

A REGIONAL DEMAND FORECASTING STUDY FOR TRANSPORTATION FUELS IN TURKEY

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Overview

Various time series and econometric models have been developed for the short-term forecasting of regional gasoline, diesel and, liquefied petroleum gas (LPG) demand in road transportation in Turkey. After many trial and error procedures, 36 econometric models have been developed revealing the effect of different socio-economic and technological factors on annual fuel demand in each region. The validity of each model is tested by means of statistical and diagnostic tests. Results provide interesting insight into the underlying drivers of fuel demand in different regions. In addition to the annual econometric models based on linear regression, various quarterly time series models were developed including several autoregressive integrated moving average (ARIMA) models with different exponential smoothing methods. The validity of the models has been checked and results have been compared based on mean absolute deviation as well as percentage and squared error values yielding the most accurate set of forecasting models. It is found that econometric models generally outperformed the time series ones and provided effective alternatives for forecasting annual fuel demand. Model projections indicate in all regions a shift away from gasoline-fueled vehicles towards diesel-fueled ones.

Methods

Various studies forecasting fuel demand make use of econometric and time series approaches (e.g. [1], [2]). In this study, multiple linear regression, moving average, double moving average, ARIMA, simple exponential smoothing, double exponential smoothing and Holt Winters' methods have been used in developing the different econometric and time series models. The employed validity and diagnostic tests included estimation of the coefficient of determination, collinearity test of independent variables, statistical test of the F-statistics, statistical test of the standard error, model function form test, first degree self-correlation test to residuals, residuals correlation tests, heteroscedasticity and normality tests, model stability test and forecasting ability of the models through Theil's U statistic.

In addition to the forecasting of fuel demand, several independent variables of the regression models were projected including population, gross value added of the transport sector, fuel prices, vehicle stock and utilization rates etc. All projections have been done with different methods so as to make use of the most reliable forecasts. Moving average, for example, turned out to be the best method for estimating the prices of gasoline and diesel whereas multiple regression analysis was used for LPG prices.

Results

Gasoline, diesel, and LPG demand of all region in Turkey has been forecasted for the year 2013. In each region, multiple regression analysis gives the best result for explaining the fuel demand.

Gasoline demand decreased linearly between the years 2006 and 2012 in Turkey whereas diesel consumption reached to record levels in the same period. There is not a dramatic change in the consumption of LPG. In Figure 1., the shares of types of fuel consumptions are displayed for the years 2006 and 2013. In this study, all regions have been analyzed. The result of Istanbul is given as an example of the largest fuel consuming region.

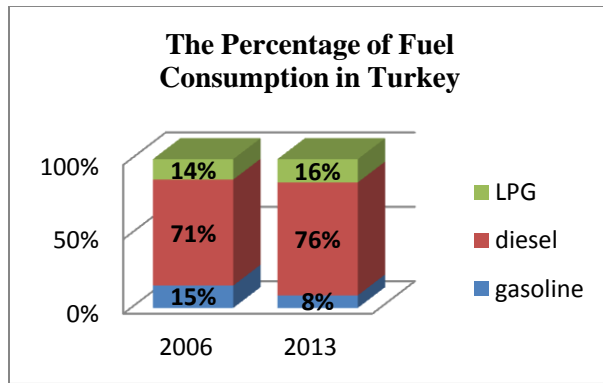


Figure 1. The percentage of fuel consumption in Turkey

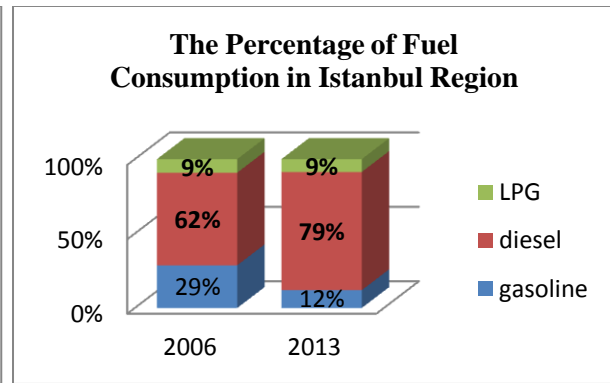


Figure 2. The percentage of fuel consumption in Istanbul region

Figure 2. presents the shares of types of fuel consumptions in Istanbul region for the for the years 2006 and 2013. The gasoline consumption in 2006 is 17% larger than the gasoline consumption in 2013. The difference in diesel consumption between the years 2006 and 2012 is significant, about 17%. As a result, Turkey's dependence on diesel could reach to precarious levels in the next decade.

Conclusions

Turkey has the highest gasoline price among all the OECD member states due to the high taxes. As gasoline prices increase dramatically, consumers are shifting to diesel and LPG in Turkey [3]. Since the late 1990s, the European diesel car market boomed whereas diesel vehicles were phased out of the Japanese market and remained at a negligibly small level in the United States while gaining popularity recently. Registrations for diesel cars and sport utility vehicles rose 24 percent in the United States from 2010 through 2012 [4]. The main reason for the attractiveness of diesel cars is fuel efficiency as diesel engines are 20 percent to 40 percent more fuel efficient than equivalent gasoline engines. However, diesel fuel contains about 15% more carbon per litre reducing the CO₂ emission advantage by favourable fuel efficiency. It is expected that increasingly stringent emissions regulations and the high cost of new anti-pollution technology will make diesel engines much more expensive [5]. Criticism on diesel vehicles has recently increased and expectations reversed such that diesel automobiles will see a downward trend (e.g. [6], [7], [8]). Results of this study indicate that this will not be the case in Turkey in the short term unless there is a new environmental tax policy or standard to discourage the use of diesel fuel. According to the International Energy Agency, tax as a percentage of total price for gasoline and diesel was %60 and %49, respectively. The sustainability of diesel's tax advantage in some European countries including Turkey, however, is questionable.

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