How are Day-ahead Prices Informative for Predicting the Next Day's Consumption of Natural Gas? Evidence from France

Arthur Thomas,[a] Olivier Massol,[b] and Benoît Sévi[c]

Forecasting the next day's consumption of natural gas has very important implications for both the cost-efficient operation of the gas pipeline network and the possibility to use that infrastructure to supply short-term flexibility services to a renewable-dominated power sector. Because of their poor accuracy, the performance of the demand forecasts issued by Transmission System Operators (TSO) has recently emerged as a very important issue in regulatory debates and has motivated the adoption of dedicated incentive schemes in several countries (e.g., Italy and the UK).

By construction, the day-ahead wholesale markets for natural gas are supposed to provide transparent spot prices that should reflect the market participation of all concerned economic agents (suppliers, trading firms, and consumers) and thus their expectations about future demand levels. The question examined in this paper is therefore whether the information in these day-ahead prices is rich enough to generate accurate predictions of the next day's consumption of natural gas (relative to the ones provided by TSOs).

To answer this question, we investigate the interactions between natural gas consumption and the information contained in day-ahead market data. We propose a simple specification that models the variations in daily gas consumption as a function of two variables (the price of natural gas and the spark ratio measuring the relative price of electricity to gas) and their lagged variations. By construction, this model captures the essential features of daily gas consumption and in particular the nonlinearities resulting from power dispatching.

As an application, we examine the case of France over the 2015–2018 period. We first estimate our proposed specification using a dataset covering the period April 1, 2015–December 31, 2016 and then use it to compute out-of-sample forecasts. This is the first attempt to model and predict France's gas demand at the daily frequency. Our results first document the existence of a long-run relationship between demand and spot energy prices. We also provide evidence of the pivotal role of the spark ratio which is found to have an asymmetric and highly nonlinear impact on demand variations. Lastly, we show that our simple model is able to generate predictions that are considerably more accurate than the forecasts published by infrastructure operators. Our results thus suggest that accounting for the information contained in day-ahead prices represents a promising avenue to improve the performance of the gas demand forecast and also points to some deficiencies in the infrastructure operators' forecasting activities.

Though our discussion is confined to the French case, the results are relevant for other countries engaged in a transition toward less carbon-intensive energy systems. Indeed, the gas consumption emanating from the country's power sector exhibits large and sudden variations because the French 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

a Department of Economics, IFP Energies Nouvelles, 1-4 av. de Bois Préau, F-92852 Rueil-Malmaison, & LEMNA, Université de Nantes, BP. 52231 Chemin de la Censive du Tertre, 44322 Nantes Cedex, France E-mail: arthur.thomas@ifpen.fr

b IFP Energies Nouvelles, 1-4 av. de Bois Préau, F-92852 Rueil-Malmaison, & Center for Energy Economics and Management, IFP School, 228-232 av. Napoléon Bonaparte, F-92852 Rueil-Malmaison, France, & Department of Economics, City, University of London, Northampton Square, London EC1V 0HB, UK.

c LEMNA, Université de Nantes, BP. 52231 Chemin de la Censive du Tertre, 44322 Nantes Cedex, France.

situation thus prefigures the new role assigned to gas-fired power plants in a previously thermoelectric-dominated power system that experiences a massive penetration of renewable generation.