

Investment literacy and Choice of Electric Appliances: The Impact of Educational Programs and Online Support Tools

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Outline

- Introduction and research questions
- Experiment Setting (online RCT)
- Econometric approach
- Results
- Conclusions

Introduction and research questions



Energy efficiency

 Improving energy efficiency using energy policy instruments is one of the most cost-effective ways of

reducing CO₂ emissions and air pollution
increasing security of energy supply

- Residential sector (30 40 % of the final energy consumption) is identified as being one of the areas with the greatest potential for energy savings
- → Insulation, Heating systems, electrical appliances



Energy efficiency gap (electrical appliances)

'Energy-efficiency gap' :

Individual decision-makers do not choose the most energy-efficient appliance, even if this appliance is also the most cost-efficient choice (minimizing lifetime costs).

Market failures

Negative externalities Lack of information (information not salient enough, only kWh,..) Asymmetric information

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Behavioral failures

Status quo bias

Bounded rationality (difficulties to do an investment analysis, calculate lifetime cost → cognitive constraint in processing information

Heuristic decision-making

Choosing by comparing purchase prices, energy label,..

Research questions

Given the existing market and behavioural failures

- 1. What is the specific role of energy and investment literacy (i.e. energy-related knowledge and ability to perform an investment analysis) for the choice of cost-efficient appliances?
- 2. The role of **educational programs** and **online support tools**



Hypotheses from our theoretical framework

- Educating individuals and enhancing their level of energy and investment literacy has a positive impact on an individual's
 - > ability to follow an optimization strategy rather than a heuristic decision-making strategy.
 - > probability to identify the most cost-efficient appliance
- Minimizing the unit cost of performing the calculation has a positive impact on an individual's
 - > ability to follow an optimization strategy rather than a heuristic decision-making strategy
 - individual's probability to identify the most cost-efficient appliance



Insight from prior research (1)

The role of energy and investment literacy

- Dwyer (2011) and Zografakis et. AI (2008)
 Energy literacy has a positive impact on energy efficiency
- Blasch et al. (2016, 2017), Brounen et al. (2013)
 - > Level of financial and energy literacy is low; Positive impact on energy efficiency



Insight from prior research (2)

Effectiveness of energy labelling and decision support tools

- Heinzle (2012), Newell and Siikamaki (2013); Houde (2014), Blasch. Et. Al. (2016)
 - Mixed results on the impact of labelling on energy efficiency
- Allcott and Taubinsky (2015); Allcott and Sweeney (2015)
 - Positive impact disclosing lifetime cost
 - No effect of more information trough sales agents on energy efficiency
 - First paper to analyze the impact of educational programs and investment calculators on energy efficiency



Experiment Setting



Data

Two separate household-level online surveys in 2016 from Switzerland

HSEU-Bern

- Utility customers of EWB (Region of Bern)
- 916 households
- Representativeness difficult to comment → limited availability of reference data at regional level
- SHEDS (Household panel survey)
 - covers German and French speaking regions of Switzerland
 - 5,015 households
 - ➡ Representative sample

Experiment Design

- Both surveys implemented a randomized controlled experiment to identify (not to choose) the most cost-efficient appliance among two refrigerators
- Random assignment to one of the three groups
 - CONTROL the control group
 - *TRSLIDE* treatment 1 that sees a set of **education-slides**
 - *TRCALC* treatment 2 that has access to a **simple web-based online calculator**



Experiment Choice of the most (cost-)efficient appliance

Assume that you need to replace your fridge. You expect that you live in your current residence for another 10 years. In a shop you find the following two fridges which are identical in terms of size and cooling service.

	Fridge - A	Fridge - B	
Purchase Price:	3300 CHF	2800 CHF	
Electricity Consumption:	1 <mark>00 kWh/year</mark>	200 kWh/year	

Assuming that one kilowatt hour (kWh) of electricity will cost about 20 Rappen on average during the next 10 years and that the value of 1 CHF in 10 years is the same as the value of 1 CHF today:

Which of the two fridges minimizes your expenditure for cooling food and beverages during the lifetime of 10 years?

The fridge for 3300 CHF

The fridge for 2800 CHF

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Experiment – treatments

Treatment 1

In the following, we will ask you to make a choice between two electrical appliances.

To support your decision we provide some information helping you to make an informed choice that considers the total cost of the appliances.

Prev Next

(a) TRSLIDE group

In the following, we will ask you to make a choice between two electrical appliances.

To support your decision we provide an online calculator helping you to make an informed choice that considers the total cost of the appliances.

Treatment 2

Link to online calculator: http://blogs.ethz.ch/energy-calc/en/

Note: The link will open in a new tab/window. You can keep the online calculator page open until you have finished the choice task on the next page. In case of technical issues in accessing the online calculator, please continue and complete the survey as usual.

(b) TRCALC group

Experiment – treatment 1 (Slides)



Experiment – treatment 2 (Calculator)



EHzürich

Experiment – debriefing question choice of an investment analysis approach

How did you reach your conclusion?

- I compared the lifetime energy cost of the two fridges.
- I compared the total lifetime cost of the two fridges (i.e. purchase price + lifetime energy cost).
- I had problems making a choice, so I chose randomly.
- I compared the electricity consumption of the two fridges.
- I compared the prices of the two fridges.
- Other reason

How useful did you consider the information pages to support your decision?						
Did not look at them	Not at all useful	Not very useful	Neutral	Useful	Very useful	
0	0	0	0	0	0	
		Prev	Next			





(b) TRCALC group

Survey questionnaire

- socio-demographics of respondent and household members
- attitudes towards energy conservation
- Energy literacy index constructed accounting for several dimensions:
 - > average price of 1 kWh in Switzerland
 - knowledge of usage cost of household appliances (2 questions)
 - knowledge of electricity consumption of household appliances (3 questions)

- Investment literacy
 - compound interest calculation
- University education dummy

Energy literacy score in 0 –11

CEDE

Econometric approach



Estimation Strategy

- Dependent variables:
 - choice of an investment analysis approach (INVES)
 - choice of the most (cost-)efficient appliance (CHOICE)
- Explanatory variables:
 - socio-demographics (age, gender, education, income)
 - measures of energy and investment literacy
 - pro-environmental attitude
 - treatments



Estimation Strategy

- **Recursive bivariate probit** (binary nature;correlation; sequential nature of the decision process)
- Ist step: Probability of choosing an investment analysis approach
- 2nd step: Probability of choosing the most (cost-)efficient appliance conditional on the decision of the 1st step

$$y_{1}^{*} = \beta_{1}' \mathbf{x}_{1} + \varepsilon_{1}, \ y_{1} = 1 \text{ if } y_{1}^{*} > 0, \quad y_{1} = 0 \text{ otherwise},$$
(1)
$$y_{2}^{*} = \beta_{2}' \mathbf{x}_{2} + \delta y_{1} + \varepsilon_{2}, \ y_{2} = 1 \text{ if } y_{2}^{*} > 0, \quad y_{2} = 0 \text{ otherwise}$$
(2)
where $[\varepsilon_{1}, \varepsilon_{2}] \sim \Phi_{2}[0, 0, 1, 1, \rho], \rho \in [-1, 1]$

Preliminary Results



Estimation results

 Table 3:
 Estimation results

	HSEU-E	Bern	SHED	S
	BP	RBP	BP	RBP
Stage 1: C	hoice of Investment Ca	lculation Approach		
Constant	-0.6273***	-0.7379***	-0.2782***	-0.3309***
	(0.1827)	(0.1839)	(0.0591)	(0.0590)
FEMALE	-0.1059	-0.0931	-0.3419***	-0.3308***
	(0.0975)	(0.0973)	(0.0379)	(0.0378)
AGE40_59	-0.0471	-0.0064	-0.1886***	-0.1824***
	(0.1081)	(0.1079)	(0.0433)	(0.0429)
AGE60P	-0.1147	-0.0705	-0.3261***	-0.3293***
	(0.1326)	(0.1335)	(0.0539)	(0.0536)
OWNER	0.2058*	0.2096*	0.0361	0.0488
	(0.1180)	(0.1183)	(0.0417)	(0.0414)
HHI6_12K	0.1293	0.0508	0.0555	0.0604
	(0.1033)	(0.1043)	(0.0407)	(0.0406)
HHI12K	0.3252**	0.2226	0.2507***	0.2466***
	(0.1485)	(0.1498)	(0.0595)	(0.0590)
UNIV	0.2876***	0.4482***	0.2112***	0.2824***
	(0.0847)	(0.0905)	(0.0361)	(0.0361)
ATTMORAL	0.1223	0.0769	0.0235	0.0264
	(0.1096)	(0.1118)	(0.0379)	(0.0376)
LANG_FR			-0.0124	-0.0219
			(0.0427)	(0.0424)
ENLIT_IN	0.0652***	0.0618***	0.0533***	0.0544***
	(0.0165)	(0.0165)	(0.0077)	(0.0077)
NVLIT	0.4499***	0.4433***	· _ ·	· _ /
	(0.1005)	(0.0997)		
TRSLIDE	0.0465	0.2664**	0.4066***	0.3878***
	(0.1027)	(0.1034)	(0.0565)	(0.0585)
TRCALC	-0.1827*	-0.1013	0.1122*	0.1173*
	(0.1067)	(0.1062)	(0.0623)	(0.0618)

Constant -0.8891***-1.7026***-0.4357***-1.3154***(0.0657)(0.1875)(0.2023)(0.0606)FEMALE -0.2800***-0.2115**-0.3397***-0.0488(0.0993)(0.1045)(0.0471)(0.0396)AGE40_59 -0.1489-0.0567-0.1067**0.0554(0.1066)(0.1167) (0.0448) (0.0456)AGE60P -0.3534***-0.2416*-0.2296***0.0511(0.1363)(0.1394) (0.0566) (0.0592)OWNER 0.0092-0.13690.0219 -0.0125(0.1175)(0.1172)(0.0438)(0.0430)0.2147** HHI6_12K 0.0284-0.031-0.0956**(0.1078)(0.1183)(0.0424)(0.0414)HHI12K 0.3778*** 0.0085 0.1419** -0.1008(0.1418)(0.1577)(0.0604)(0.0639) ATTMORAL -0.0284-0.1137-0.0936**-0.1069***(0.1082)(0.1000)(0.0393)(0.0386)ORDEFF 0.04150.0387____ (0.0810)(0.0825)LANG_FR 0.05630.0574____ ____ (0.0456)(0.0438)ALPS -0.00520.0075_ ___ (0.0462)(0.0445)0.0512*** 0.0351*** ENLIT_IN -0.003-0.0085(0.0162)(0.0183)(0.0080)(0.0087)0.4687 * * *INVLIT 0.0351_ ____ (0.1056)(0.1338)TRCALC 0.4248^{***} 0.2560*** 0.1971*** 0.2255 **(0.0936) (0.0996)(0.0621) (0.0653)2.0235*** INVES 2.4078*** ____ _ (0.1736)(0.1028)CORR 0.7212*** 0.5797*** -0.7617***-0.7175***(0.0374)(0.2027)(0.0187)(0.0930)

... Stage 2: Choice of the Cost-effective Refrigerator ...

***, **, * \Rightarrow Significance at 1%, 5%, 10% level. Robust standard error in parenthesis.

Estimation results – marginal effects

Table 4: Total Marginal effects on the selection of the most cost-effective refrigerator

	HSEU-Bern	SHEDS
TRSLIDE [#]	0.0488	0.0871
	(0.0237)	(0.0190)
TRCALC [#]	0.1698	0.1222
	(0.0404)	(0.0275)
INVES	0.6784	0.6459
	(0.0021)	(0.0003)
ENLIT_IN	0.0104	0.0089
	(0.0068)	(0.0036)
INVLIT [#]	0.1081	·
	(0.0446)	

Robust standard error in parenthesis.

Effects are at means and for the recursive bivariate probit setting.

Marginal effects of exogenous dummy variables on INVES=1.

- Both interventions are effective at increasing the chances that a costeffective refrigerator is chosen
- An increase of the energy and investment literacy increases the rate at which individuals select the most cost-effective refrigerator
- Individuals who perform an investment analysis are more likely to choose the more cost-efficient appliance

Conclusions

- From an energy policy point of view the results suggest that to improve, at least partially, the level of energy efficiency we could
- Promote educational training on energy and investment related topics
- Provide decision support tools (e.g. investment calculators) at the point of sale online or app for the mobile phone

→ empowerment of the consumers

Questions/Discussion...

Thank you!

Reference:

- Blasch J., Filippini M., Kumar N., Martinez-Cruz A. (2017). Investment literacy and Choice of Electric Appliances: The Impact of Educational Programs and Online Support Tools, *Work In Progress*
- Blasch, J. E., Filippini, M., Kumar, N. 2016. Boundedly rational consumers, energy and investment literacy, and the display of information on household appliances. CER-ETH Working Paper No. 249.

Decision-making strategies



Figure 1: Decision making, interventions, and the choice of appliance.



 Table 1: Overview of the responses from the randomized controlled experiment

		HSEU-Bern (N	V = 916)	SHEDS ($N = 5,015$)		
	N	INVES=1	CHOICE=1	N	INVES=1	CHOICE=1
CONTROL	311	179	95	4,031	1,606	1,075
TRSLIDE	291	195	117	494	286	162
TRCALC	314	175	139	490	217	178
Total =	916	549	351	5,015	2,109	1,415

INVES=1: investment analysis selected as the decision strategy.

CHOICE=1: correct identification of the most cost-efficient refrigerator.

Descriptive statistics

	HSEU-Bern ($N = 916$)		SHEDS	SHEDS ($N = 5,015$)		
	Mean	Std.Dev.	Mean	Std.Dev.	Min.	Max.
FEMALE	0.467	0.499	0.509	0.500	0	1
AGE40M	0.406	0.491	0.391	0.488	0	1
AGE40_59	0.367	0.482	0.393	0.489	0	1
AGE60P	0.227	0.419	0.216	0.411	0	1
OWNER	0.248	0.432	0.365	0.482	0	1
HHI6K	0.265	0.442	0.270	0.444	0	1
HHI6_12K	0.468	0.499	0.446	0.497	0	1
HHI12K	0.159	0.366	0.136	0.343	0	1
HHI_MISS	0.107	0.309	0.148	0.355	0	1
UNIV	0.524	0.500	0.404	0.491	0	1
ATTMORAL	0.778	0.416	0.609	0.488	0	1
LANG_FR			0.261	0.439	0	1
ALPS	_		0.214	0.410	0	1
ENLIT_IN#	4.669	2.796	3.191	2.452	0	11
INVLIT	0.717	0.451		·	0	1
CONTROL	0.340	0.474	0.804	0.397	0	1
TRSLIDE	0.318	0.466	0.099	0.298	0	1
TRCALC	0.343	0.475	0.098	0.297	0	1
INVES	0.599	0.490	0.421	0.494	0	1
CHOICE	0.383	0.486	0.282	0.450	0	1

 Table 2:
 Summary Statistics for HSEU-Bern and SHEDS datasets

[#] ENLIT_IN varies from 0 to 9 in SHEDS dataset.