Heating System Adoption in Switzerland: Behavioral Effects and Policy Consequences

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Overview

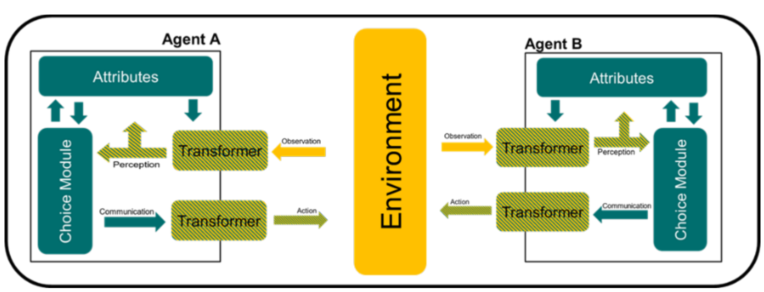
The decarbonization of residential heating is a major task on the way to a net-zero society. One strategy is the electrification of heating systems through the adoption of heat pumps. Policies to achieve this electrification necessarily address private households that decided on the adoption of new installations. This makes heating policies a politically sensitive topic. The matter is further complicated by the fact that private decision makers are known to not always act economically rational due to the existence of behavioral biases. These biases include present value bias leading to a less-than-rational adoption of favorable technologies and misconceptions of the environmental cost of technology choices.

We develop a framework to integrate such behavioral biases into a numerical modelling framework that allows to study the impact of public policies on the adoption of heating technologies. We present our framework and its translation to a numerical model. We further show how to quantify the behavioral parameters using an experimental approach and survey data for the case of Switzerland. We apply our model to analyze the impact of public policies on the adoption of heat pumps in Switzerland. These policies include classical economic instruments such as carbon taxes on fossil fuels but also information policies as well as the combination of the two.

Methods

Our basic consumer framework is provided in Figure 1. Several agents interact with each other over the environment that characterizes the information and technologies available together with the general state of the of the world (e.g., weather conditions, energy prices). Each agent is characterized by a set of attributes and can take decisions (choice module in Figure 1). To take decisions, agents need information that are observed in the environment. However, this information is transformed leading to perceived information. Observed and perceived information might be different due to two major reasons: First, information that is in principle observable might not be available to an agent. E.g., agents might only be able to observe information in their close neighborhood but not in more distant locations. Second, agents might have misperceptions, e.g., agents might observe environmental footprints but only partially pay attention to these footprints or wrongly judge their magnitude. The perceived information is taken up in the choice module which derives values for the different decision dimensions (i.e. financial evaluation, social evaluation, etc.) and aggregates those to a joint choice result. Once agents have taken a decision, they communicate this decision back to the environment.

Figure 1: Consumer choice framework



We apply the general framework to the context of the adoption of heating systems in Switzerland in two steps. First, we formulate a mathematical model that can be numerically solved and determines the empirical parameters needed to derive quantitative insights. The mathematical model builds on the above described framework and uses the attention model (Gabaix, 2014; Farhi and Gabaix, 2020) for its choice module formulation. Agents minimize the cost of satisfying future heating demand by choosing across different heating technologies. Besides usual income constraints, we allow for an additional behavioral parameter for environmental preferences in the form of the willingness to pay for carbon mitigation. An attention parameter determines the important the environmental preference in the context of the heating system decisions. In addition, we allow for a present value bias in the evaluation of current investment versus future operating cost.

For the numerical model we need to quantify these parameters together with socio-economic variables (income, location of living, home owner status) for each household in the simulation. The socio-economic variables are based on the Swiss Household Energy Demand Survey (SHEDS) survey (Farsi and Weber, 2024). For the behavioural parameters, we design three experiments included in the upcoming survey round in spring 2025. First, we measure the willingness to pay for carbon mitigation. Second, we measure the attention to the environmental preference in the context of heating system choice together with the change of this attention caused by the introduction of carbon taxes and information nudges. Finally, we measure the present value bias.

Results

We will apply our model to examine the impact of public policies on heating system adoption in Switzerland. Our main interest lies in the impact of carbon taxes on fossil fuels and information provision regarding the environmental footprint of the respective heating system as well as the combination of the two. Our approach allows us to examine the policies including non-rational households. To further analyze the importance of non-rational behavior in the numerical analysis of heating system adoption decisions, we compare the model outcomes for the scenarios with and without behavioral biases. Our approach therefore provides conclusion at two different levels. First, we contribute by informing the public debate on appropriate policy measures to decarbonize residential heating in Switzerland with an empirically founded model of non-rational consumers. Second, by comparing model outcomes with and without households with behavioral biases, we draw conclusions on the empirical importance of behavioral biases for numerical modelling of heating adoption behavior and its impacts on public policy support.

Conclusions

We develop a framework of consumer decision making including behavioral biases. The framework is used to analyze carbon taxes and information polices to foster the decarbonization of the Swiss residential heating sector. Building on the attention approach grounded in behavioral economics, we build a numerical model and show how to parameterize such models using experimental approaches and survey data. Our numerical simulations will provide support to the ongoing discussion about public policies to decarbonize the Swiss heating sector. Moreover, we provide insight on the empirical relevance of behavioral biases for the conclusions of numerical models.

References

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