A note on the effectiveness of supply-side climate policies in the European natural gas market

Daan Hulshof, University of Groningen, +31642691817, d.hulshof@rug.nl
Machiel Mulder, University of Groningen, +31631035729, machiel.mulder@rug.nl

Overview

To realise climate targets, several academic papers and societal parties have argued in favour of environmental policies aimed at directly restricting the production of fossil fuels like natural gas. These environmental policies have been coined "supply-side" policies and include, for instance, restrictive domestic production quotas. The central idea of these policies is that they result in, instead of extracting them, leaving fossil-fuel reserves in the ground, thereby reducing the consumption of fossil fuels and emissions. However, whether supply-side policies are effective in reducing fossil-fuel consumption and GHG emissions depends critically on the degree to which the constrained supply is substituted by other, unconstrained suppliers.

The question this paper addresses is: how effective are supply-side policies in reducing the consumption of natural gas? Specically, we investigate the extent to which a regulatory quota on the production of a relatively important supplier has impacted the quantity of natural gas consumption. This question is asked from a European perspective, implying a context of ambitious own climate goals, considerable own gas production and considerable imports, including from several countries that may be able (and possibly eager) to increase their exports, at least in the medium and long term.

To investigate the effectiveness of supply-side policies, this paper empirically analyses the impact on the market quantity of restricting the production of natural gas from the Dutch Groningen gas field. Globally, the Groningen field is among the ten largest natural gas fields and its production in 2013 equalled 54 billion cubic meters (bcm) or 10% of total European gas consumption. However, in 2014, as a result of earthquakes that were increasing both in frequency and magnitude, and induced by the production of gas, the government implemented a constraint on the maximum annual production from the Groningen field. This maximum quantity was decreased in every year since 2014, resulting in production equal to 8 bcm in 2020, or 1.5% of total European gas consumption. Effectively, the production restrictions on the Groningen field mimic a supply-side policy, with the only difference being that the policy is not motivated by climate concern, but another type of environmental concern.

Methods

The analysis consists of a time-series regression of gas consumption in the Northwest-European natural gas market, which we define as Austria, Belgium, Denmark, France, Germany, Italy, Luxemburg, the Netherlands and the UK. The empirical model is based on a reduced-form supply and demand model of this gas market. Realising that gas in this region is mainly consumed in the electricity, space-heating and industrial sectors, the empirical model we estimate is:

$$Q_t = a + b_0*Q_{t-1} + b_1*T_t + b_2*QRE_t + b_3*Poil_t + b_4*Pcoal_t + b_5*Pco2_t + b_6*GDP_t + b_7*R_t + b_8*SD_t + e_t$$

where t indicates time, a is a constant, Q is gas consumption, T is heating degree days, QRE is renewable-electricity production, Poil, Pcoal and Pco2 are respectively the oil, coal and CO2 prices, GDP is real GDP, R a variable that measures the forced reduction in gas production from the Groningen field, SD is the deviation in gas-storage filling grades from the historical average, the b's are the associated coefficients and e is an error term. b_7 measures the imact of a reduction in production from the Groningen field on the consumption of natural gas and, therefore, measures the effectiviness of the policy in reducing consumption and emissions. As such, b_7 is the coefficient of primary interest.

The model uses primarily monthly data over 2011-2020, which are obtained from a variety of sources: Eurostat (gas consumption, heating-degree days), Datastream (energy and CO2 prices), FRED (real GDP), ENTSO-E (renewable-electricity generation), Gas Infrastructure Europe (gas storage filling grades). The variables real GDP and the policy variable are measured on an annual frequency. The reason why estimate the model on a monthly frequency, despite that our key variable of interest is measured on annual basis, is that data availability for some variables is limited to the extent that this would greatly reduce the number of observations.

Results

The primary result from the analysis will be a regression estimate of the impact of a policy-induced reduction in the production of the Groningen field on gas consumption in Northwest-Europe. This corresponds to an estimate of b_7 in the regression model above. In addition, the other estimated coefficients provide insight into their respective impact on gas consumption. This may be compared with our a-priori expectations as well as with the findings in the literature (e.g. Nick and Thoenes, 2014; Hulshof et al., 2016; Wang et al., 2019).

Conclusions

The paper will conclude by answering the question to what extent restrictions on natural gas supply in the European market are effective in reducing consumption and thus emissions. Attention will be paid to generalizability of the paper's findings by explicitly considering the importance of the restricted supply in comparison with the size and importance of other suppliers (e.g. Russia or Norway).

References

Hulshof, D., Van der Maat., J., Mulder, M., 2016. Market fundamentals, competition and natural-gas prices. Energy Policy, 94: 480-491.

Nick, S., Thoenes, S., 2014. What drives natural gas prices? — A structural VAR approach. Energy Economics, 45: 517-527.

Wang, T., Zhang, D., Broadstock, D. C., 2019. Financialization, fundamentals, and the time-varying determinants of US natural gas prices. Energy Economics, 80: 707-719.