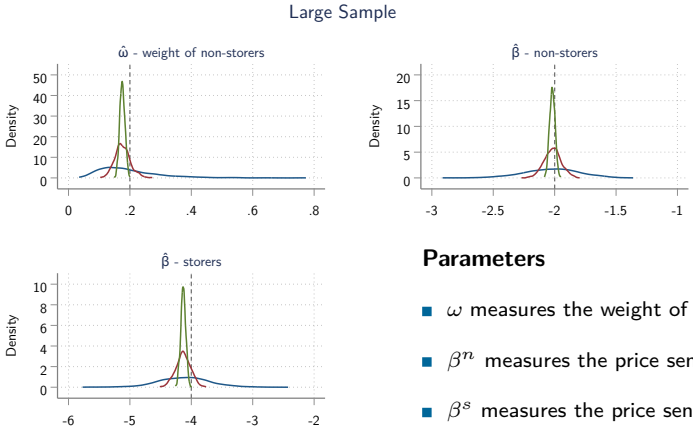
- **Research questions** (data):
  - What is the cost of abstracting from non-additively separable shocks if they are present? (simulated data) Simulation Setup
  - Should we include them in our model in the first place? (scanner data)

Preliminary Monte Carlo Results



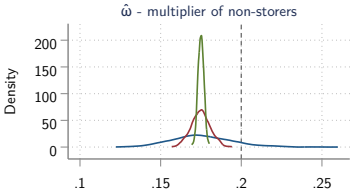
Repetitions = 1000
Sample Sizes: 500, 5000, 50000

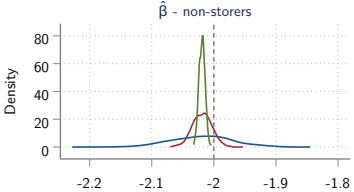
Parameters

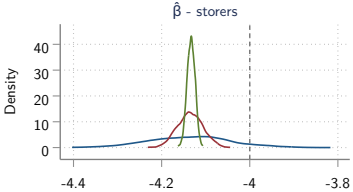
- ω measures the weight of non-storers
- β^n measures the price sensitivity of non-storers
- β^s measures the price sensitivity of storers
- Disregard demand shocks ε_t, ε_{t+1} Estimating Equation

Preliminary Monte Carlo Results

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 disregards shocks is inconsistent

Next Steps

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

Thank you

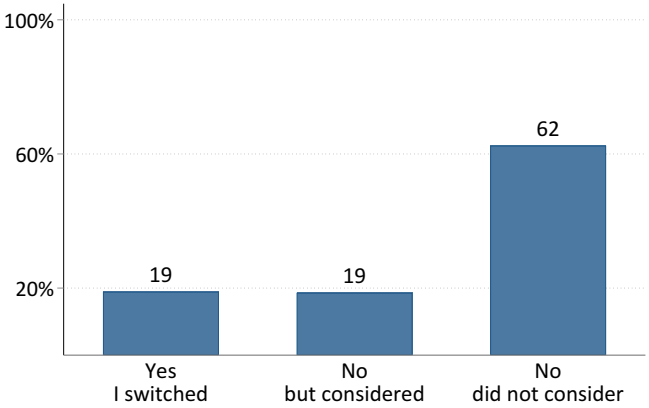
Research Proposal

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

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

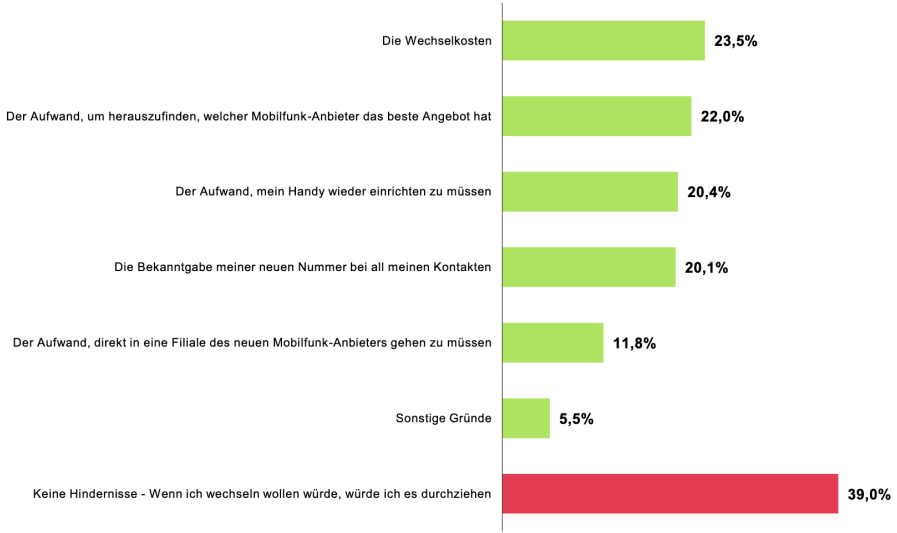
Appendix 1

Did you switch provider in 2019-2021?



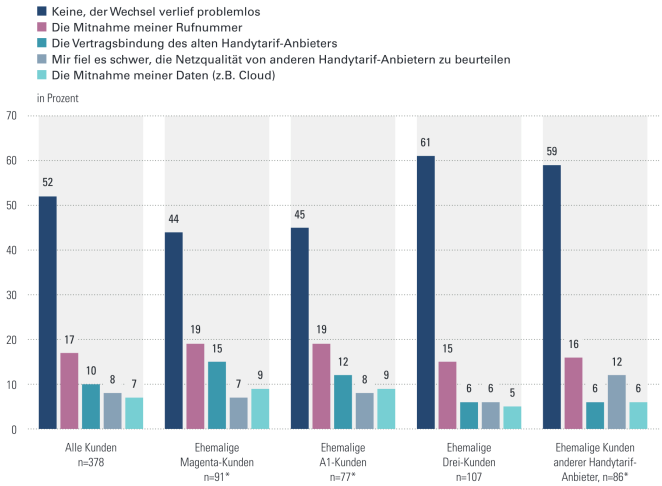
Data source: RTR (2021) Back

What do you perceive as barriers to switching?



Switchers: what did you perceive as obstacle?

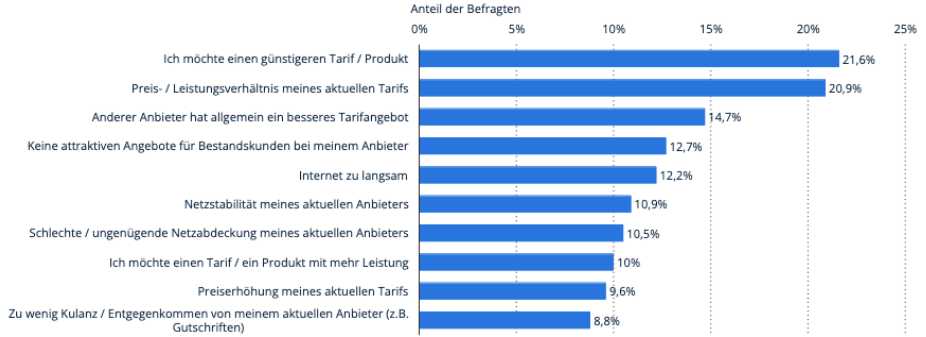
Abbildung 14: **Wechsler – Welche Faktoren haben Sie beim Wechsel des Handytarif-Anbieters als Hindernis empfunden? (Mehrfachnennung, Q29)**



Why do you consider switching provider?

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

Gründe für einen Anbieterwechsel in Österreich im Jahr 2021

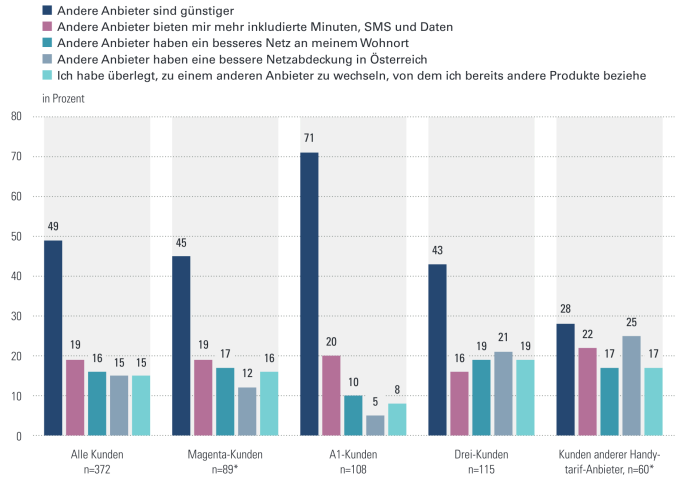


25 **Beschreibung:** Bei einer Meinungsumfrage in Österreich aus dem Jahr 2021 zu den Gründen für einen gewünschten Mobilfunkanbieterwechsel gaben mit 21,6 Prozent die meisten der Befragten an, einen günstigeren Tarif haben zu wollen. 20,9 Prozent der befragten Österreicher nannten als Grund dafür, warum sie (eher) den Anbieter wechseln würden, das Preis- / Leistungsverhältnis ihres aktuellen Tarifs. Mehr
Hinweis(e): Österreich; 5. Mai 2020 bis 5. Mai 2021; 7.928 Befragte*; ab 14 Jahre; Repräsentativ für die österreichische Bevölkerung; Top 10 ; * Basis: Entscheidungsträger bzgl. der Wahl eines Mobilfunkanbieters würden (eher) den Mobilfunk-Anbieter [...] Mehr
Quelle(n): Marktagent

statista

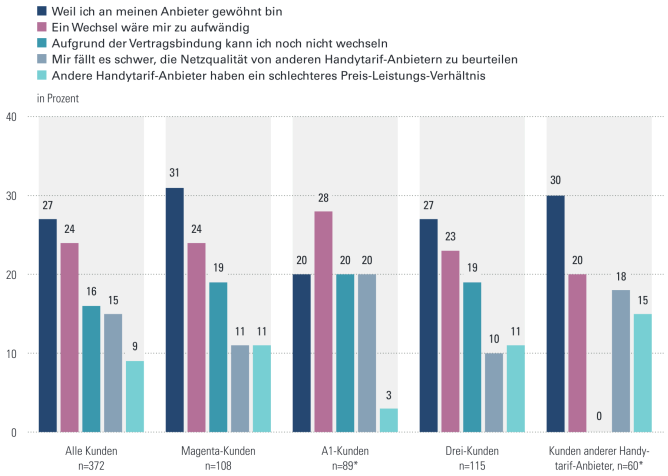
Why did you consider switching provider?

Abbildung 15: Überleger – Warum haben Sie überlegt, den Handytarif-Anbieter zu wechseln? (Mehrfachnennung, Q34)[55]



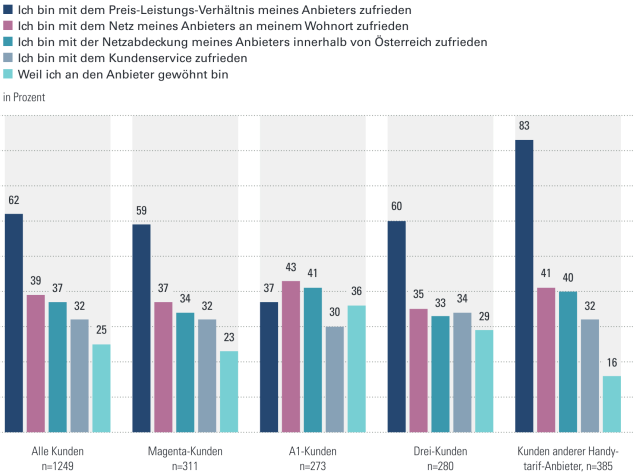
Why did you eventually not switch provider?

Abbildung 16: Überleger – Warum haben Sie den Handytarif-Anbieter nicht gewechselt? (Mehrfachnennung, Q35)[56]



Why did you not consider switching provider?

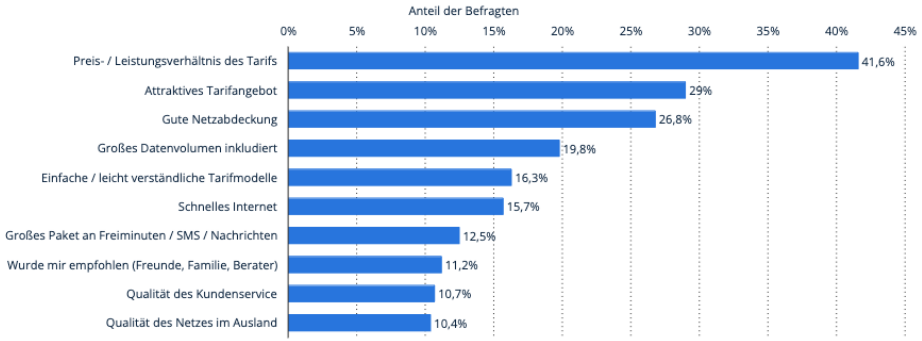
Abbildung 17: Nicht-Überleger – Warum haben Sie keinen Wechsel des Handytarif-Anbieters überlegt? (Mehrfachnennung, Q36)



Why did you choose your current provider?

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

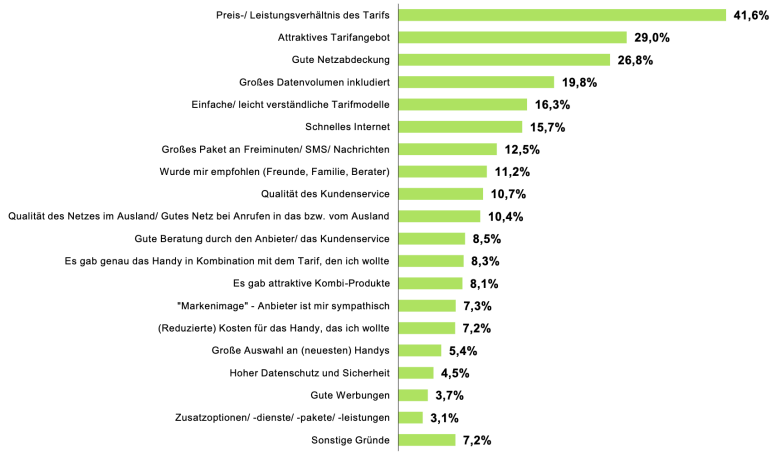
Gründe für die Wahl des aktuellen Mobilfunkanbieters in Österreich 2021



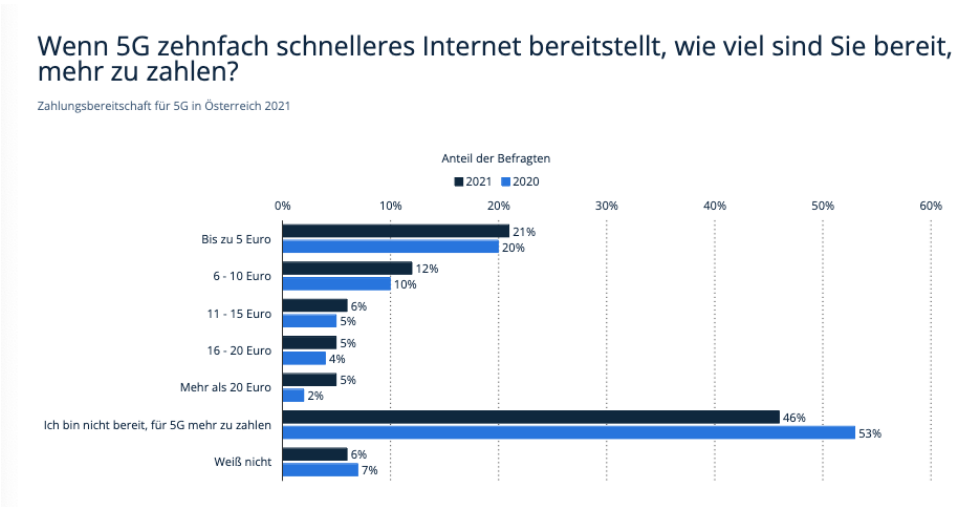
18 **Beschreibung:** Bei einer Meinungsumfrage in Österreich aus dem Jahr 2021 über die Gründe bei der Wahl des Mobilfunkanbieters, gaben 41,6 Prozent der Befragten an, sich vor allem wegen des Preis-Leistungsverhältnisses des Tarifs für einen bestimmten Anbieter entschieden zu haben. 26,8 Prozent der 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
Hinweis(e): Österreich; 6. Mai 2020 bis 6. Mai 2021; 39791 Befragte; ab 14 Jahre; Repräsentativ für die österreichische Bevölkerung; Top 10
Quelle(n): Marketagent

statista

Gründe für die Wahl des aktuellen Mobilfunk-Anbieters



Willingness to pay for 5G



Sampling

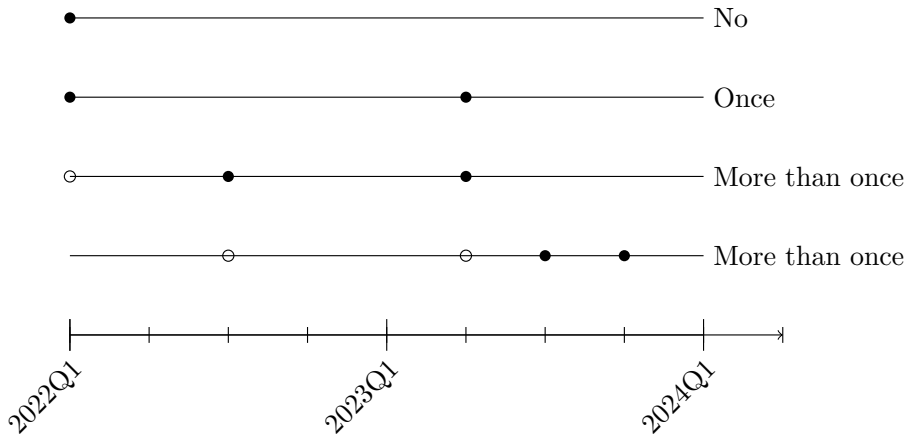
The survey filters for consumers that fulfil the following criteria:

- 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 fulfilled for both current and previous plan Back

Possibilities of single wave

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



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 Back	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
Has searched in price comparison websites	Bundle (plan+wifi, plan+fixed line)
Has searched in local shops	Family rebate

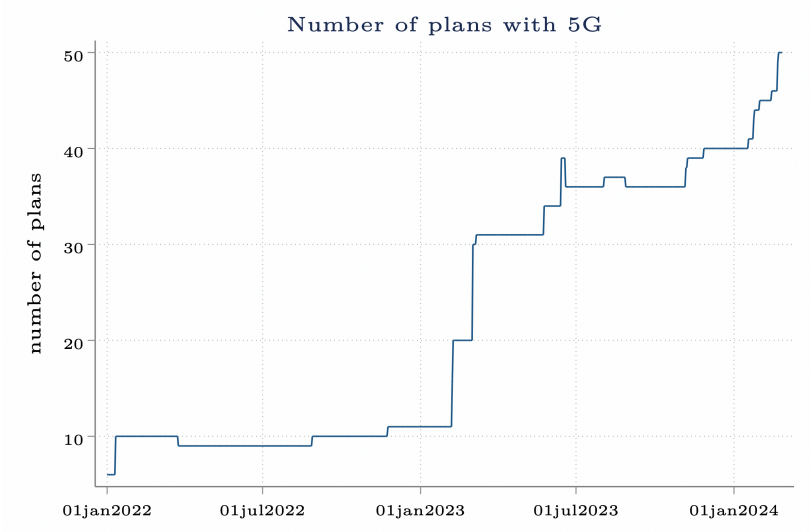
Potential further variables

- provider specific
  - brick and mortar shops by region
  - network quality by region
  - advertising expenditure over time
  - offer of phones, or at least number of phones available for bundle
- individual/demographic specific
  - ad exposure
  - proxy for ad exposure like media exposure

Why would characteristics affect attention?

- Prices
  - Reme, Røhr, and Sæthre (2022) find churn increases rater after price changes, even after price *de*creases
  - Ascarza, Iyengar, and Schleicher (2016) find that churn increases after plan recommendations (which are based on variation in characteristics of available plans; and usage)
  - Price comparison websites offer reminders
  - Can include potential savings (with come caveats) rather than price

5G


Number of plans with 5G
number of plans
50
40
30
20
10
01jan2022
01jul2022
01jan2023
01jul2023
01jan2024

Unobserved product characteristics

1. What would these be? I observe essentially all characteristics related to the *plan*
2. I do not observe characteristics related to the *provider/brand*, but what would this be? Customer service?
3. Does customer service vary over time? Maybe, but how much in 2-3 years? (Investment data from RTR shows no trend 2018-2022, except for covid drop in 2021)
4. Sample period has rather stable market conditions
5. Even if customer service varies over time, prices do not vary much –> would customer service then be correlated with price?

Identification of switching cost

- Assumptions
  - characteristics are exogenous
  - no consumer learning (time invariant preferences)
- Thought experiment: two products have same characteristics today, one was upgraded to 5G earlier than the other, which attracted consumers, if choice shares are different today then that can only be because of switching cost
- (Churn data can also help)

Daly-Zachary Conditions

Intuition:

- All cross-derivative asymmetries are due to imperfect consideration

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) Back

Latest Policies against inertia

- EU: directive 2018/1972 "European Electronic Communications Code"
- AUT: Telekommunikationsgesetz Oct 2021 "TKG 2021"
  - 1 month cancellation period (maximum)
  - 24 months commitment (maximum)
  - Provider has to notify consumer when commitment is about to end
  - 1/year provider has to highlight cheapest plan to consumer based on usage
- If consumers have full consideration these policies have no effect
- Empirical question if they work if consumers have limited consideration

Telecommunication law (TKG 2021)

§ 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.

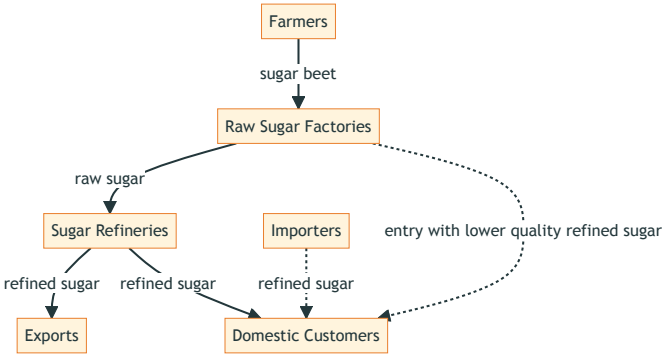
EU Directive

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

Supply Chain of the Sugar Industry



Reasons for cartel breakdowns

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

Assumptions for dynamic model of demand

- There are two types of consumers: storers and non-storers
- They have potentially different elasticities of demand
- 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

Demand elasticity in absence of stockpiling

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

Back

Appendix 3

Simulation Setup

- Simulate time series dataset
- Identification argument relies on time series variation, so method should work
- Similar mean and sd of price, quantity, sales periods and sales definition
- $P_t \overset{\text{iid}}{\sim}$ mixture of truncated $L(0.95, 0.1), L(1.25, 0.1)$, to get bimodal price distribution
- Set true parameters approx. equal to their estimates in Hendel and Nevo (2013)
- Initialise the NLLS estimation routine with the true parameter vector

Back

Demand Specification

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

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

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

- Estimation by NLLS 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 (analytically) evaluate the sample analog of the moment condition, e.g., $E(u_t) = 0$ Back

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