Peaking Interest: How awareness drives the effectiveness of time-of-use electricity pricing

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Abstract

I apply and extend new machine learning methods to identify heterogeneity in the effects of time-of-use (TOU) electricity pricing and information provision on residential electricity consumption behavior in an experiment from the Republic of Ireland. Most importantly, the effect of time-of-use pricing on peak energy consumption is 4.5 times larger for households who are aware of the change in their pricing structure versus those who are not (-10% versus -2.3%). Households with low baseline energy usage do not reduce their peak consumption on average. Information provision amplifies the effects on peak consumption, with an in-home electricity monitor nearly doubling the effectiveness of TOU pricing (-15% with one versus -8% without). Cross-validation finds that no other observables—or permutations thereof—are robustly related to treatment effect heterogeneity (conditional on the above factors of awareness, baseline consumption, and information treatment). This includes considering potential heterogeneity on more than 150 observables encompassing socio-demographic characteristics, attitudes towards energy and environmental issues, housing attributes, and household appliance characteristics. In addition, larger price increase do not appear to induce significantly larger responses. Awareness is not reliably predictable even with rich information about observable household characteristics, suggesting that targeting policy on awareness is unlikely to prove fruitful, although targeting on baseline consumption could be effective. These results suggest that the significant attention economists pay towards fine-tuning retail prices may be less important than getting consumers to pay attention in the first place.

1 Introduction and Motivation

Electricity consumers typically pay a constant price for electricity that is not tied to the marginal cost of generation, which varies significantly with demand and time of the day. Recent advances in smart metering technology now allow for charging consumers time-varying prices, raising the possibility of flexible demand that can respond to price signals in real time. The benefits of dynamic pricing are threefold. First, the mismatch between constant retail prices and time-varying marginal costs is economically inefficient, encouraging consumers to over-consume during high-cost peak periods and under-consume during low-cost off-peak periods. Second, time-of-use (TOU) pricing can reduce peak load for the grid as a whole, mitigating the need to invest in costly extra "peaking" generation capacity to serve load when demand is high. Third, recent studies (e.g.,

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