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What drives natural gas consumption in Europe? Analysis and projections

Özge Dilaver [a,b], Zafer Dilaver [c,d,*], Lester C. Hunt [d]

[a] Centre for Research in Social Simulation (CRESS), Department of Sociology, University of Surrey, UK
[b] British Institute at Ankara, 06700 Ankara, Turkey
[c] The Republic of Turkey Prime Ministry, PK 06573 Ankara, Turkey
[d] Surrey Energy Economics Centre (SEEC), School of Economics, University of Surrey, UK

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ABSTRACT

Natural gas is an important fuel source for Europe and it is expected to remain so in the near future. The market power of suppliers is an important structural element of the European natural gas market and long-term investment and contracts necessitate reliable projections of natural gas demand. This research attempts to address this need. It investigates the impact of income, real natural gas prices and the underlying energy demand trend (UEDT) on OECD-Europe natural gas consumption by applying the structural time series technique to annual data over the period 1978 to 2011. The results suggest that, in order of importance, income, the UEDT and natural gas prices all play a role in driving OECD-Europe natural gas consumption with the estimated UEDT having both increasing (gas using) and decreasing (gas saving) periods over the estimation period and the estimated long run income and price elasticities being 1.19 and −0.16 respectively. Furthermore, based upon the estimated relationship, OECD-Europe natural gas consumption is predicted to be somewhere between 572 and 646 bcm (about 472 and 533 mtoe) by 2020.

1. Introduction

Natural gas is an important fuel resource for Europe and it is expected to remain important in the next few decades (Holz et al., 2006; EC, 2008, 2009; EIA, 2009; IEA, 2010) due to increasing environmental concerns and related policies. Compared to other fossil fuels, natural gas has lower carbon intensity and higher fuel efficiency in electricity generation (EIA, 2009). It is also used as a backup fuel for intermittent renewable sources (Ghafghazi et al., 2010; Samseth, 2013). Hence, the use of natural gas in electricity generation is expected to increase in Europe as well as in the rest of the world (EIA, 2009; IEA, 2010). In addition to the effect of environmental concerns, there are also increasing trends in the indigenous demand for natural gas in the supplier countries and in the demand of developing countries (Remme et al., 2008; EIA, 2009). Indigenous natural gas production in Europe, however, is declining. Thus, the OECD-Europe's natural gas import dependence is expected to increase (Honore, 2010; Remme et al., 2008) at a time of global competition for accessing natural gas sources.

Increasing energy demand in general is a global trend and given that fossil fuel reserves remain limited,[1] energy security has become one of the primary economic and political objectives of both developed and developing countries over the last few decades (Yergin, 2006; IEA, 2010). This issue is crucial for maintaining productive facilities and for meeting consumption requirements both of which have increasingly become energy dependent in the short and medium run and for ensuring future generations will have adequate resources in the long run. From a theoretical viewpoint, the liberalisation of fuel markets is seen by some as adequate (Radetzki, 1999) for delivering both energy security and efficient allocation of scarce resources in the short run. Nonetheless, as identified by Bilgin (2009) and Helen (2010), structural and institutional conditions often impede efficiency of fuel markets and reliable demand forecasts are arguably needed for underpinning the true impact of fuel consumption on future generations.

* Corresponding author. The Republic of Turkey Prime Ministry, PK 06573 Ankara, Turkey and Surrey Energy Economics Centre (SEEC), School of Economics, University of Surrey, GU2 7XH, UK. Tel.: +90 312 422 10 00; fax: +90 312 422 23 99.
E-mail address: zaferdilaver@gmail.com (Z. Dilaver).

[1] Although the recent improvements in unconventional oil and gas production increase the amount of recoverable fossil fuels, they remain limited.

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Such structural and institutional conditions are also relevant to OECD-Europe's natural gas market. Conditions including the market power of supplier countries, the concentration of reserves (around a half of proven global natural gas reserves are located in Russia, Iran and Qatar according to BP, 2013), the requirement of long-term investment pipelines across countries to facilitate cost-efficient transportation, and the prevalence of long-term contracts all raise concerns about the efficiency of the market. Furthermore, the Gas Exporting Countries Forum (GECF), which was created in 2001, has become another concern for net importers. Although GECF currently operates as a facilitator of logistic collaboration between member countries, the possibility that it may act as a cartel to gain control over the gas supplies and prices in the future raises some concerns (Stern, 2002; Massola and Tchung-Ming, 2010). Regarding the operations of the natural gas market, generally, the most cost efficient way of transporting natural gas is via pipelines (Hafner et al., 2008; see also Pirani et al., 2009). This, however, requires long-term infrastructure investment and the energy security of the transit countries may become important at times of crisis, such as the Russia–Ukraine gas conflicts in 2006 and 2009. Regarding the institutional conditions, long-term contracts, which are often in the form of take-or-pay obligations between 80 and 90% of the annual contract quantity for a period up to 25 years (Newbery, 1984), has long been the *modus operandi* in the natural gas market. However, the increasing volumes of more flexible LNG and unconventional gas (such as shale gas, tight gas and coal-bed methane) could alter the drivers of long-term contracts in the future (Talus, 2011). Long-term contracts in natural gas markets arguably have ambiguous effects on the market structure and social welfare; on the one hand, they are considered as barriers to entry for potentially more efficient suppliers and on the other hand, they are thought to facilitate market entry by encouraging long-term investments (Hauteclocque and Glachant, 2009).

European countries can adopt energy policies that address some of these issues, for instance, increasing diversification of natural gas suppliers could reduce the share supplied by Russia and increase the shares supplied by Middle Eastern and Caspian sources, which could to some extent reduce the market power of major suppliers and improve the energy security of Europe (Bilgin, 2009). Regarding the institutional conditions, the European natural gas market is undergoing a significant liberalisation process (Talus, 2011) and the European Commission has the objective of shortening the contract period of natural gas transactions (Kavalov et al., 2009).

On the other hand, the political impacts of strong actors and major suppliers such as Russia cannot be ignored while assessing diversification strategies. Russia relies on the gas exports that are mainly directed to Europe via pipelines and thus encourages Caspian countries to divert their export routes to the east rather than west. Furthermore, there are certain interdependencies between structural and institutional conditions. For instance, diversification of natural gas sources requires investment in new pipelines and long-term contracts may be preferred to secure such investments (Oren, 2003). According to Neuhoff and von Hirschhausen (2005), the suppliers would also prefer long-term contracts as long as the elasticity of demand is significantly higher in the long run than in the short run. These interdependencies can lead to the emergence of new institutional arrangements; China, for instance has started to provide package solutions covering finance, field development and pipeline construction (Hall and Grant, 2009; Remme et al., 2008) in order to gain access to Caspian energy sources and secure long-term production sharing agreements. Hence, despite the developments in the spot markets, the drivers of long-term contracts are likely to continue to be influential in the European natural gas market over the next two decades (Stern, 2002; Neuhoff and von Hirschhausen, 2005; Hauteclocque and Glachant, 2009).

Overall, natural gas is likely to remain an important fuel in the next few decades and the global competition for accessing natural gas sources will be increasing in parallel to European demand. On the supply side, OECD-Europe's indigenous production is likely to decline while the global suppliers that are already low in number may initiate cartel-like organisations. Furthermore, the physical and institutional conditions of the market will probably require long-term measures to help deliver energy security. Not surprisingly, these developments create anxiety across an import dependent Europe (see, for example, EC, 2009). Volatility in natural gas prices or supply can have devastating effects on European economies and therefore, identification of future natural gas needs is a vital and urgent issue for policy makers in OECD-Europe (Christoffersen, 1998; Bilgin, 2009).

This paper addresses this need by analysing OECD-Europe[2] natural gas consumption, which in 2011 accounted for about 15.3% of total world natural gas consumption (IEA, 2013a). The relationship between OECD-Europe natural gas demand and the determinants income, natural gas prices, and an underlying energy demand trend (UEDT) is investigated by applying the structural time series model (STSM) to annual data over the period 1978 to 2011.[3] From this, the estimated natural gas demand function is used to produce future scenarios for OECD-Europe natural gas demand.

This is, as far as known, the first study that allows for a stochastic UEDT when estimating an OECD-Europe natural gas demand function. The benefits of using the STSM in order to underpin energy forecasts are explained in the following sections. It suffices to mention here that this methodology helps overcome some of the perceived shortcomings of previous studies by allowing for a stochastic UEDT and therefore the estimated model will hopefully perform better than previous models for producing forecasts. Given the importance of reliable natural gas forecasts for assessing European energy security, forecasts that are produced are useful for European policy makers, natural gas producing companies and financial institutions.

The paper is organised as follows. The next section reviews previous studies of natural gas demand in Europe. The third section explains the methodology of the paper with a short introduction to the STSM and the UEDT and a discussion on why this is an appropriate approach for natural gas demand modelling. The fourth section introduces the dataset and presents the results. The fifth section presents forecast scenarios of future OECD-Europe natural gas demand and the last section concludes.

2. Literature review

In this section, the existing literature on natural gas demand in OECD-Europe is reviewed and discussed in two parts. In the first subsection, previous studies that have estimated natural gas demand relationships and their associated elasticities are reviewed and compared. In the second subsection, previous projections for future natural gas consumption are summarised and discussed.

2.1. Previous studies on price and income elasticities of natural gas demand

This subsection focusses on studies that have attempted to estimate income and price elasticities of natural gas demand in some

[2] OECD-Europe consists of the EU member and candidate countries, hence the study covers the natural gas consumption of Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

[3] Both the STSM and the UEDT will be further discussed in details in the Methodology section.