The Household Appliance Stock, Income, and Electricity Demand Elasticity

Adrienne Ohler,[a] David G. Loomis,[b] and Yewande Marquis[c]

Many energy policies specifically target low-income households for assistance. Even though policies, such as the Low Income Home Energy Assistance Program (LIHEAP) and the Percentage of Income Payment Plan (PIPP) program, are implemented with concern for low-income households, often such policies fail to consider the impact that income changes have on a household's electricity consumption as well as a household's appliance stock. Given that the residential sector accounts for over one-fifth of the total primary energy consumption in the U.S., understanding the factors that impact consumption can help inform energy policy. The literature on residential electricity consumption provides a variety of income and price elasticity estimates at the household level; however, several studies find that appliance ownership and usage explain more variation in electricity consumption than socio-demographic variables such as price and income

This paper contributes to the literature on electricity demand in three important ways. First, we demonstrate that low income households are more price responsive than high income households. Second, basic summary statistics show that low-income households use less electricity than high-income households, illustrating that the differences in price elasticity estimates are likely due to differences in overall electricity use. Finally, we show that appliance ownership is a useful metric to generate differences in overall kWh electricity reduction through price changes.

Based on various appliance characteristics, we estimate the electricity reduction from a 1% price increase. As price increases, households relying on electricity for cooking, heating, and/or water heating are much more responsive than their non-electric counterparts. A non-electric household responds to a 1% price increase by reducing electricity between 31–37 kWh, on average. In comparison, an all-electric household responds to a 1% price increase by reducing electricity between 142–164 kWh, on average. These all-electric households tend to be lower income households. Using the same analysis, we consider the appliance stock through televisions, AC ownership, and fridges, and observe a greater inelasticity among "high stock" households, which tend to be high-income households. Our results show that the mechanism through which low-income households adapt to price changes differs from high-income households because of heterogeneity in their appliance stock.

The results can aid policymakers concerned about electricity demand, rising electricity rates, and the impact on low-income households. The results can also inform the design of demand response and demand side management programs. Current policies aimed at reducing electricity consumption, such as information- based marketing, home energy audits, energy efficiency rebates, dynamic pricing, and technical consumption feedback are more likely to be utilized by high-income household because of the greater perceived benefits. These programs will cause greater disparities between low- and high-income households and their behavior in the marketplace, unless designed specifically to address these divergences.

a Corresponding author. Department of Economics, Illinois State University and Department of Child Health, University of Missouri. Email: aohler@ilstu.edu.

b Department of Economics, Illinois State University Campus Box 4200. Normal, IL 61790. Email: dloomis@ilstu.edu.

c Formerly affiliated to: Department of Economics, Illinois State University. Email: yewimarquis@gmail.com.

The Energy Journal, Vol. 43, No. 1