Preferences for Energy Retrofit Investments among Low Income Renters

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Motivation

- Energy efficiency improvements through retrofits are an important tool to achieve climate goals
- However, adoption of efficient technologies and retrofits is much lower than optimal
- We focus on low income households
  - Higher potential energy savings due to lower initial energy efficiency
  - Retrofits may mitigate energy poverty
  - Landlord-tenant problem
- This work is part of the research project 'Balancing climate and social housing policies in the transformation to a low carbon society: Designing integrated policy mixes for Austria' (BALANCE), funded by Klimaenergiefonds Austria

Research Questions

1. What are the preferences of low income renters regarding home retrofits?
   - Focus on the most important attributes
     - Initial investment cost
     - Cost savings
     - CO_2 savings
     - Fairness in cost distribution between owner and renter

2. What are potential policy options based on these findings?

→ We use data from a Discrete Choice Experiment (DCE) to elicit renters´ preferences for retrofits

Related Literature

- Some papers estimate the Willingness to Pay for efficiency improvements of homeowners (Achtnicht 2011) or for specific energy-savings measures (Kwak et al. 2010) via DCEs
- Extensive literature on landlord-tenant problem and split incentives (Gillingham et al. 2012; Levinson and Niemann 2004; Melvin 2018)
- Schleich et al. (2021) find that poor access to capital can reduce the adoption of retrofit measures, in particular in combination with debt aversion

→ No focus on low income renters in particular

Methodology
Random Utility Model

- First introduced by McFadden (1974)
- The utility of individual *n* for alternative *i* in choice situation *t* can be described as

$$U_{nit} = V_{nit} + \varepsilon_{nit}$$

- Households always choose the option with the highest utility:

$$U_{nit} > U_{njt} (\forall i \neq j)$$

- The probability that individual *n* chooses alternative *i* can then be written as

$$P_{ni} = Prob\left(V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj}\ \forall i \neq j\right) = Prob\left(\varepsilon_{nj} < \varepsilon_{ni} + V_{ni} - V_{nj}\ \forall i \neq j\right)$$

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Methodology
Random Utility Model

- The deterministic utility component V_{nit} can then be written as

$$V_{nit} = \beta^{a}_{nit} msav_{nit} + \beta^{b}_{nit} rcost_{nit} + \beta^{c}_{nit} ocost_{nit} + \beta^{d}_{nit} esav_{nit}$$

with:

msav = monetary savings
rcost = renter investment cost
ocost = owner investment cost
esav = emission savings
$\beta^{a}, \beta^{b}, \beta^{c}, \beta^{d}$ = coefficients to be estimated

- This framework allows us to estimate the influence of the four attributes on the (hypothetical) retrofit decisions of the participants

Methodology
Discrete Choice Experiment

	Option A	Option B
Einsparungen an Energiekosten pro Jahr	400 €	100 €
Einmalige Kosten der Maßnahme für Sie	1.000 €	500 €
Einmalige Kosten der Maßnahme für Ihre Vermieterin bzw. Ihren Vermieter	2.000 €	1.000 €
Senkung der CO2-Emissionen	50%	25%
	Auswahl	Auswahl

- Respondents are asked to pick the option that they would hypothetically prefer
- Each respondent faces 7 choice cards with varying attribute levels

Würden Sie dieser Maßnahme tatsächlich zustimmen, falls Sie bei Ihrem Gebäude umgesetzt wird?

Ja	Nein

- Participants are able to choose ‚Nein' here if neither option appeals to them

Methodology
Discrete Choice Experiment

- We choose four attribute with varying levels

Attribute	Levels			
Energy cost savings, per year	5%	10%	15%	20%
Investment cost renter	500 €	1,000 €	1,500 €	2,000 €
Investment cost owner	1,000 €	2,000 €	3,000 €	4,000 €
CO_2 emission savings	25%	50%	75%	95%

- Fundamental tradeoff between one-time investment cost and monthly cost savings
- A purely rational actor would ignore the attributes ‘investment cost owner’ and ‘CO_2 emission savings’

Data

- The choice experiment was conducted between November 2020 and January 2021
- The participants were recruited from an online sample, based on participants of a mail-in survey conducted among beneficiaries of a social assistance program in Graz, Austria (Seebauer and Eisfeld 2021).
- 76 people performed the experiment for a total of 495 choice cards
  - Limited sample size
- 68 respondents answered all 7 of their choice cards
- The median household income among participants is 900 Euros per month (Austria: 3,171 Euros per month)
- The mean monthly savings amount is 33.28 Euros (Austria: 338.41 Euros per month)

Results
Main Models

- Model 1 includes the ‘None’ option, while Model 2 excludes it

Attribute	Model 1	Model 2
Energy cost savings, in 100 € per year	0.113***	0.100*
Investment cost renter, in 100 €	–0.064***	–0.072***
Investment cost owner, in 100 €	–0.005	–0.013**
CO_2 emission savings, in %	0.006**	0.005**

*,**, and * indicate significance at the 0.01,0.05, and 0.10 levels, respectively.

- Most attributes are statistically significant and have the expected signs
- Cost savings and renter investment cost are the most influential attributes
- Unlike in regular OLS, the coefficients cannot be easily interpreted directly

Marginal Effects

- Marginal effects are derived from the coefficient estimates and are easily interpretable

Attribute	Model 1	Model 2
Energy cost savings, in 100 € per year	2.39%	2.49%
Investment cost renter, in 100 €	–1.36%	–1.79%
Investment cost owner, in 100 €	–0.11%	–0.31%
CO_2 emission savings, in %	0.14%	0.12%

- Example: A retrofit option that is 100 € more expensive has a 1.36% (Model 1) to 1.79% (Model 2) lower chance of being selected
- Increasing emission savings by 20% would increase the choice probability by 2.8% (20 x 0.14%) according to Model 1

Willingness to Pay

- The Willingness to Pay (WTP) for the different attributes can be derived from the coefficient estimates

Attribute	Model 1	Model 2
Energy cost savings, in 100 € per year	175 €	139 €
Investment cost renter, in 100 €	100 €	100 €
Investment cost owner, in 100 €	–8 €	–17 €
CO_2 emission savings, in %	10 €	7 €

- Example: The average participant is willing to pay between 139 € (Model 2) and 175 € (Model 1) in initial investment cost in order to save 100 € every year
- Furthermore, participants are willing to pay between 7 € and 10 € for 1% in CO_2 emission savings

Internal Rate of Return

- The trade-off between investment cost and future cost savings allows us to calculate the internal rate of return of the (hypothetical) investment
- On average, people are willing to invest 175 € once to receive 100 € in savings every year according to Model 1
- The rate of return for this investment depends on the timeframe that is assumed

Timeframe in Years	1	2	5
Internal Rate of Return, in %	-27.42	28.90	67.00

Possible explanations for this are:

1. Households have a very short time horizon when considering this investment, which may be appropriate if renters expect to move out within the near future
2. Households strongly discount future savings, i.e. they have high discount rates and/or strong present bias
3. Households have low access to liquidity and would not be able to invest any substantial amount of money in the first place

Conclusions

This research has several main implications, namely:

1. The most severe obstacle to renters' willingness to invest in their non-owned dwellings is the initial investment cost
2. Renters' desired return on investment is either excessively large, or the time horizon considered is short, i.e. less than 2 years
3. Renters show a significant Willingness to Pay to achieve CO_2 reductions through retrofits

→ What are the implications for policy based on these findings?

Conclusions

Based on these research findings, some promising ways to promote stronger inclusion of renters in retrofitting would therefore be to

1. Lower investment costs for low income households, e.g. through investment subsidies

2. Promote long term or permanent rental contracts so that renters have a longer time horizon for investments

3. Advertise the potential for CO_2 savings through retrofitting

Thank you for your attention!

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https://balance.joanneum.at/

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