THE LONG RUN PRICE ELASTICITY OF DEMAND FOR RESIDENTIAL GAS CONSUMPTION IN THE UNITED STATES: A TIME VARYING APPROACH

Dr Kelly Burns, Curtin University, +61 8 9266 4235, kelly.burns@curtin.edu.au

Overview

It is well known that natural gas contributes a growing share of the world's energy mix (Burke and Yang, 2016). In fact, the International Energy Agency refers to the strong growth in natural gas as the "golden age" for this energy source (IEA, 2011). In this study, we examine how the change in the energy mix impact the own price and income elasticity of demand for natural gas by residential consumers in the U.S. Although there is a well-established body of literature estimating short and long run price elasticities of natural gas demand, a fundamental shortcoming of the existing literature is the assumption that long run price elasticities are constant over time (see, for example, Burke and Yang, 2016; EIA, 2014; Bernstein and Madlener, 2011). In fact, recent studies suggest that the U.S shale gas boom possibly created a structural break impacting both the demand and supply elasticity of natural gas demand in the U.S. (Arora, 2014). In this study, we employ a state-space model to estimate the time-varying long run own price and income elasticity of natural gas demand by residential consumers in the U.S. We find that the own price elasticity of natural gas demand is inelastic and declined by half over the sample period. The results are consistent with natural gas accounting for a growing share of total energy usage and increasing reliance on the energy source by residential consumers. We also find that the income elasticity of natural gas demand is inelastic and negative, consistent with improvements in energy efficiency and the Environmental Kuznets Curve. These results are particularly relevant for industry, policy makers and energy market modellers who utilise own price and income elasticity estimates to forecast energy consumption and production.

Methods

Using annual data from 1970 to 2016, we apply a conventional demand model to estimate the own price and income elasticity of natural gas consumption by residential users in the U.S. Unlike previous studies, we employ a state-space method that allows for time-varying coefficients to be estimated. This overcomes a major shortcoming of the existing literature that assumes elasticity remains constant over time. In our study, the time-varying coefficients are estimated recursively through a likelihood function in which the information sets are updated using the Kalman filter technique. The state-space model offer the advantage of modelling smooth changes in the estimated own price and income elasticity, and is therefore a preferable approach for accounting for changes in elasticity over time as well as potential structural breaks. Data are sourced from the Energy Information Agency and the World Bank.

Results

Preliminary results indicate that the own price elasticity of demand for natural gas by residential consumers in the U.S is inelastic and reduced by half from -0.18 in 1983 to -0.09 in 2016. This infers that demand for natural gas is becoming increasingly less responsive to price changes. The result most likely reflects the fact that natural gas accounts for a growing proportion of the total energy mix (as well as a lack of substitutability) and therefore a growing reliance on natural gas as an energy source by residential consumers.

At the same time, income elasticity remained inelastic and relatively constant varying from -0.36 in 1980 to -0.38 in 2016. The negative income elasticity of natural gas demand is consistent with other empirical results (see, for example, Waheed and Martin, 2013). We explain this result by reference to increasing energy efficiency and the Environmental Kuznets Curve, rather than natural gas being an inferior good.

Conclusions

Natural gas accounts for a growing proportion of the energy mix in the U.S. and the world. As we become more reliant on natural gas as an energy source, changes to the own price and income elasticity of demand over time should be expected. By estimating the demand model for natural gas consumption by residential consumers in the U.S. using a time-varying methodology, these results indicate that the own price elasticity of natural gas demand declined from 1970 to 2016. The results also suggest that the income elasticity of natural gas demand is inelastic and remained relatively constant over the sample period. These results are of particular relevance to industry and gas market modellers, where changes to own price elasticity of demand directly impact the total revenue of firms supplying natural gas to residential consumers in the U.S. The results are also pertinent for policy makers in terms of consumer subsidies for natural gas, such as price regulations and domestic natural gas reservations.

References

Arora, V. (2014). Estimates of the Price Elasticities of Natural Gas Supply and Demand in the United States. *MPRA paper No. 54232.*

Bernstein, R. and R. Madlener. (2011). Residential Natural Gas Demand Elasticities in OECD Countries: An ARDL Bounds Testing Approach. *FCN Working Paper 15/2011.*

Burke, P. and H. Yang. (2016). The price and income elasticities of natural gas demand: International evidence. *ANU Working Paper No. 2016/14.*

Energy Information Agency. (2014). *Price Elasticities for Energy Use in Buildings of the United States.*

International Energy Agency. (2011). *World Energy Outlook 2011 Special Report: Are We Entering a Golden Age of Gas?* Paris, France: International Energy Agency.

Joutz, F., McDowell, B., Shin, D. and R. Robert Trost. (2009). Estimating Regional Short-Run and Long-Run Price Elasticities of Residential Natural Gas Demand in the U.S. *USAEE Working Paper 09-021.*

Waheed, A. and F, Martin. (2013). 'Estimating the demand elasticities of residential natural gas in Louisiana'. *The Global Journal of Finance and Economics.* 10(2). 183-189.