[*ESTIMATING RESIDENTIAL GAS DEMAND USING HOUSEHOLD-LEVEL DATA*]

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Overview

We estimate residential gas demand using annual household-level data from England. Our dataset consists of household-level consumption data with household characteristics such as size, type, age, and energy efficiency renovation indicators of dwellings. Our large panel dataset covers more than three million households observed between 2005 and 2012.

Domestic gas consumption accounted for about two thirds of total natural gas consumption in the UK in 2014. Natural gas is expected to further increase its share in the consumption fuel mix in the UK and other countries due to, amongst other things, fewer emissions compared to coal or oil. In the domestic sector in the UK, natural gas consumption accounted for 63% of total domestic energy consumption in 2014. As natural gas is by and large the main heating fuel in England and many other countries, understanding the factors influencing its demand are crucial to policy makers and researchers alike.

Compared to the literature on residential electricity demand, there exist fewer studies on residential gas demand. Most studies analysing household-level data use smaller datasets in terms of observation size of individual consumption data or cover shorter periods of time than our study does.

Methods

We define a theoretical model of residential gas demand, where consumption is a function of the gas price, other variables such as the price of electricity, heating degree days, dwelling characteristics as well as unobserved factors. We estimate both a static and a dynamic model (in which current consumption also depends on past consumption) of residential gas consumption. To empirically investigate the dynamics of residential gas consumption, we estimate the models using fixed-effects, instrumental variables (2SLSFE), and GMM estimators. Furthermore, we estimate short-and long-run price elasticities from our model.

We estimate static and dynamic models for the whole period observed using regional gas price data. For the years 2010 – 2012 we estimate a static model using calculated individual household-level gas and electricity prices based on individual consumption figures and a common regional price formula. To account for unobserved heterogeneity bias using panel data, we specify fixed effects models. To control for potential endogeneity of the regional price of gas due to measurement error and the endogeneity bias of the calculated individual prices, we estimate the 2SLSFE model by instrumenting for the price of gas. To account for the endogeneity of the lag of consumption in the dynamic model, we also instrument the lag of consumption.

Results

Results are fairly robust across specifications and models (static and dynamic, regional and individual price data). We find that residential gas demand is relatively price inelastic, which is in line with the literature. The gas price coefficient is negative and significant across specifications and models. Energy efficiency investments such as the installation of a new gas boiler or the insulation of the loft have a statistically significant and negative effect on gas consumption. The coefficient of the lag of consumption in the dynamic model is positive and significant, indicating that current consumption is partly determined by past consumption due to the sluggish adjustment of households (i.e. households need time to replace their current heating system). As the empirical model is in log-log form, the coefficients can be directly interpreted as elasticities.

Conclusions

Understanding factors affecting residential gas demand and its responsiveness to price changes is of great relevance for designing effective energy saving policies. Our results show that prices, weather, dwelling characteristics, and efficiency measures are significant factors that explain gas demand of households. Our paper adds to the growing literature on residential energy and specifically gas demand.

References

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