BEHAVE pre-conference
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CHEETAH

CHanging Energy Efficiency Technology Adoption in Households

PRESENTATION OF FIRST (PRELIMINARY!) RESULTS: CHOICE EXPERIMENTS

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Agenda

1. Brief overview of multi-country CHEETAH survey

2. First results for stated preferences choice experiments

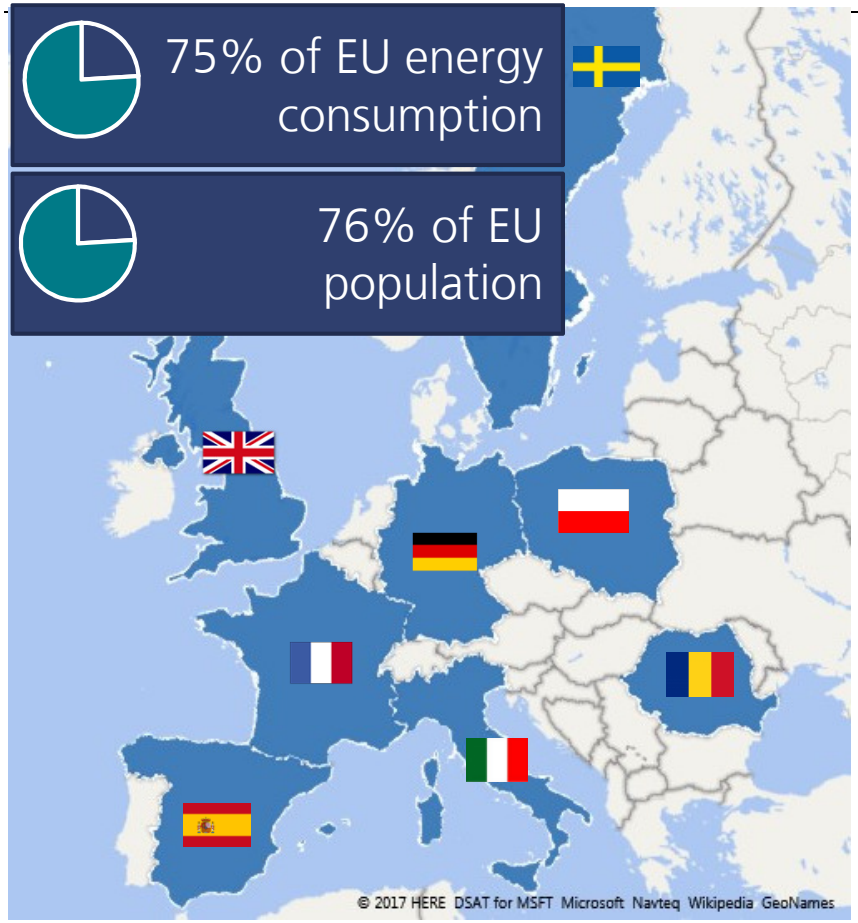
   Example 1: Refrigerators – labels & subsidies (all countries)

   Example 2: Thermostats – subsidies (all countries)

   Example 3: Heating systems – subsidies and subsidy provider (public vs. private financing) (PL) [SE, UK]

3. Discussion

1. CHEETAH Survey



- Demographically representative, online survey in 8 EU countries
- Ca. 18.300 participants
- Ca. 2000/3600 participants per country
- Data collection 7/2018-8/2018
- Stated Preferences Choice Experiments
  - All countries: two baseline CE
  - Some countries: additional CE on selected topics
- Wide range of household, individual and dwelling/appliance characteristics, attitudes, energy literacy,....

2. Results for Example 1: Refrigerators

+ cross-country comparisons

Objectives

- Influence of EU energy label on refrigerator choice
- Impact of subsidies for efficient refrigerators on choice behavior
- Influence of customer rating and warranty on choice behavior
- Heterogeneity in household response

Refrigerators

Introduction

Imagine that **your refrigerator has broken down and you need to buy a new one.** On the following pages, we will show you different refrigerator purchase options. We would like to know **which refrigerator you would choose, if these were your only options.**

Please assume that all refrigerator options fit properly in your kitchen and are currently available in colour and finish of your choice.

The refrigerators only differ on the following attributes**:**

Refrigerators

1. Size: The total internal space of each refrigerator is 220, 240, 260, 280, 300, or 320 litres. 20 litres corresponds to one small compartment. The picture below shows a 320-litre and a 220-litre refrigerator.

Refrigerators

3. Warranty: The **warranty** for each refrigerator is 2, 4, or 6 years.

4. Customer rating: Ratings are provided by customers who have bought the same refrigerator. You may assume that the refrigerators you can choose from have **average ratings** of 3.5, 4.0, or 4.5 stars out of 5 stars.

5. Purchase price: Each **refrigerator costs £250, £350, £450, £550, £700, or £850**.

6. Subsidy: You may receive a **subsidy of £25, £50, or £100 when you purchase an A+++ refrigerator**. The purchase price does not include this subsidy.

Refrigerators

2. Energy class: Refrigerators come with a label that looks like the following:

The colour **"green"** indicates a lower energy consumption while the colour **"red"** indicates a higher energy consumption compared to refrigerators with the same volume and features. You will choose among refrigerators with energy class **A+++, A++, or A+**.

Refrigerators

Table: Description of variables:

Price	Purchase price [£250, £350, £450, £550, £700, £850]
Size	Internal space of the refrigerator in liters (volume) [220, 240, 260, 280, 300, 320]
Warranty	Duration of warranty in years [2,4,6]
A1 (dummy)	A+ (reference level, does not appear in the result table)
A2 (dummy)	A++
A3 (dummy)	A+++
Subsidy	A subsidy for purchasing A+++ refrigerators [£25, £50, £100]
Star3.5 (dummy)	The customer rating is 3.5 (reference level, does not appear in the results tables)
Star4 (dummy)	The customer rating is 4 stars
Star45 (dummy)	The customer rating is 4.5 stars

Refrigerators

Each of the approx. 500 participants in each countries sees 8 choice cards

Scenario 1

Which refrigerator would you choose?

	Refrigerator A	Refrigerator B
Size	280 L	260 L
Energy class	A+++	A++
Warranty	2 years	6 years
Customer rating	3.5 stars	4.0 stars
Purchase Price	£700	£850
Subsidy	£25	£0

	Refrigerator A	Refrigerator B
I choose:	○	○

Model specification

Random Utility Model

$$U_{njt} = \beta_n X_{njt} + \varepsilon_{njt},$$

$$n = 1, \dots, N \ (individuals, e.g. 500),$$

$$j = 1, \dots, J \ (alternatives\ per\ choice\ task, e.g. 2)$$

$$t = 1, \dots, T \ (choice\ tasks,\ e.g.\ 6\ or\ 8)$$

$$WTP = \beta_{attribute} / \beta_{price}$$

Econometric analysis

Types of models

1. Conditional logit models (standard)
2. Mixed logit models (to test for heterogeneity, does not require IIA)
3. Conditional logit models with interaction terms (interaction effects for specific characteristics) a) age (>=55: elder); b) Income: 3 or 4 income categories
4. Mixed logit models with interaction terms (interaction effects for specific characteristics) a) age (>=55: elder); b) Income: 3 or 4 income categories
5. [Latent class models (endogenous classification in latent groups)]

Refrigerators: Mixed Logit results - Germany & Poland

	Germany	Poland
Mean	b/se	b/se
price	-0.0039***	-0.0036***
	(0.000)	(0.000)
size	0.0044**	0.0055***
	(0.002)	(0.001)
warranty	0.1600***	0.1976***
	(0.017)	(0.017)
A2	0.6562***	0.7246***
	(0.107)	(0.098)
A3	0.9525***	1.2104***
	(0.101)	(0.095)
subsidy	0.0062***	0.0052***
	(0.002)	(0.001)
star4	0.6188***	0.6315***
	(0.117)	(0.078)
star45	0.1207*	0.6860***
	(0.068)	(0.067)
Number of obs.	9216	12128

$^{*}\ p < 0.10,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01$

Refrigerators: Mixed Logit results - Germany & Poland

	Germany	Poland
	b/se	b/se
Interaction terms		
elder_size		
elder_A2		
elder_A3	0.3899***	
	(0.149)	
elder_wa		
elder_star4		-0.4795***
		(0.149)
elder_star45		-0.3099**
		(0.139)
elder_subsid		0.0056***
		(0.002)
lowinc_size	-0.0131***	
	(0.003)	
lowinc_A2		
lowinc_A3		
lowinc_wa		
lowinc_star4	-0.4317***	
	(0.152)	
lowinc_star45		
lowinc_subsid	-0.0070**	
	(0.003)	
midinc_size	-0.0064**	0.0095***
	(0.003)	(0.002)
midinc_A2		
midinc_A3		
midinc_wa		
midinc_star4	-0.2579**	
	(0.132)	
midinc_star45		
midinc_subsid	-0.0057**	
	(0.003)	

$^{*}\ p < 0.10,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01$

Interaction terms help explain heterogeneity

Refrigerators: WTP across countries

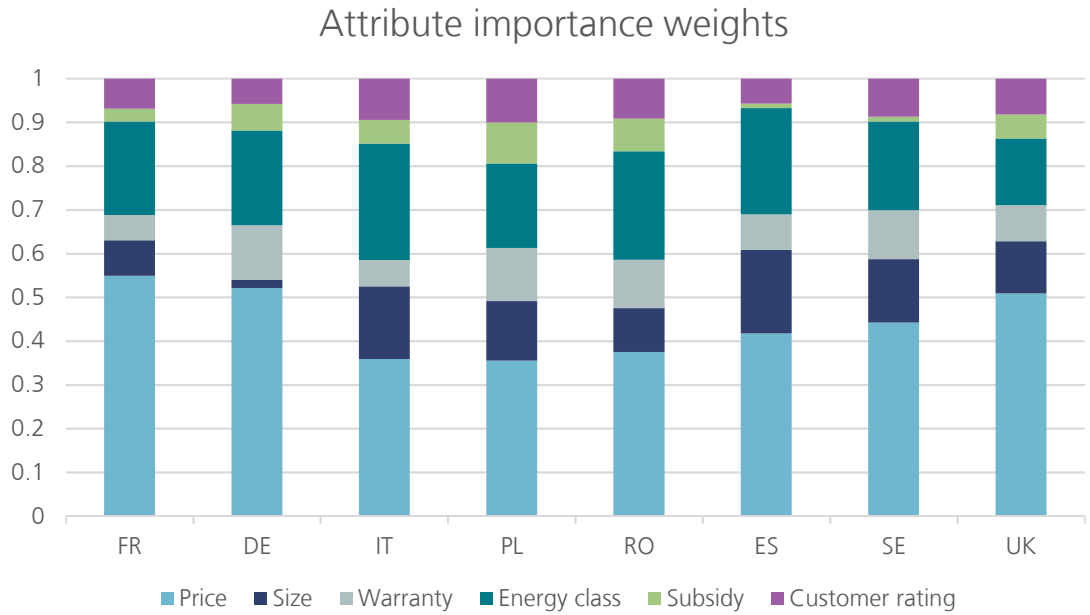
(for statistically significant effects, Mixed logit, no interaction))

	DE	PL
size	0	2.454
warranty	41.008	56.872
A2	170.469	209.211
A3	266.452	349.279
subsidy	0.498	1.782
star4	99.394	151.469
star45	35.104	177.685

Refrigerators: WTP across countries
(for statistically significant effects, Mixed logit)

	FR	DE	IT	PL	RO	ES	SE	UK
size	0.572		2.823	2.454	1.597	2.700	1.947	1.226
warranty	21.042	41.008	31.734	56.872	52.556	33.708	44.184	27.642
A2	167.383	170.469	232.436	209.211	247.698	195.440	202.111	135.811
A3	251.355	266.452	413.100	349.279	438.207	343.393	290.075	201.132
subsidy	-0.423	0.498	1.341	1.782	1.436			-1.038
star4	72.676	99.394	147.499	151.469	151.773	119.278	137.300	111.415
star45	105.943	35.104	140.475	177.685	148.836	79.139	128.841	103.906

Refrigerators: Relative importance of attributes across countries



Results for Example 2: Thermostats

+ cross-country comparisons

Objectives

- Influence of energy savings on thermostat choices
- Influence of subsidies on thermostat choice behavior
- Influence of other product characteristic and recommendations on choice behavior
- Heterogeneity in household responses

Thermostats

Introduction

Heating control devices are devices that **allow users to control the temperature of their home throughout the day**, for example by setting a different temperature at night. Moreover, some of those devices can be **connected to the Internet** and allow users to easily **adjust the temperature remotely**, for example by using a smartphone.

Example of a smart heating control device connected to the Internet using the home Wi-Fi network:

Introduction

On the following pages, we will describe different heating control devices. We would like to know **which heating control device you would choose, if you were making a purchase and these were your only options.**

Please assume that all heating control devices shown to you are of good quality and are compatible with your current heating system. The heating control devices shown to you are for the living/dining areas and only differ on the following attributes:

First results: thermostat baseline

Table: Description of variables

Price (€)	Purchase price [£150, £180, £210, £240, £270 or £300]
Subsidy (€)	Respondents may receive a subsidy [£20, £40 or £60]
Saving (%)	Heating costs saving [1%, 5%, 10%]
Recom_friend (dummy)	Recommended by friends or colleagues (**reference level**)
Recom_expert (dummy)	Recommended by independent energy experts
Recom_provid (dummy)	Recommended by your energy provider
Control (dummy)	Remote temperature control
Display (dummy)	Display of changes in energy consumption

Thermostats

Scenario 1

Which heating control device would you prefer?

	Option A	Option B
Heating bill	5% less	5% less
Remote temperature control	No	Yes
Display of changes in energy consumption	Yes	No
Recommendation	By friends or colleagues	By independent energy experts
Purchase price	£210	£270
Subsidy	£0	£60

	Option A	Option B
I prefer:	○	○

How likely would you be to buy your preferred choice if it was available?

Very unlikely	Somewhat unlikely	Somewhat likely	Very likely
○	○	○	○

Thermostats: Mixed Logit results - Germany & Poland (no interaction)

	Germany	Poland
Mean	b/se	b/se
price	-0.0071***	-0.0065***
	(0.001)	(0.001)
subsidy	-0.0010	0.0073***
	(0.002)	(0.001)
saving	0.3318***	0.2453***
	(0.027)	(0.019)
recom_provider	0.3797***	-0.0123
	(0.091)	(0.072)
recom_expert	0.5822***	0.2254***
	(0.100)	(0.080)
remote	0.3536***	0.6838***
	(0.086)	(0.078)
display	0.4027***	0.4546***
	(0.075)	(0.065)
Number of obs.	4636	5854

$^{*}\ p < 0.10,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01$

Somewhat likely or very likely to buy – ca. 60% of participants

There is substantial heterogeneity across individuals

Results of Mixed Logits with interaction terms: heterogeneity typically cannot be explained by age or income

Thermostats: WTP across countries
(for statistically significant effects, Mixed logit)

	FR	DE	IT	PL	RO	ES	SE	UK
subsidy	0.795		0.748	0.894	1.603		0.501	0.179
savings	41.451	46.680	29.746	32.949	34.161	30.473	37.989	26.249
recom_prov.	73.035	53.429	76.033		123.373	48.983	14.746	39.294
recomm_expert	67.426	81.919	78.189		123.141	55.009	43.484	30.516
remote	56.692	49.744	75.900	85.208	113.998	84.132	110.762	60.853
display	49.725	56.654	56.281	62.545	96.392	56.419	83.382	52.612

Example 3: Heating system

+ cross-country comparisons

Objectives

- Influence of energy savings on heating system choice
- Influence of subsidies and subsidy provider on heating system choice
- Heterogeneity in households' response to energy savings, subsidies, and subsidy provider
- Influence of installation time and warranty on choice behavior

Heating systems (homeowners only)

Introduction

Imagine **your heating system has broken down and you need to buy a new one**. On the following pages, different options for a new heating system will be offered to you. We would like to know **which heating system you would choose, if these were your only options.**

Please assume that all heating systems can be installed in your home and that their fuel type is the one you would like to have (for example oil, gas, coal, wood, other biomass, solar, air, water or geothermal heat). The options offered to you differ only on the following attributes:

Heating system

Table: Description of variables

Price (£)	Purchase price [£3000, £5000, £8000, £12000, £15000, £20000]
Subsidy (%)	Respondents may receive a subsidy [0, 5, 15, or 25% of the purchase price]
Subpro_none	No subsidy provider when subsidy=0, reference level
subpro_utility (dummy)	Subsidy is provided by the energy provider
subpro_gov (dummy)	Subsidy is provided by the government
heat_saving (%)	Heating costs saving
Installation (days)	Duration of installation in [half day, three days, one week]
Warranty (years)	Warranty in years [2, 5, 10]

Heating system

Scenario 1

Which heating system would you choose?

	Option A	Option B
Heating bill	25% less	75% less
Installation	3 days	half a day
Warranty	5 years	5 years
Purchase price	£3 000	£5 000
Subsidy	0%	15% (£750)
Subsidy provider	None	Energy provider

	Option A	Option B
I choose:	○	○

Heating systems: Mixed Logit results (without interaction) - Poland

	Poland
Mean	b/se
price	-0.0002***
	(0.000)
Saving	0.0298***
	(0.001)
Install	-0.1155***
	(0.022)
Warranty	0.1441***
	(0.008)
Subsidy_pub	0.0003***
	(0.000)
Sub_pro_pri	0.0002***
	(0.000)
Number of obs.	10620

$^{*}\ p < 0.10,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01$

There is substantial heterogeneity across individuals

Results of Mixed Logits with interaction terms: heterogeneity typically cannot be explained by age or income

Heating systems: WTP
(for statistically significant effects, Mixed logit)

	PL
savings	134.952
install	-523.089
warranty.	652.246
Subsidy_pub	1.140
Subsidy_priv	1.104

Thank you for your attention

http://www.briskee-cheetah.eu/cheetah/