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Short communication

An estimation of crude oil import demand in Turkey: Evidence from time-varying parameters approach

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HIGHLIGHTS

- We estimated the price and income elasticities of imported crude oil in Turkey.
- Income elasticity is statistically significant and it is 1.182.
- The price elasticity is statistically insignificant.
- Crude oil import in Turkey is more responsive to changes in income level.
- Crude oil import during the estimation period is substantially driven by income.

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ABSTRACT

The aim of this study is to model crude oil import demand and estimate the price and income elasticities of imported crude oil in Turkey based on a time-varying parameters (TVP) approach with the aim of obtaining accurate and more robust estimates of price and income elasticities. This study employs annual time series data of domestic oil consumption, real GDP, and oil price for the period 1966–2012. The empirical results indicate that both the income and price elasticities are in line with the theoretical expectations. However, the income elasticity is statistically significant while the price elasticity is statistically insignificant. The relatively high value of income elasticity (1.182) from this study suggests that crude oil import in Turkey is more responsive to changes in income level. This result indicates that imported crude oil is a normal good and rising income levels will foster higher consumption of oil based equipments, vehicles and services by economic agents. The estimated income elasticity of 1.182 suggests that imported crude oil consumption grows at a higher rate than income. This in turn reduces oil intensity over time. Therefore, crude oil import during the estimation period is substantially driven by income.

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1. Introduction

In recent years, energy demand in general and oil demand in particular has been the subject of numerous theoretical and empirical analyses. Given the key role of crude oil as a strategic commodity and source of energy on which the economies of countries are greatly dependent, the impact of oil on economic activity has been a matter of great concern to scholars and policy makers. Therefore, the empirical estimation of crude oil import demand functions have received considerable attention and have been examined using a variety of model specifications and estimation methods for different countries in terms of income-level, geographical location and economic structure (e.g. Altinay, 2007; Ghosh, 2009; Ziramba, 2010).

With the support of growing economic activity, energy demand, particularly oil demand in Turkey has a great potential for further growth given the fact that Turkish economy has enjoyed relatively rapid economic growth during the last decade. Moreover, energy demand and requirement for crude oil have also been increasing in conjunction with rapid population growth, industrialization and urbanization. Fig. 1 presents the distribution of primary energy consumption sources as of 2013 for Turkey. It is clear that in 2013 oil accounted for 27.3% of total primary energy demand in Turkey. Energy consumption of Turkey is dominated by natural gas and oil, which accounted for 57.4% of total primary energy demand in the year 2013. We observe that oil is one of the major energy consumption in Turkey. As a result, it is important to

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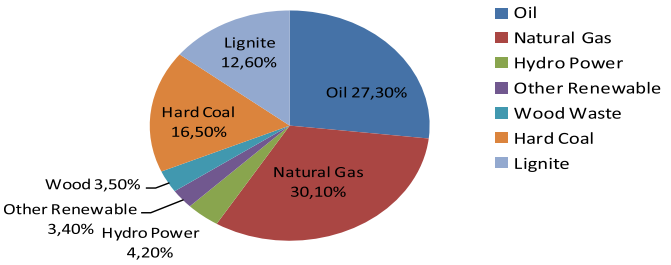

Fig. 1. Turkey Primary Energy Consumption by source (2013).

examine the determinants of crude oil demand.

As a consequence of secular growing demand in comparison with production since 1950, Turkey has been an energy import-dependent country (see, e.g, Ediger and Berk, 2011). It is estimated by the International Energy Agency (IEA) that Turkey will likely witness the fastest growth in energy demand from medium to long-term among the IEA member countries and Turkey's crude oil imports are expected to double over the next decade (IEA, 2013). On the other hand, it is also estimated by Ministry of Energy and Natural Resources (MENR) that oil demand will reach 59 million tons (EPDK, 2012). Table 1 presents the main oil indicators for Turkey. As can be seen, Turkey is increasingly dependent on imports of crude oil as its domestic consumption is increasing each year. The quantity of imported crude oil in Turkey, for instance, has steadily gone up from 318.9 thousand barrels per day (kb/d) in 1985 to more than 676.4 thousand barrels in 2014 along with its growing economy.

As of 2014, Turkey consumes 724.1 thousand barrels of oil yearly, while it produces about 47.6 thousand barrels, a level of dependency on imports greater than 93%. In the case of natural gas, its level of dependency on imports is 98%. As a result, Turkey has become one of the significant oil consumers and oil importers in the world. In view of the recent projection of Ediger and Berk (2011), crude oil will continue to play a key role in Turkey's energy mix in the future, so it is very important to examine accurately the determinants of Turkish crude oil import demand.

This study is an attempt to contribute to the related literature from an econometric perspective. In this study, we try to expand the scope of previous studies by using a novel empirical method in order to identify the basic determinants of the imported crude oil in Turkey. The principal purpose of this paper is to model crude oil import demand, estimate the price and income elasticities of imported crude oil in Turkey based on a time-varying parameters (TVP) approach with the aim of obtaining more accurate and robust estimates of price and income elasticities.

The main advantage of TVP method is that it yields more reliable and accurate results in the presence of regime shifts or structural breaks (i.e. parameter instability). The accurate and reliable elasticity estimates are evenly crucial for policy makers and experts to meet and project the increasing demand for energy and to design long-term energy policies as well as appropriate consumption policies. This is more important for the economies like Turkey, since Turkey has so limited oil sources and thus a net energy importer with more than 90% of the crude oil requirement is being met through import.

With the exception of Arisoy and Ozturk (2014), Chang et al. (2014); Inglesi-Lotz (2011), TVP approach has not been utilized widely in the estimation of energy demand literature. This is the first study, to the best of our knowledge, which estimates empirically the crude oil import demand function using TVP method. Therefore, the main contribution of this study is methodologically not only to consider the effects of regime shifts or structural breaks on the determinants of crude oil import, but also to observe how the elasticity of price and income with respect to quantity of crude oil import has changed over time. The novelty of this study is the estimation of time-varying elasticities that reflect the fact that reactions of the economic structure to technological developments change over time. Furthermore, this paper provides policy makers and experts with new values of price and income elasticities and thus contributes to the rationality of energy policy making process.

The rest of the paper is organized as follows. Section 2 presents literature review. Section 3 is devoted to the description of data and methodology. Section 4 presents the empirical results and Section 5 concludes the paper.

2. Literature review

Policy implications deriving from the empirical analysis rely implicitly on the stability of energy demand function. A stable energy demand function implies the existence of theoretical relationship between the concerned variables (Jamil and Ahmad, 2011:5519). There are several studies in the related literature on parameter instability particularly structural change or regime shifts in energy markets (e.g. Chang et al. 2014; Inglesi-Lotz, 2011; Park and Zhao, 2010; Miller and Ratti, 2009; Hughes et al., 2008). Structural change in crude oil consumption may be due to the technological developments and improvements in the petroleum usage in the petrochemical industry, heating, transportation and motorized vehicles as well as the widespread use of alternative renewable energy sources. Consequently, it is difficult to assume that the response of crude oil import to income and crude oil price and thus the relationship among volume of crude oil import, income and price of imported crude oil remains constant over the analysis period.

Although there exists by now a large literature that focuses on the demand for energy in general and oil in particular, there are relatively fewer studies on import demand for crude oil. Despite the key role of crude oil demand in many countries including Turkey, few studies using the recent econometric models have been conducted in empirical estimations. Some of the recent studies on crude oil import demand are presented in Table 2.

The results from these studies generally show that income elasticities of demand for crude oil are elastic, while price elasticities are inelastic.

Table 1
Key Oil Data in Turkey.
Source: IEA (2013, 2015).

Key Oil Data	1985	1990	1995	2000	2005	2010	2011	2012	2014
Production (kb/d)	40.6	72.5	67.7	52.8	43.5	48.3	45.6	44.9	47.6
Demand (kb/d)	359.5	477	608.3	662.8	647.5	649.8	655.9	670.3	724.1
Net imports (kb/d)	318.9	404.5	540.6	610	604	601.5	610.3	625.4	676.4
Import dependency (%)	88.7%	84.8%	88.9%	92%	93.3%	92.6%	93%	93.3%	93.4%

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