

# **Energy efficiency, information, and the acceptability of rent increases: A multiple price list experiment with tenants**

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# Why should we care?

- Energy efficiency policies are popular emissions reduction strategies
- Technological lock-in of households' heating technology choice
- Landlord-tenant split incentives
- Imperfect information and inattention to benefits

# Main contribution to the literature

- Effect of information on tenants' willingness to accept rent increases in exchange for higher energy efficiency of the heating appliance
  - Energy cost savings, energy cost variability, and CO<sub>2</sub> tax payments
- Related literature:
  - Energy efficiency in rented properties:
    - Glumac et al. (*Journal of Energy Technologies and Policy*, 2013)
    - Hoppe (*Energy Policy*, 2012)
  - Asymmetric information and split incentives:
    - Myers (2018)
    - Charlier (*Energy Policy*, 2015)
    - Gillingham et al. (*Energy Journal*, 2012)
  - Imperfect information and inattention to benefits:
    - Allcott and Knittel (2017)
    - Blasch et al. (*Resource and Energy Economics*, 2017)
    - Houde and Aldy (2017)
    - Allcott and Taubinsky (*AER*, 2015)
    - Newell and Siikamaki (*JAERE*, 2014)

# What are the main findings?

- Effect of information on tenants' willingness to pay (WTP) for energy efficiency. Display of:
  - **Expected energy cost savings:** leads to an endline average WTP of CHF 64.87 per month (about CHF 780 or USD 810 per year); a 73% increase compared to baseline choices
  - **Past variability in energy costs:** dampens the impact of financial information, so that average WTP increases "only" by 42% relative to baseline choices, i.e. to CHF 53.32 per month
  - **Expected CO<sub>2</sub> tax payments:** has no incremental impact on tenants' WTP

# Roadmap

- Experimental design
- Empirical strategy
- Experimental results
- Conclusion

# Multiple price list (MPL) procedure

- Hypothetical technology *replacement* choice (label  $A^+$  vs. B)
  - Incentivizing truthful preference revelation
- Focus on one single dimension of space heating: energy efficiency
  - Fixing subjects' heterogeneous expectations (e.g. comfort considerations)
- Trade off rent increase against energy efficient boiler: baseline choice task, informational intervention, endline choice task

# Baseline MPL choice task

OFFER I:

**STANDARD HEATING SYSTEM**



**NO change in rents**

SELECT I



OFFER II:

**ENERGY EFFICIENT HEATING SYSTEM**



**Fr. 10 increase in monthly rents**

SELECT II



# Informational interventions

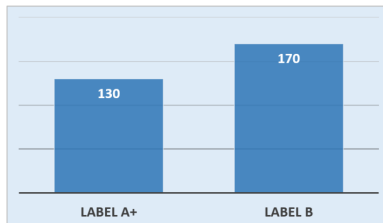
Treatment indicator	Treatment group name	First information screen	Second information screen	Endline choice task
$T_{iA}$	Control	Neutral I	Neutral II	Rent increase (baseline)
$T_{iB}$	Heating cost	Heating cost	Neutral I	Rent increase
$T_{iC}$	Heating cost salient	Heating cost	Neutral I	Rent increase + Heating cost
$T_{iD}$	Heating cost variability	Heating cost	Heating cost variability	Rent increase + Heating cost
$T_{iE}$	CO <sub>2</sub> tax	Heating cost	CO <sub>2</sub> tax	Rent increase
$T_{iF}$	CO <sub>2</sub> tax salient(A <sup>+</sup> lower tax)	Heating cost	CO <sub>2</sub> tax	Rent increase + Heating cost + CO <sub>2</sub> tax (A <sup>+</sup> lower tax)
$T_{iG}$	CO <sub>2</sub> tax salient(A <sup>+</sup> no tax)	Heating cost	CO <sub>2</sub> tax	Rent increase + Heating cost + CO <sub>2</sub> tax (A <sup>+</sup> no tax)



# Heating cost information screen

Choosing an energy efficient heating appliance can lower your household's heating costs significantly: keeping everything else equal, switching from an appliance graded B to one graded A+ would decrease energy use by 25 percent on average. This implies that heating costs for a household who pays Fr. 170 per month with an appliance graded B could decline to Fr. 130 per month with an A+ appliance.

**HEATING COST IN SWISS FRANCS PER MONTH**



Therefore, while more energy efficient appliances are typically more expensive to purchase (the investment cost), over a 15-year lifetime the additional cost may be more than compensated by lower heating costs.

# Endline MPL task with heating costs

OFFER I:

STANDARD HEATING SYSTEM



NO change in rents  
Fr. 170 monthly heating costs

SELECT I



OFFER II:

ENERGY EFFICIENT HEATING SYSTEM



Fr. 10 increase in monthly rents  
Fr. 130 monthly heating costs

SELECT II



# Endline MPL task with heating costs and CO<sub>2</sub> tax

OFFER I:

STANDARD HEATING SYSTEM



NO change in rents  
Fr. 170 monthly heating costs  
(incl. Fr. 55 CO<sub>2</sub> tax)

SELECT I



OFFER II:

ENERGY EFFICIENT HEATING SYSTEM



Fr. 10 increase in monthly rents  
Fr. 130 monthly heating costs  
(incl. Fr. 42 CO<sub>2</sub> tax)

SELECT II



# What is our empirical strategy?

- Elicitation of tenants' relative utility of an energy efficient heating appliance ( $u_i^s$ ) in WTP-space
- Exploitation of within and between subject variation to identify the effect of information on tenants' choices ( $\beta_k$ )
  - **Average treatment effects:**

$$u_i^s = \alpha + \sum_k \beta_k T_{ik} + \epsilon_i$$

- **Quantile treatment effects:**

$$Q_\tau(u_i^s) = \alpha(\tau) + \sum_k \beta_k(\tau) T_{ik} + \epsilon_i(\tau)$$

# WTP across baseline/endline choices and treatments

Treatment	N	Mean	Std.-dev.
Baseline choices ( $u_i^0$ )	406	37.51	42.29
Endline choices ( $u_i^1$ ):			
Control ( $T_{iA}$ )	58	38.71	43.55
Heating cost ( $T_{iB}$ )	63	44.96	48.99
Heating cost salient ( $T_{iC}$ )	57	64.87	51.74
Heating cost variability ( $T_{iD}$ )	61	53.32	41.59
CO <sub>2</sub> tax ( $T_{iE}$ )	57	43.95	38.72
CO <sub>2</sub> tax salient ( $T_{iF}$ , A <sup>+</sup> lower tax)	52	60.14	48.92
CO <sub>2</sub> tax salient ( $T_{iG}$ , A <sup>+</sup> no tax)	58	58.15	42.54

*Notes:* All WTP estimates are measured in in CHF per month (2017 exchange rate: CHF 1 = USD 1.04).

# Average treatment effect of information on tenants' WTP

	(1) WTP (panel) $u_i^0$
Control	1.201 (5.398)
Heating cost screen	7.454 (5.885)
Cost MPL task	19.91** (9.190)
Cost variability screen	-11.55 (8.647)
CO <sub>2</sub> tax screen	-1.013 (7.997)
CO <sub>2</sub> tax MPL task	-4.765 (11.37)
Constant	37.51*** (2.107)
Observations	812
Adjusted R <sup>2</sup>	0.038

Notes: Dependent variable is baseline WTP  $u_i^0$  and endline WTP  $u_i^1$ . Standard errors are clustered at the respondent-level and reported in parentheses. \*, \*\*, and \*\*\* denote statistical significance at 10%, 5% and 1% levels respectively.

# Quantile treatment effect of information on tenants' WTP

	(1) WTP (panel) $u_i^e$	(2) WTP (panel) (10th quantile)	(3) WTP (panel) (20th quantile)	(4) WTP (panel) (30th quantile)	(5) WTP (panel) (40th quantile)	(6) WTP (panel) (50th quantile)	(7) WTP (panel) (60th quantile)	(8) WTP (panel) (70th quantile)	(9) WTP (panel) (80th quantile)	(10) WTP (panel) (90th quantile)
Control	1.201 (5.398)	0 (3.018)	0 (4.187)	0 (6.601)	-10*** (2.975)	0 (2.614)	0 (3.138)	-10 (7.961)	0 (15.91)	37.50*** (11.86)
Heating cost screen	7.454 (5.885)	5 (4.921)	10 (6.768)	0 (7.087)	0 (2.624)	0 (2.593)	0 (3.193)	17.50** (7.579)	0 (4.493)	37.50** (16.89)
Cost MPL task	19.91** (9.190)	0 (7.897)	10 (28.37)	30*** (8.835)	20*** (4.744)	20*** (4.662)	27.50** (10.91)	0 (10.79)	62.50*** (6.145)	0 (16.38)
Cost variability screen	-11.55 (8.647)	0 (8.792)	0 (28.44)	-10 (8.846)	-10** (4.972)	0 (6.162)	0 (11.77)	0 (10.62)	-37.50*** (8.794)	0 (8.031)
CO <sub>2</sub> tax screen	-1.013 (7.997)	0 (7.075)	0 (11.38)	10 (19.04)	10** (4.583)	10** (4.523)	10* (5.284)	0 (7.588)	0 (6.475)	-37.50** (18.94)
CO <sub>2</sub> tax MPL task	-4.765 (11.37)	10 (14.38)	0 (31.03)	-20 (21.51)	-10 (6.879)	-10 (6.793)	-10 (12.19)	0 (12.54)	-37.50*** (9.071)	37.50* (22.56)
Constant	37.51*** (2.107)	0 (1.124)	5*** (1.442)	15*** (4.180)	25*** (1.272)	25*** (1.252)	35*** (1.302)	45*** (6.657)	62.50*** (2.447)	87.50*** (10.44)
Observations	812	812	812	812	812	812	812	812	812	812
(Pseudo) R <sup>2</sup>	0.038	0.0149	0.0509	0.0499	0.0472	0.0528	0.0545	0.0423	0.0254	0.0268

Notes: Dependent variable is baseline WTP  $u_i^0$  and endline WTP  $u_i^1$ . Column 1 reports OLS estimates. Column 2-10 report regression results for each decile of the WTP distribution. Standard errors are clustered at the respondent-level and reported in parentheses. \*, \*\* and \*\*\* denote statistical significance at 10%, 5% and 1% levels respectively.

# Summary and conclusion

- **Tenants are willing to contribute** to the additional cost associated with energy efficient heating investments
  - Facilitation and standardization of pre-renovation contracts between landlords and tenants
- **Specific financial information increases tenants' WTP** substantially
  - Importance of realistic ex-ante estimates of energy savings associated with energy efficiency investments
- Considering energy efficiency investments, **tenants hold more than financial motives but are unresponsive to CO<sub>2</sub> tax information**



Thank you!

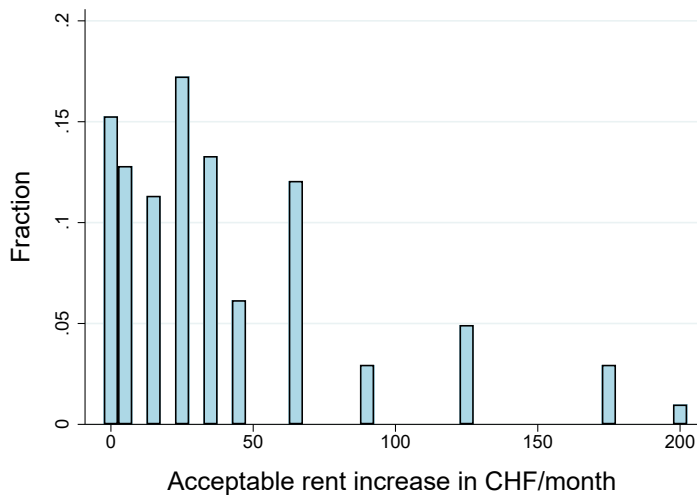
Contact: [ghislaine.lang@unine.ch](mailto:ghislaine.lang@unine.ch)

# Data: Swiss Household Energy Demand Survey (SHEDS)

	N	Mean	Std.-Dev.	Min	Max
<i>Respondent characteristics</i>					
Female indicator	406	0.53	0.50	0	1
Age (in years)	406	43.38	15.01	20	85
University indicator	406	0.47	0.50	0	1
Risk aversion <sup>a</sup>	405	0.93	0.74	-1.84	1.51
Discount rate (in %) <sup>b</sup>	404	7.76	20.16	.5	100
<i>Household characteristics</i>					
Household income <sup>c</sup>	340	3.74	1.41	1	6
Multifamily house indicator	406	0.84	0.37	0	1
Oil heating indicator	406	0.37	0.48	0	1
Individual meter for heating indicator	406	0.40	0.49	0	1

Notes: <sup>a</sup>Risk aversion is based on the results of a MPL experiment and it is coded as a range from -1.84 (highly risk loving) to +1.51 (extremely risk averse). <sup>b</sup>The discount rate corresponds to the actual rate measured in the results of a MPL experiment and ranges from 0.5% (very patient) to 100% (very impatient). <sup>c</sup>Monthly gross household income is coded as: 1 – CHF 3,000 or less; 2 – CHF 3,000-4,459; 3 – CHF 4,500-5,999; 4 – CHF 6,000-8,999; 5 – CHF 9,000-12,000; 6 – CHF 12,000 or more.

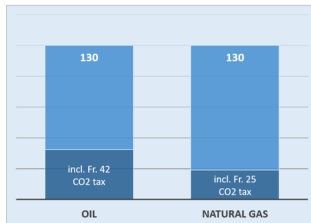
# Distribution of baseline WTP ( $u_i^0$ )



# CO<sub>2</sub> tax information screen

Switzerland participates in international efforts to reduce the risk of climate change, and the government has enacted laws that require a reduction in CO<sub>2</sub> emissions by 20 percent from 1990 to 2020. Fossil fuels are important contributors to CO<sub>2</sub> emissions and, since 2008, in Switzerland heating oil and natural gas are taxed in proportion to the CO<sub>2</sub> emitted when they are used in heating systems.

HEATING COST IN SWISS FRANCS PER MONTH

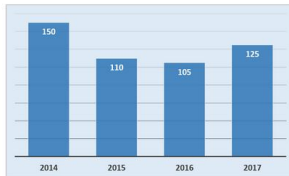


This CO<sub>2</sub> tax has increased from Fr. 12 per ton of CO<sub>2</sub> emitted in 2008 to Fr. 84 per ton of CO<sub>2</sub> in 2016. At the current rate, this corresponds to a tax on heating oil of around Fr. 42 for a monthly heating bill of Fr. 130, while the tax on natural gas amounts to Fr. 25 for a monthly heating bill of Fr. 130. For other fuels, including wood and electricity, the CO<sub>2</sub> tax is nil.

# Heating cost variability information screen

*tmp\_td4.* Heating costs depend in great part on the cost of fuel. Yearly energy costs for a boiler operated with heating oil, for instance, vary from year to year with the price of oil: while average monthly heating costs were at Fr. 150 per household in 2014, they only amounted to Fr. 105 per household in 2016.

HEATING COST IN SWISS FRANCS PER MONTH



Therefore, because of varying energy prices, heating costs of households who select an energy efficient heating system may not necessarily decline as much as expected.

# Cheap talk scripts

- Basic instructions

- *“For the next set of questions, please imagine that your landlord plans to replace your buildings current heating system. Note that this choice could influence your rent, and we will imagine different scenarios about such a choice and seek to understand which alternative would be best for your household.”*
- *“If your landlord decides to install a more costly and highly energy efficient (A<sup>+</sup>) appliance, she/he may ask for an increase in rents to cover the additional costs.”*
- *“When making your choices, please assume that the change of appliance will necessarily take place in 2017. The selected heating appliance would fully replace your current central heating appliance, but the rest of your heating system, such as the radiators, would not be changed.”*

# Cheap talk scripts

- Consequentiality reminders

- *"The information that we collect will be used to inform Swiss energy policy, and it is therefore important that your answers reflect your specific situation and your personal tastes."*
- *"There is no right or wrong answer. It is important that your choices reflect your preferred situation, as this research will contribute to inform energy policy in Switzerland."*

- Budget reminders

- *"In particular, some of the following questions will involve costs to your own household; please give careful consideration to how these costs would affect your financial budget."*
- *"In making your choices, please remember that any money spent on your dwelling will not be available for other expenses by your household."*