Empower the consumer! The role of energy-related financial literacy

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Outline

- Energy efficiency gap and bounded rationality
- Level of energy related financial literacy in three European countries
- How can we help consumers in taking energy related investment decisions
Energy efficiency gap and bounded rationality
Energy efficiency and climate change

• **Increase of the level of energy efficiency** is crucial to cut CO₂ emissions and to fight climate change and limit the average global temperature increase to 2°C

• Residential sector one of the areas with the greatest potential for energy savings

Source: International Energy Agency
«The cheapest and cleanest energy choice of all is not to waste it»
Inefficiency in the use of energy in the residential sector may be due to:

- low adoption of new energy-efficient technologies (energy efficiency gap)
- inefficient use of electrical appliances / heating system

Energy consumption strongly influenced by investment decisions (type of cars, electrical appliances, houses,...)
Energy efficiency gap

**Private view:** Individual decision-makers do not choose the most energy-efficient technology, even if this technology is also the most cost-efficient choice (min lifetime costs)

**Social view:** some energy-efficiency technologies that would be socially efficient are not adopted

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

**Behavioral failures**
*Bounded rationality*
*Cognitive Constraints, Status Quo Bias, Sunk Cost, Loss aversion, Endowment effect*

......
Thaler & Mullainathan (2008) «The standard economic model of human behavior includes three unrealistic traits- unbounded rationality, unbounded willpower, and unbounded selfishness»


Standard economic model: individuals behave rationally, they have access to all information,....make decisions by rationally weighing all costs and benefits, they optimize...
Bounded Rationality

“Bounded rationality, an idea first introduced by Herbert Simon, refers to the obvious fact that human cognitive abilities are not infinite. We have limited computational skills and seriously flawed memories.....”


Bounded rationality: there are limits to our thinking capacity, available information, and time (Simon, 1982)
Energy related investment decision

• Renovation of a house, change of the heating system, substitution of an electrical appliances, buying a new car,... are decisions that show benefits and costs over a long period of time

✎ From an economic point of view these decisions imply an intertemporal optimization

✎ In order to make these complex decisions, individuals need to collect information, make assumption regarding the price, utilization over the life cycle, perform an investment analysis or calculate the lifetime cost
Different decision-making strategies

Rational consumer
make decisions using information and cognitive skills to calculate the lifetime cost

Rational decision-making
☞ Choose the appliance that minimizes lifetime usage cost based on upfront price, energy price, intensity of use, lifetime

Bounded-rational consumer
make decisions using limited information and with cognitive constraints in processing information

Heuristic decision-making
☞ Choosing by comparing purchase prices
☞ Choosing by comparing the energy label
☞ Choosing by comparing energy consumption
☞ ...
☞ choices that are simply “good enough”
Age
Income
Gender
Education
Financial literacy
Energy related knowledge
Attitudes
……

Rational decision-making
Heuristic decision-making
Level of financial and energy related financial literacy in three European countries

http://www.penny-project.eu/
Definitions literacy

- **UNICEF**: ability to use reading, writing and numeracy skills for effective functioning and development of the individual and the community.

- In the last decades the word «literacy» has been used in a much broader way, metaphorical way....information literacy, media literacy, scientific literacy, financial literacy, energy literacy.
Financial literacy and energy literacy

- **Financial literacy:**
  
  “Knowledge of basic financial concepts, such as the working of interest compounding, the difference between nominal and real values, and the basics of risk diversification” (Lusardi and Mitchell (2008))

- **Energy literacy:**

  Energy Literacy is an understanding of the nature and role of energy in the world and daily lives accompanied by the ability to apply this understanding to answer questions and solve problems.
  
Energy related financial literacy

- Energy related financial literacy

  the combination of energy-related knowledge and cognitive abilities that are needed in order to take decisions with respect to the investment for the production of energy services and their consumption

(Blasch, Boogen, Daminato and Filippini (2018))
Measurement of energy related financial literacy

- Energy related financial literacy measured with several questions
  
  - **Lifetime cost**
  - Energy prices
  - Usage cost of appliances
  - Knowledge of energy saving of different technologies
  - Interest rate
  - Compound interest
  - Stock option (risk diversification)
Some of the questions

**Knowledge of electricity price:** How much do you think 1 Kilowatt hour (kWh) of electricity currently costs in Switzerland (on average after taxes)? Please indicate your best guess without checking your bill or other resources.
- Amount in Rappen (no decimals)
- Don't know

**Running cost of a washing cycle:** How much do you think it costs in terms of electricity to run: A washing machine (load of 5 kg at 60°C)
- 0-19 Rappen
- 20-39 Rappen
- 40-59 Rappen
- 60-79 Rappen
- 80-100 Rappen
- More than 100 Rappen
- Don’t know
Financial literacy 1: Suppose you had 100 CHF/euros in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?
- More than €102
- Exactly €102
- Less than €102
- Don’t know

Financial literacy 3: Please tell me whether this statement is true or false: “Buying a single company’s stock usually provides a safer return than buying stocks of several companies.”
- True
- False
- Don’t know
**Lifetime cost calculation:** Suppose you own your home, your fridge breaks down and you need to replace it. As a replacement, you can choose between two alternatives that are identical in terms of design, capacity and quality of the cooling system. Fridge A sells for 400 CHF and consumes electricity for the amount of 300 kWh per year. Fridge B has a retail price of 500 CHF and consumes electricity for the amount of 280 kWh per year.

Assume the average cost of energy is 0.20 CHF per kWh, the two models have both a lifespan of 15 years and that you would get a return of 0 percent from any alternative investment of your money. Which choice of purchase minimizes the total costs of the fridge over its lifespan?

- Fridge A
- Fridge B
- Fridge A and B are equivalent in terms of total costs
- Don’t know
Results for a sample of 4600 European households
Penny project, EU

Figure 1: Results of survey questions on energy-related financial literacy.

Table 4: Results of survey questions on energy-related financial literacy across countries.

<table>
<thead>
<tr>
<th></th>
<th>Italy (%)</th>
<th>Netherlands (%)</th>
<th>Switzerland (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge price</td>
<td>Correct</td>
<td>11.41</td>
<td>36.77</td>
</tr>
<tr>
<td></td>
<td>False/Don't know</td>
<td>88.59</td>
<td>63.23</td>
</tr>
<tr>
<td>Cost of washing</td>
<td>Correct</td>
<td>29.03</td>
<td>33.91</td>
</tr>
<tr>
<td></td>
<td>False/Don't know</td>
<td>70.97</td>
<td>66.09</td>
</tr>
<tr>
<td>Cost of PC</td>
<td>Correct</td>
<td>31.1</td>
<td>33.73</td>
</tr>
<tr>
<td></td>
<td>False/Don't know</td>
<td>68.9</td>
<td>66.27</td>
</tr>
<tr>
<td>Knowledge LED savings</td>
<td>Correct</td>
<td>41.78</td>
<td>54.46</td>
</tr>
<tr>
<td></td>
<td>False/Don't know</td>
<td>58.22</td>
<td>45.54</td>
</tr>
<tr>
<td>Compound interest rate</td>
<td>Correct</td>
<td>84.62</td>
<td>92.65</td>
</tr>
<tr>
<td></td>
<td>False/Don't know</td>
<td>15.38</td>
<td>7.35</td>
</tr>
<tr>
<td>Understanding of inflation</td>
<td>Correct</td>
<td>76.99</td>
<td>87.84</td>
</tr>
<tr>
<td></td>
<td>False/Don't know</td>
<td>23.01</td>
<td>12.16</td>
</tr>
<tr>
<td>Risk diversification</td>
<td>Correct</td>
<td>72.08</td>
<td>83.59</td>
</tr>
<tr>
<td></td>
<td>False/Don't know</td>
<td>27.92</td>
<td>16.41</td>
</tr>
<tr>
<td>Lifetime cost calculation</td>
<td>Correct</td>
<td>30.17</td>
<td>54.96</td>
</tr>
<tr>
<td></td>
<td>False/Don't know</td>
<td>69.83</td>
<td>45.04</td>
</tr>
</tbody>
</table>

Figure 3: Energy-related financial literacy by country and household characteristics

Analysis of the determinants of the level of energy related financial literacy

Econometric/Statistical methods ⇒ ordered probit regression model

\[ \text{Level} = f(\text{gender, country of residence (IT), education, income, age,...}) \]

- Has an important negative effect
- Has an important positive effect
- Has a partial positive effect, but not really important
How can we help consumers in taking energy related investment decisions?

Boundedly rational consumers, energy and investment literacy, and the display of information on household appliances

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Narrowing the energy efficiency gap: The impact of educational programs, online support tools and energy-related investment literacy

J. Blasch, M. Filippini, N. Kumar, A. Martinez, Cruz

Working Paper 17/276
September 2017
Possible instruments

Information on operating cost

Educational program to increase the level of energy and financial literacy

Investment calculator
Based on a theoretical model we developed some hypothesis

Organized 2 online surveys and collected data on Swiss households ($N \sim 5000$)

Online randomized control experiment

Identify the appliance with lowest lifetime cost

Econometric methods → the impact of energy and financial literacy and educational program/calculator on the probability to identify the cost-minimizing appliance

$$CHOICE = x_2'\beta_1 + \alpha_{EN} ENLIT + \alpha_{MA} INVLIT + \alpha_{TSL} TRSLIDE + \alpha_{TCL} CALC + \alpha_{INV} INV\text{CALC} + u_i$$
Experiment

Identification (not to choose) 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.

<table>
<thead>
<tr>
<th></th>
<th>Fridge - A</th>
<th>Fridge - B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase Price</td>
<td>3300 CHF</td>
<td>2800 CHF</td>
</tr>
<tr>
<td>Electricity Consumption</td>
<td>100 kWh/year</td>
<td>200 kWh/year</td>
</tr>
</tbody>
</table>

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

- Random assignment of the households 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**
We tested the effectiveness of these three instruments (randomized control experiments)

<table>
<thead>
<tr>
<th>Information on operating cost</th>
<th>Educational program</th>
<th>Investment calculator</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Treated group (N=1420)</strong> with monetary information</td>
<td><strong>Treated group (N=785)</strong> with educational program</td>
<td><strong>Treated group (N=804)</strong> with investment calculator</td>
</tr>
<tr>
<td><strong>Control group (N=1415)</strong> only information on kwh</td>
<td><strong>Control group (N=4342)</strong> no program</td>
<td><strong>Control group (N=4342)</strong> no calculator</td>
</tr>
</tbody>
</table>

Econometric/Statistical methods ➔ Impact on the probability to identify the least cost electrical appliances

- Has an important positive effect
- Has a positive effect, but not really large
- Has an important positive effect
Conclusions I

- From an energy policy point of view the results suggest that to improve, at least partially, the level of energy efficiency we could
  - Oblige the producers of electrical appliances to provide **monetary information** on yearly energy consumption
  - Promote **educational training** on energy and investment related topics
  - Provide **decision support tools** such as online or mobile phone calculator tools or calculators at the point of sale

  for **empowerment of the consumers**
More general:

- The effectiveness of the introduction of environmental taxes/subsidies can increase if people are informed and have a high level of energy related financial literacy.

- Mixture of energy policy instruments: education, information, taxes and subsidies and standard.
Thank you for your attention!