Yıldız Arikan and Gürkan Kumbaroğlu

SHORT - AND LONG - RUN ELASTICITIES OF OIL PRODUCTS IN TURKEY

Yıldız Arikan: Sabancı University, Faculty of Management, Orhanlı, Tuzla 34956, Istanbul, Turkey,
Gürkan Kumbaroğlu: Department of Industrial Engineering, Boğaziçi University, 34342 Bebek, Istanbul, Turkey

Overview

Estimation of price and income elasticity of oil products is very important because it gives way to planning and policy analysis. Its importance is related with measuring demand changes as a result of price and income variations. Consumer's respond to such changes has significant consequences on a country's energy imports, balance of payments, economy and environment as a whole. This paper presents the results of a study for estimating the price and income elasticity for gasoline, LPG, diesel, and fuel oil in Turkey. Our findings indicate that gasoline, LPG, and fuel oil demands are highly elastic with respect to price and income variations, both in the short-run and long run. Diesel demand is inelastic with respect to price changes. Main determinant of diesel demand is found to be the gross domestic product (GDP) of industry. The demand for fuel oil on the other hand is responsive to price changes only and inelastic with respect to growth of income.

Methods

A major concern in measuring the price and income elasticity of demand is the estimation of the order and the speed of the response of the consumers to variations in the prices and income For this reason a distinction is made between short-run and long-run elasticity of demand. In the short-run consumers are restricted by the existing capital stock and habits which they have developed over the years. These conditions take time to change. In the long run consumers can replace some of the inefficient existing stock of fuel consuming capital with more efficient ones as well as making new investments, which can enable them to switch to another fuel or new technology. It might be said that short run response arises from the behavioral change in the utilization rate of existing capital stock, where as long run response is shaped by the new and replacement investments into capital stock itself. For this reason it is common fact that long-run elasticity figures are greater than short-run elasticity figures and their calculation and interpretation requires special care and effort.

In this study, to measure the elasticities, a partial adjustment-modeling framework has been developed following after Houthakker and Taylor (1970), in line with the approach as described in Al-faris (2000)

In partial adjustment models it is assumed that there is a desired demand (an equilibrium value) that the consumers are trying to reach in time and in each period they make partial adjustments to reduce the gap between their existing level of demand and the desired level. Therefore in this approach the adjustment to price and income changes is not instantaneous and completed in one period as in the static models, but it is carried to the future periods as well.
Describing this behavior, we used the following basic functional form in our elasticity estimates.

$$LnQt = \xi 0 + \xi 1\ LnP1t + \xi 2\ LnP2t + \xi 3\ LnYt + \xi 4\ Ln\ Qt\text{-}1 + \xi \quad (1)$$

In this equation Qt, and Qt-1 are demands at period t and t-1, P1t is own price of the fuel in period t, P2t is the competing fuel's price in period t, and Yt is an indicator of income (like per capita GDP, etc.)

With this functional form, short-run own and cross price elasticity are given by $\xi 1$, and $\xi 2$ and the income elasticity is $\xi 3$ Long-run elasticities are calculated from the short-run elasticities by dividing them with $(1- \xi 4)$, $\xi 4$ being the coefficient of the lag variable, Qt-1.

We adopted this modeling framework because its assumption of partial adjustment is fairly realistic and makes it possible to obtain both short-run and long run elasticities at one step of solution.

Results

For each fuel, the model was estimated by using OLS with quarterly time series data for a period of 2000-2005. For each fuel a large set of independent variables have been tested and variables that remained in statistically significant solution cases have been identified. Price and income elasticity values have emerged from the coefficients of these variables. Summary of the results is displayed in Table. 1 below.

Table 1. Price and income elasticities: A summary

Fuel Type	Coefficient of one period lag variable	Price Elasticity		Income elasticity	
		Short-run	Long-run	Short-run	Long-run
Gasoline	0,459	-0,701	-1,295	0,467 (GDP_Trade)	0,863
LPG	0,287	-0,358 (LPG price) 0,496 (Gasoline price – cross price elasticity)	-0,503 (LPG price) 0,695 (Gasoline price – cross price elasticity)	0,547	0,767
Diesel	0,000	-	-	0,048 (GDP-Agricul.) 1,256 (GDP-Industry)	
Fuel Oil	0,510	-0,406	-0,827		

Since the study is based on quarterly data, short run may be considered as 3 months where as long run is a convenient length of time for a series of adjustments to become effective, depending upon the coefficient of the lag- variable Qt-1.

Conclusions

A number of comments and conclusions are possible from the results of the partial adjustment models developed:

Since quarterly data has been used, short run elasticities capture relatively

Gross Domestic Product by sectors as trade, agriculture and industry are the income variables that affect different fuel demands.

Among all fuels, gasoline has the highest elasticity of price.

LPG demand has significantly big cross price elasticity for gasoline price, both in the short-run and long run. LPG is largely used by taxicabs and this cross price elasticity is a

result of the ease with which taxicabs can instantaneously switch from gasoline to LPG in case of gasoline price increase. However gasoline demand is not sensitive to LPG prices.
Diesel demand is inelastic to price changes, and since the coefficient of lagged variable is zero, we cannot calculate the long run values from short run.
Fuel oil demand has a decreasing trend in Turkey. Results show that demand is inelastic with respect to income.
Since the model is estimated by using logarithm of the variables, the coefficient of the one period lag variable ($\xi 4$) shows how much would a 1% change in demand in the previous period affect demand in the current period. If this coefficient is close to 0,5, then $1/(1- \xi 4)$ will be close to 2 and the long run elasticity will be about twice the short run elasticity. Practically speaking the higher the $\xi 4$, the more is the coupling between two consecutive periods and the more any response the consumers show to prices and income changes will be carried to forthcoming periods. Hence the long run response (summarized by the long run elasticity) will be relatively high.

Acknowledgements
Special thanks are due our research assistants, Kemal Sarıca and Onur Özgün, for their unique technical contribution in collecting and organizing data and runs.

References
Abdul-razak F. Al-faris (1997) "Demand for oil products in the GCC countries", Energy Policy, 25(1997) 1, 55
H. S., Houthhakker, and L.D., Taylor (1970), "Consumer Demand in the United States", Harvard University Press, Cambridge, M.A