An Experimental Study of Monthly Electricity Demand (In)elasticity

David P. Byrne,[a] Andrea La Nauze,[b] and Leslie A. Martin[a]

The price elasticity of demand for electricity is a key parameter for analyzing the costs of climate change mitigation, the incidence of carbon pricing, market power, and electricity market design. This paper reports results from a field experiment designed to estimate this elasticity at the monthly level. In our experiment, we partnered with an electricity retailer to randomly provide households discounts of up to 95% off of their per-unit electricity price for two months. We provided different levels of discounts, some very large, which allows us to document highly inelastic demand at the monthly level across the entire range of the demand curve.

Combining our experiment with billing, smart meter, and survey data, we find that residential electricity demand is unresponsive to large reductions in both marginal and average prices. Our preferred own-price elasticity of demand estimate is -0.003. The estimate is statistically insignificant, but economically important as it points to perfectly inelastic demand. With 95% confidence, we can rule out households in our sample having a price elasticity more negative than -0.04.

We believe that the most likely explanation for our findings is that an intermediate, month-long time horizon is both too long to allow for significant inter-temporal smoothing of electricity use, and too short to change habits or household appliance stock. Over this time horizon, adjustment costs in behavior and technology can rationally justify non-response.

Our research design and data allow us to consider numerous other possible explanations for our finding of highly inelastic electricity demand in the medium run. These include households being unaware of our experimental discounts or confused, sample representativeness, price salience, appliance stocks, customer absenteeism in the home, and experimenter-goodwill. Given our experiment and data, we show that it is unlikely that these alternative explanations drive our results.

Our paper differs from the recent body of experimental evidence on electricity demand primarily in our choice of time horizon. We consider prices shocks that are much longer in duration than is common in the experimental literature. In the context of this literature, the unique time frame of our experiment and magnitude of the price shocks that we study is policy relevant. Monthly price variation reflects changes in wholesale costs due to commodity price volatility and seasonality in both demand and supply. Indeed, previous research demonstrates that there are significant potential efficiency gains from passing through this variation to households, but the magnitude of the gains depends critically on the price elasticity of demand. Furthermore, monthly price elasticities have implications for the incidence of a price on carbon. In light of our null result, if households are inelastic over the medium-short run as we find, they will bear the full cost of carbon pricing over this period. Our findings directly point to this possibility, and any related distributional and political consequences.

a Corresponding authors. Department of Economics, The University of Melbourne, 111 Barry Street, Parkville, VIC 3010, Australia. E-mails: byrned@unimelb.edu.au and leslie.martin@unimelb.edu.au.

b Department of Economics, University of Pittsburgh.

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