HOUSEHOLDS' TECHNOLOGY CHOICES AND LONG-RUN ENERGY PRICE SENSITIVITY

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Overview

Aggregate energy demand is derived from the energy-consuming capital stock of firms and consumers. In the short run this stock is fixed, limiting the possibilities for adapting to higher energy prices. Adjustment to persistent changes in energy price levels happens over the long run, through investment into new technology. Empirically evaluating the long-term price elasticity therefore requires looking into the investment decisions that determine the capital structure. This paper accomplishes exactly this task by analysing Finnish households' choice of heating technology at the moment of building a new house.

The analysis is based on an exceptional dataset, which combines individual-level administrative registry data on households and investments with local electricity price data. The price data explicity differentiate between the short-term and long-term price faced by consumers.

In this study, the quality of the data and the context of the choice situation are such that many of the difficulties typically present in assessing long-term investment can be overcome. First, the data are drawn from administrative records, allowing for a large sample size, accurately measured variables and values which refer exactly to the time of building the house. Second, the electricity price data contains the distribution prices of electricity, which are regulated and price levels are highly persistent over time at the level of a distribution grid area. This makes the distribution price a long-term price relevant for investments with a long lifetime. Third, the heating investment decision does not include a dynamic aspect, as home owners do not time their heating system purchase with developments in energy efficiency. Furthermore, the choice situation is simple in the sense that there is a limited amount of well-established technologies that the household can choose from.

Methods

The analysis is based on a standard logit model of discrete choice, where the dependent variable is one of six main heating technologies available. The determinants of the utility function include house characteristics related to heat consumption, household characteristics, the price of electricity, and controls for time and building location. Robustness checks are carried out also using linear probability models (OLS).

Engineering estimates of heat consumption in new houses are used to form average expected heat demand for the houses in the data. Substitution patterns estimated from the discrete choice model are then used to evaluate how heating electricity demand will change as electricity prices increase.

Results

The elasticity of demand for electric heating technology with respect to the distribution price of electricity is estimated to be -0.63 at the mean distribution price level of 4 c/kWh. The retail price of electricity is not found to be statistically significant for heating technology choice.

The main substitutes for electric heating are ground source heat pumps and wood. The engineering estimates of heating energy consumption together with the estimated substitution patterns imply an elasticity of -0.33 for the annual demand of electricity for heating in new detached residential houses.

House size is the most important variable in explaining the choice of heating technology. The probability of choosing central heating as opposed to direct electric heating increases with house size.

The household characteristics that have the largest impact on technology choice are previous experience of house ownership, education level, income and family size. Households with higher education and income are more likely to install ground heat pumps than one of the conventional technologies (electric heating, wood or oil). The choice probability for ground heat is especially sensitive to the highest levels of income.

Location is an important determinant of technology choice and the sensitivity to electricity prices varies by location. As electricity prices increase, the choice probability for wood heating increases rapidly in rural locations. In urban locations wood is not an important substitute for electric heating.

Conclusions

The elasticity of heating technology investment to electricity prices found in this study is highly statistically significant and large in magnitude. As electricity prices increase, households substitute away from electric heating and install more ground source heat pumps and wood heating. This substitution is based simply on price sensitivity, as no investment subsidies or other policy measures have been in place for newly built houses in Finland. The results thus speak for price sensitive households, and do not support undervaluation of future costs in the aggregate. This implies that price instruments such as taxes can be used in energy policy to induce investment into energy efficient technologies.

However, the results on house characteristics imply that there is notable heterogeneity in the determinants of investment across households. The significant impact of income on technology choice, especially for the technology with the largest investment cost, suggests that credit constraints may hinder investment for some households. Also larger families are found to be more likely to install the option with the lowest investment cost, which could speak for the importance of disposable income. Previous experience of home ownership very highly impacts choice probabilities, indicating that there may be information asymmetries between households.

The findings of this study thus suggest that if monetary incentives are used to accelerate energy efficiency investments involving large upfront costs, these incentives should be targeted at househols with low disposable income. Futhermore, lack of information may be an investment barrier. Targeted information tools could induce investment, but designing such tools would require a good understanding of how information is currently distributed across households.

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