

Empirical Methods for the Analysis of the Energy Transition

Slide Set 12

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Spring
Econ 498-1

The liberalization of the retailing market of electricity

- Competition in the retailing market has been rather slow.
 - ▶ Some areas maintain natural monopolies for retailing (no competition by design).
 - ▶ Incumbency advantages are substantial due to long tradition of natural monopolies.
 - ▶ Consumers have large switching costs.
 - ▶ Even when competition picks up, companies may go bankrupt (more than in other industries).

The challenge of a thriving retail market

- Deregulation of utilities → expansion of retail choice for energy consumers
- However, choice frictions due to
 - ▶ **Search Frictions / Inattention:** Households may not choose to search for or pay attention to offerings by other retailers (or have accurate information)
 - ▶ **Incumbent Brand Advantage:** Consumers may view the retailers (especially the incumbent) as vertically differentiated
- Concerns that these impact households with low-income more (based on electricity markets (Waddams Price, Webster, and Zhu, 2013) and more generally (Byrne and Martin, 2021)).

Today's plan

- We will review several papers that examine the performance of retail electricity markets, putting emphasis on the data available and the focus of the research questions.
- Big emphasis on the presence of switching costs and incumbent preferences by consumers, but range of data quality and estimation strategies might differ.
 - ▶ Aggregate markets shares and flows
 - ▶ Micro-data
 - ▶ Survey data
 - ▶ Experimental treatments

Note: Today's papers focused on estimation without full equilibrium model, see Giulietti, Waterson, and Wildenbeest (2014) for a Stahl-style pricing model.

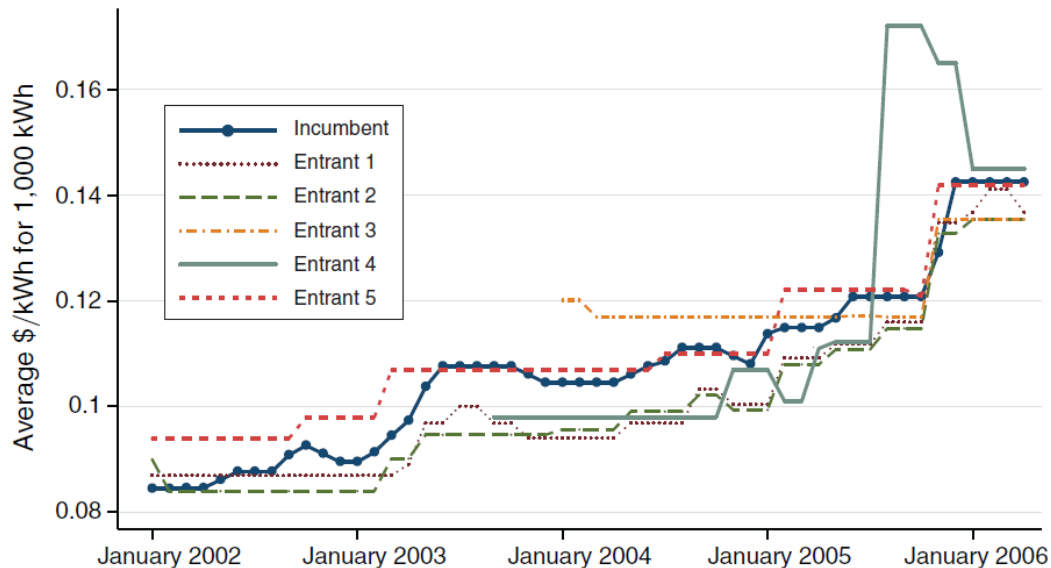
Power to Choose? – Hortaçsu, Madanizadeh and Puller (2017)

- **Goal:** Study a particular retail choice program to measure the size of choice frictions and to understand the underlying mechanisms
- **Methodology:** Household (Hh) choice model with 2 stages:
 - 1 Hh decides whether to consider an alternative retailer. If it does
 - 2 Hh chooses the retailer the maximizes utility
- **Preview of the results:**
 - ▶ Only 2% of Hh search for retail options every month
 - ▶ Conditional on searching, customers attach higher utility to incumbent product

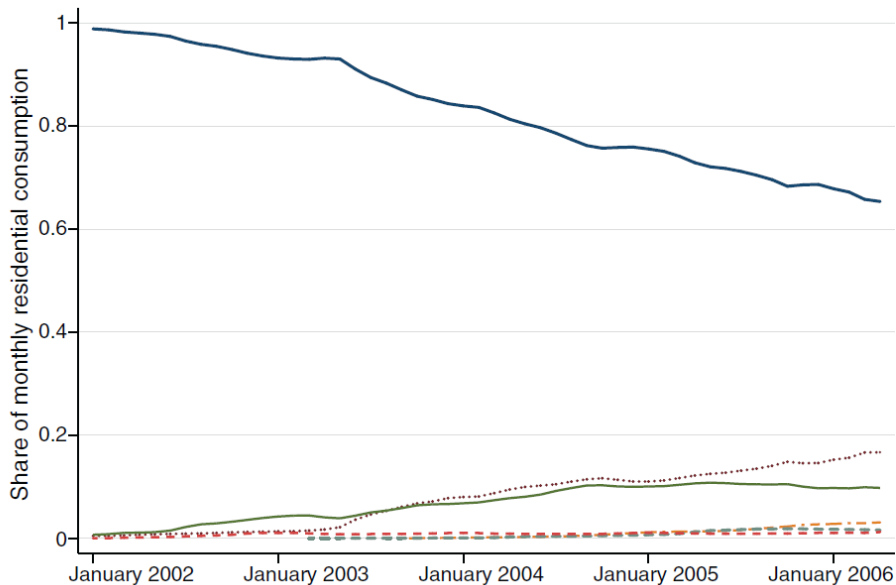
The program: Retail Electricity Choice in Texas

- Historically, residential electricity served by **vertically integrated** utilities at **regulated prices**
- In 2002, opening of retail market:
 - ▶ By default, Hh were assigned to the retail firm **affiliated** with the old incumbent
 - ▶ The incumbent price was regulated ("*price-to-beat*")
 - ▶ New retailers procure power to the wholesale market and sell it to consumers at a competitive price
 - ▶ Publicized via website www.powertochoose.com
- **Data:**
 - ▶ 192,000 residential meters from January 2002 until April 2006
 - ▶ Information on the electric retailer used by the household and the electricity consumption for every month.
 - ▶ Match meter address to census block group data on demographics

The Program: Prices



The Program: Market shares



The Model

- 1 Decision to Choose:** Each month a household decides whether to consider alternative retailers. The probability of considering a (possibly new) retailer varies by characteristics:

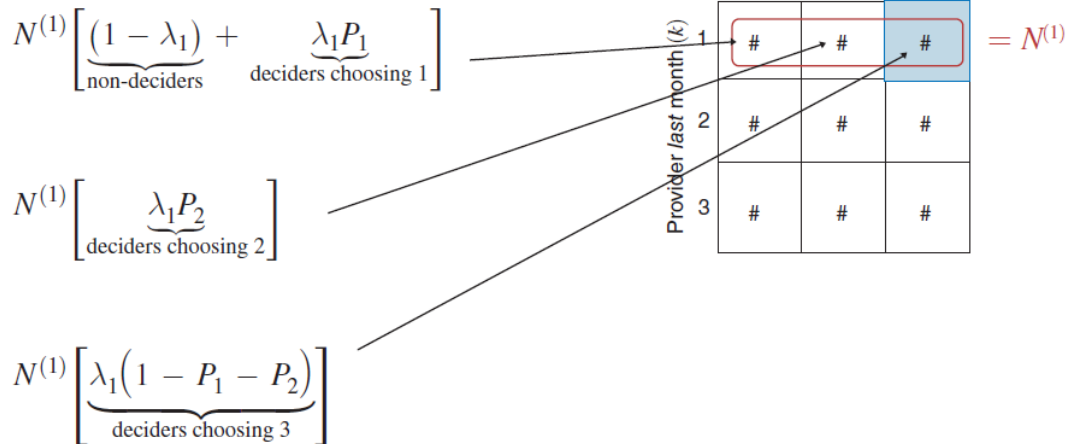
$$\lambda_t^k(\gamma) = \frac{e^{W_t^k}}{1 + e^{W_t^k}} \quad \text{where} \quad W_t^k = \sum_r \gamma_r Z_{rt}^k$$

- 2 Choice of retailer:** Each household who enters the choice stage in month t chooses the retailer from the choice set that yields the highest utility:

$$U_{ijt} = V_{ijt}(\theta) + \epsilon_{ijt} \quad \text{where} \quad V_{ijt}(\theta) = \sum_s \theta_s X_{jt,s}$$

$$P_{ijt}(\theta) = \frac{\exp(V_{ijt}(\theta))}{\sum_{k>1} \exp(V_{ikt}(\theta))} \quad \text{(Conditional Choice Probabilities)}$$

Illustration of Identification Strategy



Parameterization of W and V

- Decision to choose $W_t^k(\gamma)$:
 - ▶ Incumbent, seasonality, “large bill”
- Choice of retailer $V_{ijt}(\theta)$:
 - ▶ Price, incumbent, incumbent trend
- Additional specs:
 - ▶ Paper considers alternative models for different demographics as an extension.
 - ▶ Paper also gets some traction from movers, which are assumed to make decision to choose $\lambda = 1$.

Results: Decision to Choose

	Benchmark (1)	Seasonality in search (2)	Large bill affects search (3)	All (4)
<i>Stage one: Decision to choose</i>				
Parameters (γ)				
Constant	-3.363 (0.045)	-3.720 (0.123)	-3.468 (0.048)	-3.643 (0.149)
Incumbent	-0.643 (0.064)	-0.647 (0.062)	-0.589 (0.068)	-0.626 (0.064)
January		0.222		0.038
February		0.375		0.315
March		0.266		0.043
April		0.041		-0.125
May		0.210		0.176
June		0.228		0.170
July		0.638		0.364
August		0.635		0.474
September		0.541		0.424
October		0.547		0.429
November		0.383		0.365
Large bill (\$ change in two most recent bills)			0.007 (0.002)	0.003 (0.003)
Estimated effects				
Pr(monthly search) incumbent customer (λ)	0.018	0.018	0.018	0.017
Pr(monthly search) entrant customer (λ)	0.033	0.033	0.032	0.032

Results: Choice of Retailer

	Benchmark (1)	Seasonality in search (2)	Large bill affects search (3)	All (4)
<i>Stage two: Choice of retailer</i>				
Parameters (θ)				
Price (cents/kWh)	-0.435 (0.091)	-0.464 (0.083)	-0.462 (0.096)	-0.445 (0.085)
Incumbent brand dummy	2.764 (0.256)	2.946 (0.269)	2.789 (0.294)	2.834 (0.293)
Incumbent month-of-sample counter	-0.076 (0.014)	-0.086 (0.015)	-0.075 (0.016)	-0.080 (0.016)
Estimated effects				
Incumbent price elasticity	-2.52	-2.61	-2.67	-2.55
Average entrant price elasticity	-4.51	-4.82	-4.80	-4.62
Incumbent brand effect (\$/mo) in January 2004	\$61.86	\$61.61	\$58.72	\$61.85
Incumbent brand effect (\$/mo) in April 2006	\$14.87	\$11.67	\$14.66	\$13.50

Extensions

1 Demographics:

- ▶ Both sources of inertia are larger for neighborhoods with lower income, lower education, and more senior citizens.
- ▶ Initial incumbent brand effect declines to very similar levels by the end of the the sample

2 Movers

- ▶ No initial conditions problem, but brand effect still large (or even larger).
- ▶ Suggests it is not just an issue of Hh being “started” there (inertia).

3 Policy counterfactual: the effect of an information intervention - adding a flyer to an existing bill - could increase consumer surplus

Take aways

- Paper presents a very simple identification argument for switching probabilities, although limited by amount of switching.
- Fundamental source of price variation also unclear (focused on consumers' responses under exogeneity assumption).
- Competition in Texas took off quite quickly (compared to other settings), in part due to the “price-to-beat” design.
- In practice, some bankruptcies brought some consumers back to incumbent, but today probably among most diversified retail markets.

Enrich, Li, Mizrahi and Reguant (2022)

Some new features that increase differentiation

- Electricity retailing traditionally largely undifferentiated, function mostly billing and good practice in procurement to be competitive.
- Some new trends:
 - ▶ Green/renewable labeling (whether actually green or not).
 - ▶ Innovative pricing via smart meters.
 - ▶ Combination of solar installations (leasing) + pricing.

Smart meters and information

- Incumbents might be at an advantage due to access to smart meter information.
- Easier to target customers and tailor their offers and nudge switching, even if price discrimination strictly not allowed.
- Policies are put in place to facilitate sharing of data, but obstruction remains a risk.

This paper: Competition in the Spanish market

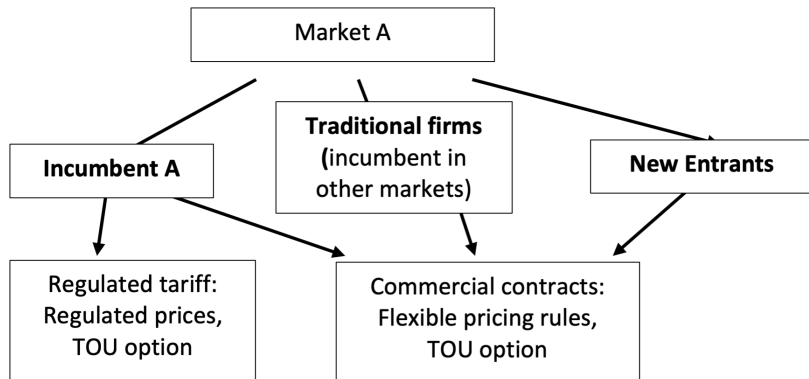
- We present an overview and exploration of these issues using an aggregate data set from the Spanish electricity market.
- The evidence suggests that competition challenges remain large, although some modest evidence of increased pricing innovation exists.
- Note: This is a short paper and a clear follow-up to the previous one, not trying to re-invent the wheel.

Background: Liberalization of regional monopolies

- At the onset of liberalization, five firms served almost all customers in separate distribution territories.
- Regulated firms were divided into a regulated distributor (which provides a default regulated tariff) and a commercial retailer.
- Commercial retailers could compete in the other territories.
- New firms also entered the market.

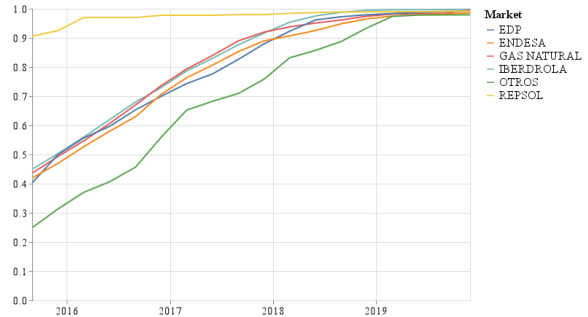
Background: Structure of competition

- Regulated tariffs cannot choose prices.
- Firms can include price discrimination in their contracts.
- Since 2015, regulated tariff has real-time pricing.



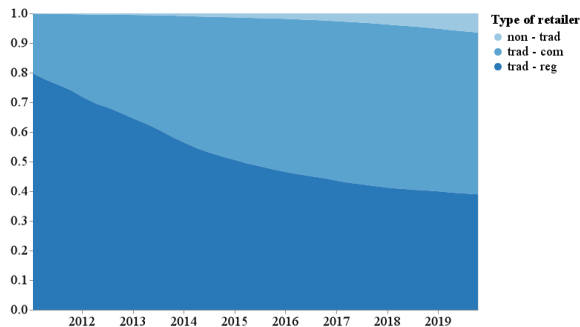
Background: Smart meters

- Huge effort in mid 2010s to reach universal smart meter coverage.
- Consumers can access their data on the regulated distribution website.
- Consumers may also be able to access their data on their retailer website.



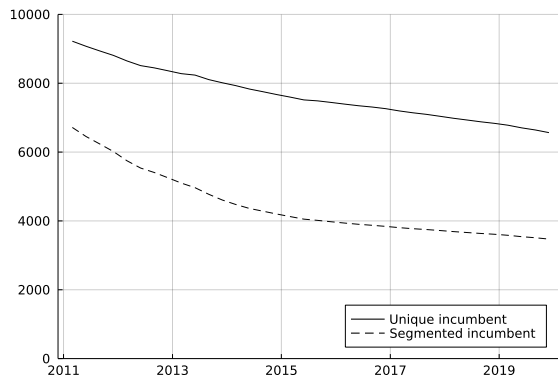
Data: aggregate market-level data

- We observe residential market share (in # customers) for each category (regulated/not, non-TOU/TOU), firm, and geographical area at the quarterly level (2011-2019).
- Shares show large presence of traditional firms even 10 years after liberalization, HHI remains high.



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Other data and some limitations

- Flow data: how many consumers appear as new, exit, or switch providers.
 - ▶ Challenge: Not at market level, limited detail on switching patterns.
- Price data: for each contract offered (most popular ones), green label, etc.
 - ▶ Challenge: Based on contemporaneous offers, more granular than market shares so cannot fully exploit.
- Hourly consumption data: consumption of consumers in each time discrimination category (non-TOU/TOU).
 - ▶ Challenge: No geographical or firm disaggregation.

Examining incumbent advantage and switching costs

- We exploit the presence of **incumbents in and out of their market** to identify firm vs. incumbent advantage.
- We exploit **flow data** out of regulated firms to identify switching behavior.
- Nice feature: same firm can be both an incumbent and an entrant due to different traditional monopoly boundaries.
- Estimation follows closely the previous paper but adapted to not having the full switching matrix (and only aggregate data!).

Observed flows and stocks

- $N_{mt}^{r \rightarrow i}$: flows from regulated tariff to incumbent commercial tariff;
- $N_{mt}^{r \rightarrow o}$: flows from regulated tariff to non-incumbent (other) commercial tariffs;
- $N_{mt}^{i \rightarrow r}$: flows from incumbent commercial tariff to regulated tariff;
- $N_{mt}^{o \rightarrow r}$: flows from non-incumbent (other) commercial tariffs to regulated tariff;
- A_{mt}^r : New customers that chose the regulated tariff;
- N_{jmt} : Number of households on a given firm and market, $\forall j = 0, \dots, 6$.

Moments

- $\hat{N}_{mt}^{r \rightarrow i} = \lambda_{rmt}(\beta)(1 - \phi)N_{rm,t-1}P_{imt}(\theta),$
- $\hat{N}_{mt}^{r \rightarrow o} = \lambda_{rmt}(\beta)(1 - \phi)N_{rm,t-1} \sum_{j \notin r,i} P_{jmt}(\theta),$
- $\hat{N}_{mt}^{i \rightarrow r} = \lambda_{imt}(\beta)(1 - \phi)N_{im,t-1}P_{rmt}(\theta),$
- $\hat{N}_{mt}^{o \rightarrow r} = (1 - \phi)P_{rmt}(\theta) \sum_{j \notin i,r} \lambda_{jmt}(\beta)N_{jm,t-1},$
- $\hat{A}_{mt}^r = A_{mt}P_{rmt}(\theta),$
- $\hat{N}_{jmt} = (1 - \phi) \left((1 - \lambda_{jmt}(\beta))N_{jm,t-1} + P_{jmt}(\theta) \sum_k \lambda_{kmt}(\beta)N_{km,t-1} \right) + A_{mt}P_{jmt}(\theta),$

where ϕ is a common constant rate of attrition of households in market m at time t .

Main Results

- Large incumbency advantage confirming market share results.
- Smart meters seem to correlate with reductions in incumbency advantage (not great variation though!).

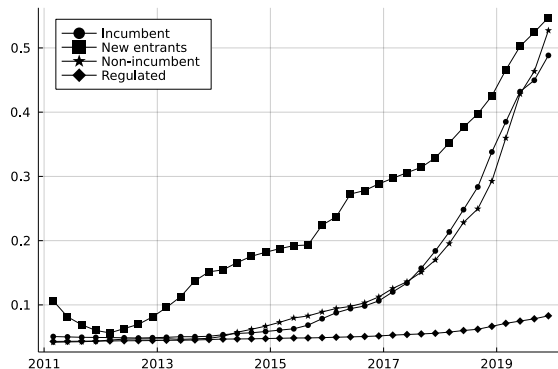
	(1)	(2)	(3)	(4)
Panel A: Search				
Incumbent (β^i)	0.90	0.67	0.92	0.89
Regulated (β^r)	0.64	0.21	0.52	0.46
Smart meter			0.08	
$\bar{\lambda}$	0.02	0.02	0.01	0.02
Panel B: Incumbency Advantage				
Incumbent (θ^i)	3.39	3.25	5.62	5.71
Regulated (θ^r)	2.34	2.02	2.32	2.24
Smart meter			-5.05	
Smart meter * Inc			-2.33	-2.46
Price		0.05	-0.06	-0.07
\bar{P} Incumbent	0.58	0.53	0.52	0.52
\bar{P} Regulated	0.20	0.15	0.16	0.16
\bar{P} Fringe	0.14	0.24	0.26	0.26
Market, Date	No	Yes	Yes	Yes
Market X Date	No	No	No	Yes

Examining price discrimination

- Our market share data explicitly separate consumers on TOU vs non-TOU plans at the firm-geographical market level.
- We can **exploit roll-out of smart meters** to examine how competition with smart meters changes.
- Some difficulties:
 - ▶ Roll-out of smart meters quite fast and coordinated.
 - ▶ Given lags and switching costs, limited time period with differential access to smart meters.
 - ▶ For today, just show general patterns.

Smaller firms use price discrimination earlier

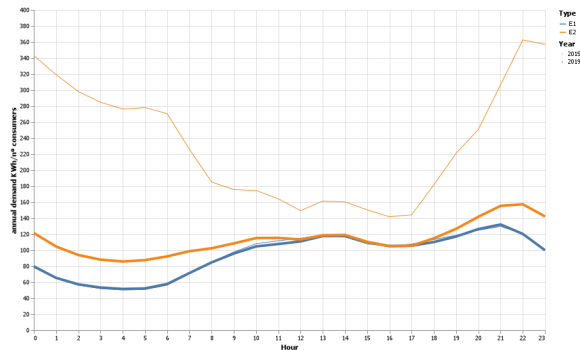
- Firm strategy to attract new customers as TOU has attractive prices for the average consumer.
- Consumer search is more likely in the presence of switching to TOU.
- Switching into TOU largely increased, but it does not seem to reflect in improved switching in the estimation (work in progress).



Do smart meters increase selection?

- Early switchers into TOU more selected.
- Unfortunately, data limitations do not allow us to look into targetting/selection by firm.

Demand per Capita Profile
Comparison of E1 and E2



Summary

- We collect data from the Spanish electricity market and show limited improvement in the extent of retail competition.
- Switching costs and lack of diversification in line with other markets.
- Smart meters appear to increase product differentiation, but data limitations do not allow us to accurately test for firm-level strategies.

Alert the inalert – Dressler and Weiergraeber (2023)

Dressler and Weiergraeber (2023)

- **Question:** How important are competing sources of inertia: switching, search, heterogeneous preferences (E.g., brand effects)?
- **Context:** Belgium, with a liberalized market and a public website (similar to powertochoose).
- **Data:** Panel of market shares, repeated cross-section of survey data on choices (with info on access to price comparison website, PCW), advertising, wholesale instruments.
- **Results:** All sources of inertia are relevant, with some mattering more depending on the demographics. Switching costs more important than search, low with PCW.

Model: informed vs. less-informed decisions

- Consumers not using the website have an awareness probability of retailers based on advertising effort.
- Conditional on PCW, the choice set contains all retailers.
- In the model, consumers trade-off the cost of searching vs. using the coarser awareness set.
- Choice utility captures switching costs by including current choice (at contract-level).
- Utility also contains flexible contract preferences (BLP).
- Note: all consumers are still aware of some choices, so search here assumed to happen every period.

- 192 moments constructed by multiplying six main moments with shifter and/or instruments:
 - ▶ BLP aggregate moments (after contraction to get unobserved shocks)
 - ▶ Churn rate predictions
 - ▶ Aggregate PCW usage predictions
 - ▶ Individual PCW usage predictions
 - ▶ Relative individual switching propensity (based on survey questions of how many times they have changed before)
 - ▶ Individual contract/firm prediction choice error

Identification

- **Heterogeneous preferences:** identification comes from observed variation in market shares when the characteristics of the available contracts vary
- **Switching cost:** the intuition is finding whether consumers switch to contracts of similar characteristics when prices decrease
- **PCW search cost and the advertising awareness:** survey data allow to compare the evolution of the joint distribution of consumers' PCW usage, the conditional market share distribution among PCW users, and the conditional market share distribution of PCW non-users

Main Results I

	Baseline Coefficients	WTP in EUR	Extension Coefficients	WTP in EUR
Mean price coefficient	-15.9270*** (0.1907)	-	-25.1690*** (0.1766)	-
Income x price	0.1723*** (0.0144)	-	0.4793*** (0.0077)	-
Incumbent (non-seniors)	-0.6477*** (0.0392)	-4.07	-1.6251*** (0.0493)	-6.46
Incumbent (seniors)	3.8328*** (0.0755)	24.06	5.1934*** (0.6118)	20.63
Mean green coefficient	0.1936*** (0.0439)	1.22	0.2056*** (0.0528)	0.82
Variance green coefficient	0.0509 (0.0847)	-	0.0461 (0.0365)	-
Switching cost	3.5951*** (0.0271)	22.57		
Switching cost (non-seniors)			5.2261*** (0.0166)	20.76
Switching cost (seniors)			3.9028*** (0.6146)	15.51

Main Results II

			(0.0140)	
PCW search	2.7515*** (0.0475)	-	2.3571*** (0.0457)	-
PCW search-Internet	-8.9856*** (0.1328)	-	-7.3627*** (0.1276)	-
PCW search-Campaign	-0.3614*** (0.0121)	-	-0.1645*** (0.0318)	-
PCW search-Senior			0.4734*** (0.1740)	-
Adv. constant	-2.1168*** (0.0057)	-	-0.3317*** (0.0200)	-
Adv. expenditure	0.6264*** (0.0217)	-	0.1846*** (0.0291)	-

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