INFORMATION FEEDBACK FROM IN-HOME DISPLAYS AND SALIENCE EFFECTS: EVIDENCE FROM RESIDENTIAL ELECTRICITY CONSUMPTION

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Overview

Inattention and limited information-processing capacity are, among others, key factors that lead to deviations from full optimization in consumption. Inattention could lead to suboptimal choice of consumption for individuals regardless of their capacity to process information while individuals with limited information-processing capacity could make mistakes in choosing their optimal consumption even if they are fully informed. Welfare loss in society that is associated with deviations from full optimization in consumption requires policy interventions that increase attention and information-processing capacity.

This paper focuses on the policy interventions that correct for consumption biases associated with inattention and limited capacity by providing real-time information feedback via an in-home display (IHD) to households. Real-time information feedback provided via an IHD is expected to decrease the difference between the optimal and actual levels of electricity demand by increasing households' attention (Sexton et al., 1989; Matsukawa, 2004; Abrahamse et al., 2005; Houde et al., 2013; Attari et al., 2014; Lynham et al., 2016). Because of learning over time, the repetition of attention may improve households' capacity to process information about electricity usage.

Methods

I measure the effects of information acquisition on households' usage of electricity using hourly data on whether or not households used IHDs in a randomized field experiment. This experiment corresponds to a "framed field experiment," which typically uses experimental participants from the market of interest and incorporate important elements within the context of the naturally occurring environment with respect to the commodity, task, stakes, and information set of the subjects. The field experiment was conducted in summer 2012 by the Keihanna Eco-City Next-Generation Energy and Social Systems Demonstration Project Promotion Council. Households living in a southern area of Kyoto, Japan, were assigned to either control or treatment groups. The experiment was implemented on weekdays during July 23 to September 13 in 2012. An IHD was provided free of charge to households assigned to the treatment group. The control group households did not have IHDs. The area's climate during experimentation was hot and humid, the maximum ambient temperature often exceeding 30 degrees Celsius.

The treated households could consult a graph of their half-hourly electricity consumption in real time on a tablet display at any time during the experiment. Whether or not the households used IHDs was automatically recorded each hour during the experiment by electronic devices installed on the premises. It is difficult to ensure that households using many electric appliances with different consumption levels attain a satisfactory level of electricity consumption. Access to the electricity information in the graph enables households to raise their attention and information-processing capacity

Results

Using a simultaneous equation model with discrete choice of hourly IHD usage and continuous hourly consumption of electricity of 501 households over 36 days, I measure the effects of real-time information feedback on residential electricity consumption over time. The estimated model includes dummy variables associated with incentive payments for peak reduction as explanatory variables. The estimation results indicate that cumulative usage of IHDs over time would raise electricity consumption of the average household, an effect statistically significant at the 5% level for both the fixed and random effects models. They also indicate that the elasticities of the actual electricity consumption with respect to the cumulative IHD usage are small for the average household: other things being equal, a 100% increase in the cumulative usage of IHDs raises the actual consumption of electricity of the average household, which was lower than the optimal electricity consumption before the experiment, by approximately 0.4%. These results imply that information acquisition through the use of an IHD affects electricity consumption by raising attention and learning over time.

Contrary to the energy-conservation literature (Sexton et al., 1989; Matsukawa, 2004; Abrahamse et al., 2005; Houde et al., 2013; Attari et al., 2014; Lynham et al., 2016), the cumulative usage of IHDs could raise electricity consumption in this paper. This may be due to a "boomerang effect," which raised electricity usage of well-informed households whose electricity saving had exceeded the optimal saving before obtaining information about their actual usage. In fact, the energy-using effects of the cumulative usage of IHDs were found for "energy-saving" households whose electricity consumption had been relatively modest before the experiment. In contrast, the cumulative usage of IHDs slightly reduced electricity consumption of "energy-using" households whose electricity consumption before the experiment had been substantially higher than other households.

Conclusions

This paper uses hourly data on whether each household uses an IHD in a randomized field experiment to investigate how acquiring information from an IHD affects electricity consumption through attention and learning over time. The empirical evidence offered by this paper indicates that the effects of the cumulative usage of IHDs on residential electricity consumption depend on the pre-experiment level of electricity consumption. While the cumulative usage of IHDs reduced the electricity consumption of "energy-using" households, it raised that of "energy-saving" households whose electricity consumption had been relatively modest before the experiment. Thus, providing households with IHDs, which was found to be an effective policy instrument for energy conservation in previous studies, could have an adverse effect on energy conservation.

References

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