HOW TO SUPPORT ENERGY EFFICIENCY – AN EXPERIMENTAL INVESTIGATION OF INDIVIDUAL PREFERENCES

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Overview

During the last two decades energy efficiency has become a strategic goal of energy policy. Adopting a macro-economic perspective, a bulk of literature deals with energy efficiency problems by arguing along three steps (Prindle et al., 2010). *First*, a large technical potential to increase energy efficiency and to curb energy consumption in all sectors of the economy at low cost is identified. *Second*, despite this technical potential the willingness of market participants to invest in energy efficiency measures is rather limited. Different barriers or market failures such as asymmetrical evaluation of cost and benefits are held responsible for the gap between potential and actual investment behaviour. *Third*, these barriers give rise to the widely accepted conclusion that policy measures are needed to promote energy efficiency investments. In the face of a multiplicity of political instruments it remains controversial which policies are best suited to achieve efficiency goals: On the one hand, subsidy programmes and information campaigns are used to promote voluntary investments. On the other hand, regulative measures such as efficiency standards for buildings or household appliances are imposed to force firms and households to invest in energy efficiency.

Adopting a micro-economic perspective, a lot of papers investigate individual decision making in the field of energy efficiency. Offering well-designed hypothetical investment projects and using classical survey-based stated preference methods, they ask for implicit discount rates of efficiency investments or isolate potential success factors (Alberini et al. 2013; Grösche and Vance 2009). In this paper we present an experimental investigation of energy efficiency investment decisions which highlights two additional dimensions, which have not been addressed in the empirical literature so far:

1. Energy efficiency is modelled as an *impure public good* (Cornes and Sandler, 1996). From an individual perspective investments in energy efficiency affect three economic goods: First, investments in efficiency (such as thermal insulation of buildings or the purchase of more efficient household appliances) cause opportunity costs in terms of forgone current consumption. Second, increased efficiency leads to a future private benefit resulting from decreasing energy consumption and expenditures (rebound effects and the effects of increased comfort are neglected). Third, energy efficiency investments contribute to a public good, as a reduced demand for energy saves scarce resources and reduces greenhouse gas emissions.

2. Apart from allocation effects, policies aiming to increase efficiency investmens also have *distributional effects*. As the subsidization of energy prices or efficient appliances cause public expenditures, questions of the distribution of these costs within society arise. Previous experimental results show that that individuals' Willingness-to-Pay for climate protection is significantly affected by social preferences and attitudes towards the perceived fairness of cost allocation methods (Menges and Traub 2009). Moreover, political measures such as subsidization of energy prices to combat fuel poverty give rise to trade-offs between social and climate policy goals as they reduce incentives to invest in energy efficiency.

The experimental approach we apply is based on a set of incentivized choice experiments with a representative sample of participants recruited from the general public. We explore households' willingness to invest in energy efficiency under alternative institutional arrangements balancing the trade-off between social aspects and climate policy goals. Moreover, we investigate efficiency and effectivity of alternative policy measures to stimulate private households' efficiency investments.

Methods

The two dimensions of energy efficiency mentioned above cannot be easily addressed using stated preference methods that fail to induce incentives for respondents to consider the opportunity costs of environmentally friendly decisions. Moreover, the public good element of energy efficiency unfolds interaction problems and causes strategic behaviour which cannot be controlled in traditional survey-based methods. Our *experimental design* takes these considerations into account, using a simplified public good game to let individuals make investment decisions under controlled conditions. The effects of individual investments are modelled in a payoff function including

- the opportunity costs of energy efficiency investments in terms of reduced private consumption,

- the private benefits of efficiency investments resulting from reduced energy expenditures
- and external effects (public benefits) reflecting the positive spillovers of efficiency investments.

Each individual faces the following endowment: The available budget is given by the individual's (gross-) income minus his or her expenditure for energy consumption. Opportunity costs of energy efficiency spending are assumed to be linear in terms of forgone consumption; private and public benefits of efficiency investments are non-linear with positive but diminishing marginal benefits. The Nash equilibrium is determined by maximizing the expected payoff with respect to the individual efficiency investment. The welfare optimum represents the level of each individual's efficiency spending, which maximizes the sum of payoff functions. As typical for public good experiments, welfare-optimal investments increase overall benefits only in the case of mutal cooperation. Considering the public benefits of energy efficiency each individual faces an incentive to ride free on the contribution of all other individuals. In our experiment three participants form a group, each taking on responsibility for a household characterized by certain levels of income and energy expenditures. Individuals are asked to allocate their disposable income and chose between energy efficiency investment and consumption. Additionally, individuals are supplied with illustrative examples of decision outcomes depending on the choices of the other participants. Validity is ensured providing monetary incentives: Apart from the usual show-up fee participants receive a lottery-driven chance to win their experimental payoff in "real" money. In order to test the influence of income heterogeneity, fuel poverty and different energy efficiency policies, different experimental treatments are deployed varying in certain elements of endowments and payoff functions. By comparing investment behaviour between different treatments we are able to address the following research questions and hypotheses:

- How do different allocation and distribution policies influence individual investment decisions?
- Do forced investments cause crowding-out effects and reduce voluntary investments (Menges et al. 2005)?
- Do heterogeneous incomes and perceived fairness of policy measures alter investment behaviour?
- Do different mixes of efficiency policy measures alter the aggregate level of households' efficiency investments?

Results

The final experiment will take place in July 2014. A total of 500 individuals will be examined in ten treatments. Conclusions will be drawn from individual willingness to invest as core object of examination. Also, both between- and within-subjects analysis using micro-econometric estimation techniques are undergone to identify social-policy parameters best suited to explain decisions. Preliminary pilot studies of the experimental design show that free-riding behaviour is rather limited when subjects understand the public good features of energy efficiency and that progressive cost-sharing rules to finance subsidies for poor households increase overall efficiency investments. Moreover, it can be shown that mandatory efficiency measures crowd out voluntary investments of households to some extent. However, it is interesting to note that crowding-out effects depend on the perceived fairness of cost-sharing rules, which are varied between different treatments.

Conclusions

This experiment is part of an interdisciplinary empiricial research project on the social acceptance of energy and climate policy in Germany ("Energiewende") funded by the Federal Ministry of Education and Research. In co-operation with philosphers and social scientists we integrate basic concepts of environmental justice and financial fairness into our experimental treatment design. The underlying idea of our approach is to translate normative statements on sustainability into real-life incentive structures. Conclusions drawn from this positive approach will give answer to the question to which extent the social acceptance of energy efficiency polices depends on the formation of complementary social policy institutions.

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