How (a)symmetric is the response of import demand to changes in its determinants? Evidence from European energy imports

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ABSTRACT

Energy imports are crucial for European countries, yet little is known about determinants of their import demand. We update long-outdated estimates of import demand elasticities using recent data for crude and derived energy products and contribute to the debate on the asymmetry of import demand by using recent developments in econometric modelling. Our results have important implications for the geopolitics of energy markets in Europe. (Asymmetric) Income seems to be the most relevant determinant of import demand; Economic growth and fossil fuel consumption are correlated, even in the context of the European agenda towards renewables. Our results suggest that European economic recovery may derail the drive for lower fossil consumption, and that changes in the natural gas market may further complicate this drive, especially regarding Russia as the primary supplier to the Eurozone.

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1. Introduction

European energy markets are likely to continue to change dramatically. The domestic fossil resources are mostly exhausted (Eurostat, 2017), European countries are moving away from nuclear energy (Smedley, 2013), and the development of alternative sources of energy (Eddy, 2014; Clark, 2017) is an attempt to reduce greenhouse gas emissions (Neslen, 2014). In addition, Eurozone domestic production can cover only a minor part of energy consumption, resulting in high import dependency. Yet while the political debate on the European energy markets is heating up, recently further triggered by the US withdrawal from the Paris climate agreement (Crilly, 2017), empirical evidence on factors that affect the energy import demand is lagging behind.

The economic literature on energy demand dates back to 1950s. Dozens of empirical studies have been conducted for various energy sources, time periods, estimation techniques and countries (see Adewuyi, 2016 and Salisu and Ayinde, 2016 for an overview). Particularly much is known about energy demand in Northern America, South-East Asia and Turkey. An increasing number of studies focus on South and Western Africa. While mostly sharing a red-thread finding that income and price are important energy demand determinants, the individual results vary considerably across products and countries considered.

Much less is known about energy import demand. The few studies that exist focus on crude oil imports of mostly developing countries, including Turkey (Altinay, 2007, Ediger and Berk, 2011, Ozturk and Arisoy, 2016), China (Zhao and Wu, 2007; Roberts and Rush, 2012), Barbados (Moore, 2011), India (Ghosh, 2009), Indonesia (Mardiana et al., 2013), or South Africa (Ziramba, 2010). The analysis for developed countries includes Korea (Kim and Baek, 2013) and the US (Gamacho-Gutierrez, 2010). While some authors name the expansion of transport sector or exports as determinants of energy imports, oil prices and income seem to be the most important determinants of import demand. Similarly to the case of domestic energy demand, the magnitude of these effects varies considerably across studies.

The only study on European energy imports that we were able to find is Kouris and Robinson (1977), who analyze crude oil imports of the European Economic Community (EEC) in the aftermath of the oil price spike in 1973–75. Recent developments on the European energy market, the data availability and improved tools of econometric analysis call forth revisiting the determinants of European import demand, which is the major goal of this article.

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Since crude oil is a large but not the only product in the European energy mix, we expand our study by looking at imports of fifteen product groups that are included to the HS classification under the code 27: Mineral fuels. This includes the crude fuels – oil, coal and gas as well as derived products, such as lignite, peat, coke, pitch, tar and products of it, refined oil and petroleum jelly or bituminous mixtures. While some of these products only account for a minor part of the energy imports, imports of others (e.g. petroleum jelly, peat and coal gas) steadily increase in importance, both in terms of imported volume and share.

Instead of examining individual European countries, we consider the Eurozone as a single economic bloc. Although such an approach leads to a certain loss of information on a country level (we critically assess our selection criteria in the following), we are confident that this is a suitable approach for the present case. Even if the results we obtain are country-averages, we still can show how imports respond to changes in their major determinants and demonstrate that these relationships are more complicated than the empirical literature often assumes. Sharing the same currency and belonging to the EU, a level on which the European energy policy is carried on, further strengthen our choice of a single import market.

Our analysis builds on the few existing studies on energy import demand. We improve on them by introducing possible asymmetric reactions in demand and estimating dynamics at a product-level. In doing so, we address the bottlenecks of the earlier empirical attempts to model asymmetries in energy markets. The contribution of our paper to the understanding of energy markets is threefold:

(i) We update the estimates of the import demand equation for Europe by using recent data since the last study available is 40 years old;

(ii) We expand the portfolio of studied imports and consider both crude and derivative energy products to assess whether results are sensitive to the nature of the products studied;

(iii) We contribute to the debate on the asymmetry of import demand by using recent econometric developments that address critiques of earlier asymmetry studies. We test for hidden cointegration and use the nonlinear ARDL (NARDL) model by Shin et al. (2014) to introduce long- and short run asymmetries in the import demand model.

Our results have important implications for the geopolitics of energy markets in Europe. In particular, we find that that income is the most important energy import determinant, that coal behaves as a normal instead of an inferior good; and that economic growth and fossil fuel consumption are correlated, even in the context of European subsidies for renewables. Moreover, primary energy imports are heavily affected by the dynamics of the natural gas market, and coal prices affect oil imports. Implications are straightforward: European economic recovery may derail the drive for lower fossil fuel consumption and changes in the natural gas market, especially regarding Russia as the primary supplier to the Eurozone, may complicate this drive, as natural gas is a substitute for oil imports.

The remainder of the article is divided as follows. In Section 2, we briefly overview the findings from existing studies on energy import demand and survey the literature on possible reasons behind an asymmetric response of import demand to changes in its major determinants. In Section 3, we derive an empirical specification from a theoretical model and introduce a way to account for hidden cointegration in an extended nonlinear version of a classic ARDL specification. In Section 4, we briefly describe the energy market of the Eurozone and the data. In Section 5, we first discuss the results from a simple symmetric model (ARDL with Bounds testing), which is a standard specification of a majority of the existing studies, and then we relax the symmetry assumption in our regressors one by one and report the results from the NARDL

models. In Section 6, we present the economic implications of our results and in Section 7 we have some final comments and directions for further research.

2. Literature review

Academic literature has a long and well established tradition determining the components of energy demand. The majority of empirical studies that estimate energy demand functions uses annual data on a country level. For emerging markets, there are studies for Brazil (Alves and De Losso da Silveira Bueno, 2003), Ghana (Adom, 2013), India (Filippini and Pachauri, 2004), Indonesia (Sa'ad, 2009), Iran (Pourazarm and Cooray, 2013), Mexico (Galindo, 2005), Nigeria (Dayo and Adegbulugbe, 1987, Iwayemi et al., 2010), Pakistan (Jamil and Ahmad, 2011), Sri Lanka (Amarawickrama and Hunt, 2008), Taiwan (Holtedahl and Joutz, 2004), and Turkey (Halicioglu, 2007). The evidence on developed countries is centered on the US (Houthakker et al., 1974, Silk and Joutz, 1997, Maddala et al., 1997, Kamerschen and Porter, 2004, Dergiades and Tsoulfidis, 2008, Luchansky and Monks, 2009 or Wadud et al., 2010) or comes from panel models where groups of countries such as OECD are considered (e.g. Liu, 2014, Griffin and Schulman, 2005, Adeyemi et al., 2010). These studies mostly suggest that prices and income are the most important determinants of energy demand, which is often inelastic to changes in both variables, although results vary significantly across countries and periods.

Of all empirical results regarding the estimation of energy demand, we are mostly interested in those focused on European industrial sectors and/or that look at the determinants of energy imports. Unfortunately, there are precious few articles on these dimensions of energy markets analysis (Zhao and Wu, 2007).

Regarding European industrial sectors, results show a large variation in energy demand for different industrial sectors and address response to demand shocks. Variation across sectors comes from Boug (2000) and Agnolucci (2009). In particular, Boug (2000) found that for Germany the average long run elasticity of demand was 0.75 for income and − 0.30 for prices. In Agnolucci (2009), estimates were for UK and Germany and in his preferred specification the energy demand responses were inelastic, with an elasticity of 0.52 for economic activity and − 0.64 for price. These values lead the author to conclude that energy taxes might be an effective strategy for reducing energy consumption given the higher importance of price in determining energy demand. Complementing the inter-sectoral results, Andersen et al. (2011) found evidence that, in European industrial increases, demand shocks generally have a larger effect on gas demand than price increases.

On the determinants of energy imports, Moore (2011) used monthly data from 1998 to 2009 and the bounds testing approach to evaluate import demand of oil for Barbados. His results suggested that oil imports can be a good source of tax revenue given their small price elasticity. Kim and Baek (2013) used a similar econometric approach to look into crude oil import demand of Korea using quarterly data from 1986 to 2010. In their sample, income was a more powerful determinant of the long-run behavior of crude oil imports than crude oil price, in the short run, price seemed to be more important. For the case of India, Ghosh (2009) showed that the link between income and imports of the crude oil is statistically insignificant. Ziramba (2010) analyzed the South African import demand for crude oil using the annual data (1980–2006) and a two stage error-correction model (ECM) to show that income and prices of oil are the main factors that explain imports. The import demand was price and income inelastic for the case of South Africa. Zhao and Wu (2007) conducted analysis for China's energy import demand using vector ECMs for 1995–2006. They found that in the long run growth of industrial production and expansion of the transport sector affects oil imports, while domestic energy output had a substitution effect.

Adewuyi (2016) is the only study looking at import demand beyond crude oil, emphasizing the possibility of different elasticities related to