



Analysis of influence of fuel price on individual activity-travel time expenditure

Dujuan Yang*, Harry Timmermans

Eindhoven University of Technology, Urban Planning Group, PO Box 513, Den Dolech 2, 5600 MB Eindhoven, The Netherlands



ARTICLE INFO

Available online 30 August 2013

Keywords:

Fuel prices

Travel time

Seemingly unrelated regression analysis

ABSTRACT

Fluctuation in fuel prices may lead to adaptations in people's activity-travel behavior. Compared to other triggers of behavioral change, the impact of fuel prices has received only scant attention in the literature, especially with respect to short-run change in activity-travel behavior. To gain insight into this issue, travel diaries of a representative sample of individuals in the Netherlands who use the car for daily travel were analyzed. Seemingly unrelated regression analysis was used to examine the effects of fuel price on people's travel time expenditures for different kinds of activities, differentiating between weekdays and weekends. The results indicate that fuel price is negatively correlated with travel time expenditures by car, and that this relationship differs between weekdays and weekends. When faced with increasing fuel prices, people seem to prefer reducing travel time expenditure by car for compulsory trips more than for leisure trips.

© 2013 Elsevier Ltd. All rights reserved.

1. Introduction

The empirical literature on the responsiveness of consumers to changes in fuel prices has a long history (Oum et al., 1992; Goodwin, 1992; Espey, 1998; Graham and Glaister, 2002, 2004; Hanly et al., 2002; Dargay, 2007). These authors have mainly examined the impact of petrol price fluctuations on fuel consumption, vehicle miles travelled and vehicle stock, both at the macro- and micro-level. The results of these studies indicate that if the real price of fuel increases by 10%, traffic volume will be reduced by approximately 1% within one year, while the amount of fuel consumed will go down by about 2.5%, building up to a reduction of more than 6% in the longer run. Similar effects have been reported for increased fuel efficiency and lower vehicle ownership. As income is an essential factor in this context, these studies have also examined income effects. If real income goes up by 10%, the number of vehicles and the total amount of fuel consumed will both increase by nearly 4% within one year, and by over 10% in the longer run.

Brons et al. (2008) conducted a meta-analysis to assess the impact of price fluctuations on gasoline demand, considering three components: fuel efficiency, mileage per car and car ownership. Based on a system of fixed effects equations, they found that consumers are not very sensitive to price changes. Further results

showed that the response to a change in fuel price is mainly caused by fuel efficiency and car ownership in the short-run. However, in the long-run, the increase in price sensitivity is mainly explained by an increase in price sensitivity with respect to mileage per car. More recently, Romero-Jordán et al. (2010) and Li et al. (2011) examined consumer response to increasing gasoline prices, focusing on the consumption of gasoline, vehicle miles travelled and choice of vehicle. Unlike previous research, they studied the impact of fuel taxes separately from tax-exclusive gasoline prices. They found that gasoline taxes play an important role in fuel consumption. Rising gasoline taxes are associated with larger shifts towards high fuel economy vehicles and greater reductions in gasoline consumption than comparable increases in tax exclusive retail price. However, they did not find a similar pattern for vehicle miles travelled.

Most of these studies are based on aggregate data at the country or sub-national level. Other studies used disaggregate individual or household level data. Examples include Greene and Hu (1986), Blum et al. (1988), Hensher et al. (1990), Dahl and Sterner, 1991 and Greening et al. (1995). Hensher et al. (1990) developed a model to explain vehicle kilometres per annum for households in the Sydney Metropolitan area in terms of a range of vehicle characteristics and household consumption and income attributes. Based on a sample of 1172 households, collected between 1981 and 1982, they found evidence of a substantial price effect on vehicle use. The estimated short-run price elasticities of vehicle use were -0.26 for 1 vehicle households, -0.33 for 2 vehicle households and -0.39 for 3 vehicle households. In a more recent study, Rouwendal (1996) investigated short-term

* Corresponding author. Tel.: +31 402475963; fax: +31 402438488.

E-mail addresses: d.yang@tue.nl (D. Yang), h.j.p.timmermans@tue.nl (H. Timmermans).

response to fuel price increase, using the Dutch Private Car Panel in terms of fuel consumption and information about cars and their drivers. His results showed that a 10% increase in fuel price will induce drivers to drive more efficiently as reflected in an increase of the average distance travelled per liter by 1.5%.

Although these previous studies have found evidence of fuel price fluctuation effects, some questions have remained unanswered. First, almost all studies mentioned above only investigated the effects of fuel price fluctuations on travel distance, car ownership and fuel consumption (e.g. Koushki, 1991; Brons et al., 2008; Hensher and Zheng, 2010). Although over the two decades of travel demand analysis, time has been a variable of central importance, there is less research on travel time expenditure as a demand variable to reflect effects of behavioural change due to increasing fuel prices. However, when faced with increasing energy prices for fuel, besides choosing an energy-saving transport mode to reduce fuel consumption, individuals who usually use the car as transport mode also need to decide whether they should adapt the duration of one or more activities. In turn, changes in activity duration may affect travel times as we know that willingness to travel longer distances is influenced by activity duration (e.g., Hamed and Mannering, 1993; Kitamura et al., 1990, 1998). Individuals may even decide to become less involved in out-of-home activities and spend more time at home to reduce fuel consumption. However, the latter strategy may increase their in-home energy consumption, but we leave this aspect for future research. The study of travel time expenditure is also especially relevant because several authors have found evidence of a stable time budget (e.g., Bieber et al., 1994; Vilhelmson, 1999; Schafer and Victor, 2000). Empirical evidence to that effect however has been concerned with the aggregate level. At the same time there is evidence of a high degree of inter-personal variation in travel time budgets. Moreover, little is known about the effects of changing fuel price on time expenditure in activity-travel patterns. If individuals need to adapt to changing prices, they should consider dependencies between travel time and activity duration which play an important role in people's activity-travel scheduling decisions. Moreover, individuals have some sense of priority when deciding on activity participation and other choice facets underlying activity-travel schedules. Finally, activity participation and scheduling decisions are influenced by space-time and temporal constraints. Thus, one may expect that the effect of increased fuel prices is more complex than previous studies may have unravelled in the sense that the effect may vary between activity-travel patterns involving different purposes and varying time and space-time constraints. The first issue requiring further study concerns the question how fluctuations in fuel prices co-vary with the different activity-travel patterns and underlying purposes.

Second, few prior studies have examined time expenditure differences between weekdays and weekends when comparing fuel consumption in the context of a person's activity-travel patterns. Competition for the car and allocation of household responsibilities matter more on weekdays. Often, the day-of-week variable is treated as an exogenous variable and does not play any role in determining the causal structure of the activity duration or time use model. However, this could be problematic as the effects may differ between weekdays and weekends, reflecting the fact that time use substantially varies by day of the week (e.g. Yun and O'Kelly, 1997; Sugie et al., 2003; Wiehe et al., 2008; Frondel and Vance, 2010). Therefore, it is reasonable to hypothesize that there is significant day-of-the-week effect in the impact of fuel price on people's activity-travel patterns.

In order to overcome these limitations of previous studies, this study seeks to answer the following questions. First, does fluctuation in fuel prices have an impact on people's activity-travel time expenditure? If so, does the impact differ between weekdays and

weekends? To answer these questions, a multi-group structure simultaneous equations model was formulated. Seemingly unrelated regression analysis was used to allow for the possibility that the error terms of the various equations may be correlated. The data for the analysis was derived from a national activity-travel diary dataset, collected in the Netherlands.

The paper is organized as follows. First, a description of study area and dataset will be provided in Section 2. This is followed by an explanation of the design of the study and the conceptual framework. Next, we will discuss the results. Finally, the study will be summarized, and limitations of the present study and avenues of future research will be discussed.

2. Data

2.1. Data sources

The dataset used in this study was assembled from two sources. The main part of the dataset stems from the Dutch National Travel Survey (MON). The survey covers 2004 to 2009, with almost equal sample sizes for every year. An observation in this dataset is a trip conducted by a household member. Overall, this is a comprehensive cross sectional data source for analyzing activity-travel behaviour of Dutch residents. It consists household samples, covering all provinces in the Netherlands. Besides household, individual, and transportation ownership information, the survey includes a single-day activity-travel diary. The diary contains details about all trips made on the designated day and about the activities conducted at trip destinations, such as start time, start point, transport mode, type of fuel used, travel purpose, activity type, activity duration, etc.

The primary research question driving this study is how people respond to fuel price fluctuation. Since information on fuel prices relevant to individual households is not available from the national travel survey, it is necessary to use national average price data. Fuel prices for diesel and petrol were derived from the energy publication website of AA (<http://www.aaireland.ie>). The AA Public Affairs Fuel Price Report uses data sources from Experian Catalist (www.catalist.com). The fuel prices are an average of mid-month prices from 28 different countries. The data for fuel prices per liter for the Netherlands could be dated back to 2000. Fig. 1 presents fluctuations in fuel price between 2002 and 2009. Overall, diesel price increased from 0.7 euro per liter to 1.5 euro per liter, and peaked in July of 2008. From March 2002 to July 2008, petrol prices in the Netherlands increased at an average rate of about 10% per year, and dropped to 1.2 euro per liter at the end of 2008. Next, another round of price increases can be observed. Petrol prices climbed to 1.5 euro/liter and then became stable.

Next, the fuel price data were merged with the MON data. Because different types of fuel used for travel are recorded in the MON data, the prices for different types of fuel were linked to the travel data. The sample chosen for this study is the individual who used the car for travelling. Data were constructed as follows. First, the eight trip purposes distinguished in MON (work, business visits, services/personal care, shopping, study, social or recreational trip, tours or hiking, and other trips) were classified into three broad categories: compulsory (study and work-related trips), maintenance (services/personal care, shopping, delivery goods), and leisure (social or recreational trip, tours or hiking). Next, transport modes were classified into three categories: car (car driver or car passenger), public transport (bus, train, tram/metro), and slow transport mode (bike or on foot). Then, each individual's daily diary was processed to identify the duration of three kinds of trips (compulsory, maintenance and leisure) by three transport modes (car, public transport and slow transport mode) and

Download English Version:

<https://daneshyari.com/en/article/7498073>

Download Persian Version:

<https://daneshyari.com/article/7498073>

[Daneshyari.com](https://daneshyari.com)