ARE DAY-AHEAD PRICES ENOUGH TO EXPLAIN AND PREDICT THE NEXT DAY'S NATURAL GAS DEMAND? EVIDENCES FROM THE FRENCH CASE

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Overview

Over the last two decades, a series of European regulatory reforms have prompted the emergence of a collection of day-ahead wholesale markets for natural gas, the so-called "gas hubs", that turned out to become an important source of gas procurement as the previously monopolized industry structure gradually became more fragmented (Miriello and Polo, 2015). By construction, the functioning of these markets is thus closely affected by the detailed balancing rules used by the Transmission System Operator (TSO). Despite the recent harmonization of the balancing procedures imposed by the European Commission, market analysts recurrently point important differences in the perceived degree of trading liquidity observed at the European gas hubs (Heather and Petrovich, 2017). A fundamental public policy issue is, thus, whether the current market design generates transparent spot prices that reflect the market participation of all the concerned agents: suppliers, trading firms and consumers.

The purpose of this paper is to empirically investigate the informational content of the day-ahead prices for natural gas. Building on the original approach in Forbes and Zampelli (2014), the present paper hypothesizes that if day-ahead markets prices are efficient, then day-ahead prices should reflect the processed information of all market participants regarding the next day's load. This paper thus explores whether the day-ahead price of natural gas and the spark ratio measuring the relative price of electricity to natural gas are sufficient to explain and forecast the next days consumption of natural gas.

We believe that our analysis can provides useful guidance to a large audience interested in the dynamics of natural gas demand in the short-run and in the reaction of that demand to market prices. While a large applied econometrics literature has approached the question using medium to low frequency data (e.g., monthly, quarterly or annual), that reaction has, to the best of our knowledge, never been examined using daily data. In principle, the use of daily data provides a much richer data set for eliciting short-run effects from lagged changes in prices on the observed demand. Geweke (1978) stresses that estimation over broader data intervals can result in significant bias. His analysis indicates that aggregation over time can create a type of omitted variables bias problem because the intertemporal lag distribution is not properly specified. In our case, the use of daily data may provide more reliable estimates of the price elasticity of natural gas demand than monthly, particularly if natural gas demand responds rapidly to energy price changes. As that parameter plays a very important role in the models developed to examine the impacts of a possible sudden temporary disruption in gas supplies on optimal import policies (e.g., Abada and Massol, 2011), our modeling approach usefully contributes to the policy discussions related to the security of foreign-controlled gas supplies in importing nations.

As an application, we examine the two wholesale markets for natural gas in France: Point d'Echange de Gaz Nord (PEG Nord) and Trading Region South (TRS). The results document the efficiency of the wholesale markets and show that a simple price-based forecasting model can be powerful enough to outperform the day-ahead consumption forecasts published by TSOs.

Methods

We consider the period covering 2014-2018 and assemble a data set comprising natural gas consumption data and daily transaction price data for day-ahead wholesale natural gas and wholesale electricity for the peakload block. As a learning-validation procedure will be used, our dataset is divided in two parts.

Our econometric methodology is based on the Autoregressive Distributed Lag (ARDL) modelling approach (Pesaran et al., 1997) and the associated bounds testing approach which is aimed at testing the long term relationship between the volume of natural gas demanded and its drivers. The ARDL approach allows to treat the case where time series do not have the same properties of stationarity. Our analysis considers two nonlinear extensions of the orginal ARDL model, the Nonlinear Auto-Regressive Distributed Lag (NARDL) model of Shin

et al. (2014) and a new one named Threshold-ARDL (TARDL), to investigate the presence of a long-run relationship between the three variables and to explore the potential asymmetric influence of the spark ratio on observed consumption levels.

Results & Conclusions

Though our discussion is confined to the French case, we believe that the results are pertinent for other countries engaged in a transition toward less carbon intensive energy systems. In France, the gas consumption emanating from the power sector exhibits large and sudden variations because Combined Cycle Gas Turbines (CCGT) plants are primarily dispatched as peaking units which leads to large flow variations in the gas network as these plants ramp up and down. That situation is likely to prefigure the new role assigned to gas-fired power plants when a previously thermoelectric dominated power systems experiences a massive penetration of renewable generation.

Our empirical findings: (i) provide evidence of a symmetric and significant long-run relationship between the three variables; (ii) document the magnitude of the demand price elasticities; and (iii) show that, in the short-run, the spark ratio has an asymmetric and non-linear impact on observed demand levels. In each market, the reported relationship obtained with the new TARLD specification is sufficiently robust to produce a day-ahead forecast that is considerably more accurate than that published by network operators.

References

Abada, I. and O. Massol (2011). Security of supply and retail competition in the European gas market. Some model-based insights. Energy Policy 39(7): 4077–4088.

Forbes, K., Zampelli, E., (2014).Do Day-Ahead Electricity Prices Reflects Economic Fundamentals? Evidence from the California ISO. The Energy Journal, 35(3).

Geweke, J. (1978) Temporal Aggregation in the Multiple Regression Model. Econometrica, 46(3): 643–661.

Heather P. and B. Petrovich (2017). European traded gas hubs: an updated analysis on liquidity, maturity and barriers to market integration. Oxford Institute for Energy Studies. Energy Insight: 13 May 2017.

Miriello, C. and M. Polo (2015). The development of gas hubs in Europe. Energy Policy, 84: 177–190.

Pesaran, M., Shin, Y., (1997), An Autoregressive Distributed Lag Modelling Approach to Cointegartion Analysis. Chapter 11 in Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium, Strom S (ed). Cambridge University Press: Cambridge.

Pesaran, M., Shin, Y., Smith, R., (2001). Bounds Testing Approaches to the Analysis of Level Relationships. Journal of Applied Econometrics, 16: 289-326.

Shin, Y., Yu, B. and M.J. Greenwood-Nimmo (2013). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. InWilliam, C. Horrace, Robin, C. Sickles (Eds.), "'Festschrift in Honor of Peter Schmidt"', Springer Science & Business Media, New York.