Free Riding, Upsizing, and Energy Efficiency Incentives in Maryland Homes

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Executive Summary

Residential energy efficiency policies in the US and several other countries have traditionally relied on standards for equipment and new home construction, on incentives, and, more recently, on the explicit provision of information about the energy efficiency of devices and buildings. Incentives usually take the form of tax credits or direct rebates to the consumers who install insulation or energy-saving windows, and/or purchase high-efficiency heating systems, air conditioners, water heaters, and appliances. In 2005-2009, federal expenditure on residential energy efficiency programs was $2.2 billion (2009 $), and in FY 2013 federal expenditures on tax preferences for energy efficiency improvements in existing and new homes was almost $4 billion (2013 $).

For policy purposes, it is important to assess whether these incentives are cost-effective, namely whether they ultimately attain reductions in energy usage and CO2 emissions are at reasonable cost per kWh or ton of CO2 saved. Such assessments are complicated by at least three major factors. First, people generally replace energy-using equipment at the end of life and those who receive incentives might have done this replacement anyway. Second, incentive programs are likely to attract persons who are systematically (and unobservably) more motivated or productive at reducing usage. Finally, concerns exist about the so-called "rebound effect," which may occur because the improved efficiency has lowered the price of each unit of energy services. If the rebound effect is sufficiently pronounced, the ensuing increase in electricity usage may partially or completely erode the efficiency gains.

Earlier empirical work in this area has been hampered by data limitations. In this paper, we have developed a unique panel dataset that documents 1) monthly electricity usage over a period of

5 years, 2) structural characteristics of the dwelling, 3) household characteristics, and 4) energy-efficiency renovations and incentive-taking activity on the part of the household, for a sample of residents of four counties in Maryland. We also have information (from the Census) about the neighborhood where these households reside.

We use this unique dataset to set up a study based on the difference-in-difference approach (i.e., a retrospective case-control study) to see if replacing existing heat pumps with new ones, which are more energy-efficient due to standards, has attained electricity usage reduction. Attention is restricted to households who use heat pumps because 1) they are heavy electricity usage, 2) electricity is the only "fuel" used by these households, and 3) heat pumps are used for heating in the winter and for cooling the home in the summer.

We find that replacing an existing heat pump with a new one reduces electricity usage—by 8% on average—controlling for household-specific fixed effects, weather and time of the year. There is a large difference between "natural replacers" (those that replace units without incentives) and incentive recipients. The former reduce their electricity usage by about 16%; for the latter the reduction is virtually nil, despite the fact that the manufacturer-specified energy efficiency ratings and the cost on the new heat pump is virtually identical across the two groups.

The larger the rebate, the *less* the electricity reduction. Rebates of $300 and $450 (the typical rebates offered by utility or state programs) result in usage reduction of 6.22% and 5.5% respectively. Rebates of $1000 or more have no effect on usage. Our calculations of the cost per ton of CO2 saved mirror these findings, and result in very large cost per ton at rebates of $1000 or more. These effects are consistent with a pronounced rebound effect for incentive takers, and with the fact incentive takers were disproportionately replacing "inadequate" units, using the rebates to defray the cost of more powerful units, or of units that end up being used more.