

The Price Elasticity of Electricity Demand in the United States: A Three-Dimensional Analysis

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Executive Summary

Accurate forecasts of electricity use are important for cost-effective infrastructure investment and the operational planning of electricity utilities. Knowledge on the responsiveness of electricity demand to electricity prices can provide valuable inputs for these forecasts. Price elasticity estimates are also useful in the modeling of tax, climate, and other policies.

In this study we use state-level data for the United States (US) to estimate the short- and long-run price elasticities of electricity demand for the residential, commercial, and industrial sectors, as well as for total electricity use. Our dataset covers the years 2003–2015. The long-run price elasticity is estimated using a cross-state approach, while panel regression approaches are employed to identify the short-run elasticity. We control for other variables that potentially affect electricity use. In our short-run analysis, the use of a multidimensional panel dataset enables us to account for the effects of unobserved variables influencing electricity consumption that are common to sectors in any state (across all years), sectors in any year (across all states), and states in any year (across all sectors).

Our results suggest that the long-run price elasticity of electricity demand in the US is close to one. Electricity use by industry is the most price-sensitive and electricity use by the commercial sector the least, with residences a middle case. The high price sensitivity of the industrial sector makes sense given the considerable input substitution and efficiency possibilities in many industrial settings, and the ability of firms to locate electricity-intensive industrial activities in states with relatively low electricity prices. The two states with the largest primary aluminum production capacity, for example, are Washington and Kentucky, where electricity prices are low. Our estimates of the long-run price elasticity of electricity demand are larger than those of most prior studies.

Our estimate of the same-year price elasticity of aggregate electricity demand is much smaller, at around -0.1 or less for all sectors. The magnitude reflects the fact that possibilities to adjust to

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price changes are more limited in the short run. We find that short-run electricity demand has become slightly more sensitive to electricity prices in the period following the onset of the Great Recession. We find no significant difference in the short-run price elasticity between regions.

Reductions in the costs of electricity generation using solar and wind technologies mean that it is possible that we are heading for a future of low electricity prices. Our estimates imply that the short-term demand-side responses to any future reductions in electricity prices are likely to be small. The long-run effects may be much larger, especially for the industrial sector.

This is a time of rapid change in the US electricity sector, making it important to have up-to-date estimates of the price elasticity of electricity demand. With the onset of the Great Recession of 2007–2009, electricity use has plateaued, following decades of rapid growth. The US Energy Information Administration reference case foresees electricity use growth of less than 1% per annum over coming decades, with substantial improvements in energy efficiency along the way. Rapid technical change in renewables, a natural gas boom, and moves towards time-of-day pricing are among the factors that are making this a time of rapid change in the US electricity sector.

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