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Preferences for environmentally friendly and unfriendly measures to control the climate at home: A stated choice analysis for Germany

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1. Background

Motivation

- Negative effects of climate change, e.g. due to rising temperatures and heatwaves (e.g. IPCC, 2014)
- Climate change leads to changes in the energy demand of the residential sector (e.g. IPCC, 2014)
  - Demand for heating decreases
  - Demand for cooling increases
- Energy demand for cooling also depends on the adaptation behavior of households for the indoor climate (e.g. Auffhammer and Mansur, 2014)
  - Environmentally friendly, e.g. insulation
  - Environmentally unfriendly, e.g. air conditioning system

→ Information about individual preferences for measures to control the indoor climate at home is of high interest

Literature review

- Many empirical studies that only consider individual mitigation activities
  - Willingness to pay price premiums for climate-friendlier goods (e.g. Ziegler, 2017; Schwirplies and Ziegler, 2016)
  - Willingness to buy energy efficient home appliances (e.g. Schleich et al., 2018; Bradford et al., 2017; Qiu et al., 2017)
- Few empirical studies on both residential mitigation and adaptation measures (e.g. Achtnicht, 2011; Alberini et al., 2013)
- Even fewer empirical studies that only consider individual adaptation to climate change
  - Tourism-related adaptation (e.g. Schwirplies and Ziegler, 2017; Wu et al., 2017)
  - Flood-related adaptation (e.g. Osberghaus 2015)

Contribution of study

- Analysis of the preferences for different measures to control the indoor climate at home
- Analysis of combined adaptation and mitigation as well as of pure adaptation measures
- Comparison between environmentally friendly and environmentally unfriendly adaptation measures

2. Data and variables

Sample and stated choice experiment

- Large-scale online survey among citizens in Germany
- Subsample of the stated choice experiment: 972 tenants, who implemented or planned to implement a climate control measure

	Solar control window	Insulation	Ceiling fan	Air conditioning system
Increase monthly gross cold rent	2%, 4%, 6%	6%, 8%, 10%, 30%	1%, 2%, 4%	4%, 6%, 8%
Improvement indoor climate	Slight, medium	Slight, medium	Slight, medium, strong	Slight, medium, strong, enormous
Change annual energy costs in €	-5, -20	-120, -270	3, 5, 8	80, 120, 160
Change annual CO_2 emissions in kg	-10, -45	-280, -590	5, 10, 20	180, 280, 370

Econometric approach

- Application of flexible mixed logit models
- Random parameters
  - Change of the annual energy cost in €
  - Change of the annual CO_2 emission in kg
  - Dummy variables for the improvements of indoor climate
- Parameters are estimated by simulated maximum likelihood method
  - 1,000 Halton draws in simulator
  - Robust estimation of the variance covariance matrix
- Mean WTP is estimated by dividing estimated (mean of random) parameters of latter attributes by estimated (fixed) parameters of the increase of the monthly gross cold rent

Variables

- Possible determinants of environmentally friendly adaptation
  - Environmental values (e.g. Schwirplies and Ziegler, 2016)
  - Political identification (e.g. Neumayer, 2004)
  - Gender (e.g. Ziegler, 2017)
  - Patience (e.g. Qui et al., 2017)
  - Risk preferences (e.g. Schleich et al., 2018)
- Control variables
  - Socio-demographic characteristics (age, educational level, monthly income, monthly rent, household size, type of house, location) and belief in anthropogenic climate change
  - Initial climate control equipment

3. Econometric results

Estimation results: Model 1

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Model 1 (Base category: **Air conditioning system**)			
	Estimates (robust z-statistics)		
	Mean parameter	**Parameter of the standard deviation**	**Mean WTP** (€)
Alternative specific attributes			
Monthly rent increase	-0.175 *** (-11.40)	-	(€0.14 * 12 =) €1.68
Change annual energy costs	-0.004 *** (-4.93)	-0.007 *** (-2.70)	-0.14
Change annual CO_2 emissions	-0.001 *** (-3.17)	-0.001 (-0.73)	-0.03
Medium improvement of indoor climate	0.462 *** (10.23)	0.408 *** (4.40)	14.48
Strong improvement of indoor climate	0.798 *** (6.37)	0.555 (1.29)	25.04
Enormous improvement of indoor climate	1.043 *** (7.67)	-0.191 (-0.46)	32.73
Alternative specific constants			
ASC: Solar control window	1.109 *** (5.99)	2.613 *** (10.92)	34.80
ASC: Insulation	2.359 *** (4.37)	-3.289 *** (-9.46)	74.01
ASC: Ceiling fan	-1.360 *** (-5.17)	2.983 *** (14.62)	-42.66
ASC: Air conditioning system	base category		
Number of observations	972		

Estimation results: Model 2

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Model 2 (Base category: Air conditioning system)		
	Estimates (robust z-statistics)	
	Mean parameter	Parameter of the standard deviation
Main explanatory variables		
NEP x solar control window (SCW)	0.356 ** (2.42)	-
NEP x insulation (I)	0.424 (1.31)	-
NEP x ceiling fan (CF)	0.354 ** (2.38)	-
Affinity left-wing parties x SCW	0.841 ** (2.27)	-
Affinity left-wing parties x I	1.048 (1.21)	-
Affinity left-wing parties x CF	0.856 ** (2.31)	-
Female x SCW	1.075 *** (2.91)	-
Female x I	0.734 (1.14)	-
Female x CF	1.075 ** (2.02)	-
Patience x SCW	-0.358 (-0.99)	-
Patience x I	-0.138 (-0.22)	-
Patience x CF	0.040 (0.09)	-
General risk aversion x SCW	-0.171 (-0.38)	-
General risk aversion x I	-0.815 (-1.19)	-
General risk aversion x CF	-0.385 (-0.68)	-
Control variables	**Included**	
Alternative specific attributes	**Included**	
Number of observations	770	

4. Conclusions

Summary and political implications

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- Strong stated preferences for the reduction of CO_2 emissions and for solar control windows and insulations, which are also mitigation measures and thus environmentally friendly
- Positive effects on environmentally friendly measures
  - Environmental values
  - Political-left wing affinity
  - Females
- Directions for future research
  - Analysis of landlords
  - Analysis of owner occupiers
  - Analysis of revealed preferences data

Thank you!