PREFERENCE CHARACTERISTICS AND ENERGY EFFICIENCY INVESTMENT: FOCUSING ON TIME, RISK, AND SOCIAL PREFERENCES

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Overview

The motivation of this study is an energy efficiency gap, *i.e.*, the gap between optimal and actual energy efficiencies. In terms of policy interventions, the energy efficiency gap raises the following question: Why do consumers fail to adopt energy efficient technologies that are even economically superior (Gerarden et al., 2014)? If we have an answer to this question, we will be one step closer to saving energy. Many scholars have discussed what causes the energy efficiency gap and how to resolve it. As a result, market imperfections and behavioral issues are attributed to the energy efficiency gap (Hirst and Brwon, 1990; Gillinham et al., 2009). Market imperfections refer to problems of energy price, market and system whereas behavioral issues are highly relevant with inherent characteristics of individual decision-making.

I am interested in the behavioral issues resulted from heterogeous preferences. A lot of studies have been addressed market imperfections, but, discussions addressing behavioral issues have been begun recently. Therefore, the theoretical and empirical bases for policy interventions addressing behavioral issues are very weak. Behavioral issues are useful to explain why some people invest in energy efficiency but others do not under the same conditions. They are also useful to understand people's actual decisions on energy efficiency investments, which deviates from the ideal decisions. In particular, I focus on preference characteristics because an enegy efficiency investment can be converted into a decision of how much pay more upfront capital costs for reducing energy costs over a long period of time (Hausman, 1979). I presume that time, risk, and social preference characteristics could influence this decision-making.

Based on this motivation, I investigate the following research question. What is the influence of time, risk, and social preference on a decision of energy efficiency investments? I focus on the decision of home energy retrofit that improves the envelope (insulation and windows) or systems (heating, ventilation, air conditioning and controls) of a residential building.

Methods

A theoretical model is proposed by developing Allcott and Greenstone (2012)'s model. In this model, an agnet i is required to make a choice between two options: Option A is doing home energy retrofit; and Option B is maintaining the current status. An agent's choice depends on the cost comparison between two options. Here, an agent is assumed to pay for capital investments in the period 0 and to pay for energy costs in the period 1. Option A incurs incremental upfront capital cost (c) and unobserved cost from adopting energy efficient technologies (ξ_i) but more energy efficient ($e_A<e_B$). Then, an agent will choose option A if and only if the condition in Eq. (1) is satisfied.

$$D_i(p \cdot m_i \cdot e_A) + \varphi_i D_i(m_i \cdot e_A) + c + \xi_i < D_i(p \cdot m_i \cdot e_B) + \varphi_i D_i(m_i \cdot e_B) \quad (1)$$

Here, D_i represents a discounting factor of the energy costs, φ_i the degree of internalizing negative externalities from energy consumption, p energy price at the period 1, and m_i the taste for usage of HVAC system at the period 1. Eq (1) givest the following three research hypotheses. The first hypothesis is the more discounted future value, the lower the possibility of home energy retrofit. The second hypothesis is the more risk averse, the lower the possibility of home energy retrofit. The third hypothesis is the more internalized negative externalities, the higher the possibility of home energy retrofit.

Results

For collecting the data for verifying the hypotheses, a well-designed survey was conducted. 1,609 reseponses of the household head or spouse aged from 20 to 65 in 16 regions of Korea were collected. I analyze this data using two types of probit models. The dependent variable of the model 1 is whether an agent has experienced home energy

retrofit, and the dependent variable of model 2 one is whether an agent has a plan of home energy retrofit in 3 years. The independent variables of the two models are same, and they consist of preference characteristics, socio-economic factors, and housing and energy-use conditions. The estimation results of model 1 demonstrate that in the respondents' past decisions of home energy retrofit, the effect of time preference is insignificant whereas the effects of risk and social preferences are significant and support the hypotheses. The estimation results of model reveal that in the respondents' future decisions of home energy retrofit, all the influences of time, risk, and social preferences are likely to be significant and the directions are consistent with my expectation.

Conclusions

This study enlightens us about the influences of time, risk, and social preferences on an agent's decisions of energy efficiency investment. My findings partially support the three research hypotheses, and their implications are as follows. First, the cost-effectiveness of a financing program for energy efficiency improvements will be enhanced if options, which adjust cash flows considering anomalies of time preference or relive the pecuniary risk of energy efficiency investments, are added. Second, improving people's awareness of environmental pollution and climate change issues can eventually contribute improving energy efficiency. Third, strengthening people's personal norm contributes to improving energy efficiency although it seems to be unrelated with.

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