

A Behavioral Analysis of Private Car Use by Households

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Abstract

The relevance of econometric studies of ownership and use of private cars for environmental issues is sketched and some recent results are reviewed.

1 INTRODUCTION

The private car has been in the centre of concern about environmental issues ever since it became a mass consumption good. Exhaustion of oil resources, air pollution, acid rain and the greenhouse effect are all related to ownership and use of private cars by a large number of households. The private car is an ambiguous symbol of western society in the late twentieth century. On the one hand it reflects its success in providing a high level of material well-being to the large majority of the population. On the other hand it brings out the failure of the same society to solve the environmental problems evoked by its successes.

The widespread anxiousness about the future sustainability of western societies has given rise to much concern about the continued growth of automobile ownership and use. However, the popularity of the private car has increased over the years and should be expected to do so in the future. This apparent paradox has been interpreted by social scientists as a social dilemma: everybody knows how to improve society, but apparently nobody is willing to take the necessary actions himself.

2 AN ECONOMIC APPROACH

Social scientists seem to agree on the proposition that human behavior with respect to automobile ownership and use can be fruitfully considered as being driven by the desire to reach some purposes, for instance being able to reach the work location fast and comfortably. The driver is then assumed to act deliberately on the basis of a consideration of the benefits and costs associated with the various alternatives available to him. This plausible vision may be termed 'rational,' although that term should be interpreted in a limited sense. It does not suppose, for instance, that the actor takes into account the effects of his behavior on other people in the same way as the effects that concern himself. Nor is it required that future consequences should be given the same weight as immediate consequences. It is precisely because of these characteristics of human decision making that widespread concern about environmental problems coexists with increasing popularity of the private car.

Welfare economics has developed a recipe for this problem. The basic trick is to introduce a tax to be paid by the actor that has the same effect on his decision making

as a proper calculation of all present and future effects of his behavior on society as a whole would have. The environmental costs that are neglected by the decision maker because they do not concern him, or do not concern him immediately, are in this way brought to his attention and the balance between individual and societal rationality is restored.

With respect to the contribution of the private car to the greenhouse effect, this prescription would require an estimate of the costs of adding one additional unit of carbondioxide to the environment and charging them to each driver. Since the emission of greenhouse gases is closely related to the amount of fuel used, a fuel tax would be the appropriate policy instrument. Since such a tax has been introduced in all western countries, the required increase of this tax should not be expected to give rise to implementation problems. Moreover, the widespread concern for environmental problems may be expected to offer the necessary political support for such a measure.

The real problem for following this strategy is the determination of the marginal environmental costs of the emission of greenhouse gases. The present state of knowledge only allows one to think about the effects of such gasses in general and imprecise terms. Nevertheless, it may be said that enough is known to justify a policy directed at a reduction of the further emission of such gasses. In order to see what policy efforts are required in order to reach the desired effect, it is necessary, among other things, to investigate the determinants of automobile ownership and use by households.

3 A DECISION CHAIN

It is useful to distinguish a number of steps in decision making with respect to the private car:

- The most elementary decision concerns ownership. Should one buy one (or more) private car, or make use of public transport?
- If a car is purchased, what type should it be? A large number of brands and makes are available. Fuel type, cylinder volume and weight are important characteristics for the environmental aspects of automobile use.
- Which use will be made of the car? How many kilometers should be driven for home-work interactions, for business purposes, for social purposes and on holidays?
- The driving style influences fuel use significantly. Car users who like to accelerate fast and drive at high speeds cause more environmental damage than others.
- The decisions taken at all steps determine the emission of greenhouse gases by automobiles.

The various steps in this decision chain show a certain hierarchy in the sense that the ones made earlier are more basic. For instance, the type of car is only relevant if a car will be bought. It should be kept in mind, however, that the various steps should be considered as interrelated. For instance, decisions with respect to car ownership are made on the basis of, among other things, preferences with respect to car use for different purposes.

One important consequence of the many facets of decision making with respect to automobile ownership and use is that the introduction of, for instance, a higher fuel price may be expected to have a number of different effects that may operate at different time scales and possibly in different directions. For instance, an increase in the fuel tax may have the immediate effect of a decrease in the number of kilometers driven for social purposes. When a new car is bought, fuel efficient makes will be bought more often. This results in lower costs per kilometer, which mitigates the immediate effect of

the higher. Moreover, the higher costs of mobility may induce people to consider the possibility of living in the neighbourhood of his work relation more intensely than he would have done otherwise. This may result in a shorter commute, which strengthens the original effect of the tax measure.

4 A REVIEW OF RESEARCH RESULTS

Research on the various aspects of automobile ownership and use dates back to the early history of econometrics. The early studies concentrated on time series of numbers of automobiles owned or produced. Gradually research shifted towards the micro economic aspects of car ownership and use. In the eighties econometric models that enabled a researcher to study the ownership and use of one or more cars by individual households became available (see Mannering and Winston [1985]. For the Netherlands this type of model was introduced by De Jong [1990] who found substantially larger effects of changes in fuel prices on both the number of kilometers driven and the decision to own a car than were suggested by earlier studies: a change in variable costs of 1% would in the short run give rise to .65 % less kilometers driven, while in the long run the effect would increase to 1.11%. Since fuel costs are the major component of variable costs, this suggests that drivers are sensitive to changes in these prices. De Jong used cross section data and did not take into account differences between car types. His results were therefore not based on observed reactions to changes or differences in fuel costs per kilometer driven. In the period from 1980 to 1993 fuel prices changed significantly only in 1986 and 1991. Use of time series would therefore offer only limited opportunities for measuring the effects of fuel prices in a more direct way.

De Jong's work provided a good starting point for the work that is currently being done at the Department of Household and Consumer Studies of Wageningen University. The aim of this research is to provide a more detailed picture of household behavior in the various parts of the decision tree. Although this work is still in progress, we can mention some preliminary results here.

One part of the project is a more careful investigation of drivers reaction to the decrease in fuel prices occurring at the beginning of 1986. Monthly data concerning the year 1986 were analyzed by Van Staalduinen and Rouwendal [1994] who found gasoline price elasticities for the number of kilometers driven that are of the same order of magnitude as those found by De Jong. The short run sensitivity of the demand for automobile kilometers for changes in fuel prices is mainly due to the social motive, as commuting and business travel are usually harder to change.

The demand for commuting kilometers is determined to a considerable extent by the choice of the residential and work locations. In Rouwendal and Rietveld [1994] a search model that explains these choices is developed and estimated. Empirical application of this model enables one to estimate the required compensation for an additional kilometer of commuting for various types of workers. Part of the required compensation consists of fuel prices. Preliminary estimates of the model confirm the existence of such a trade off, suggesting that the long run effects of higher fuel prices on commuting distance should not be ignored.

Another study concerned the determinant of the driving style. Rouwendal [1994] regressed the fuel use per kilometer, as indicated by the main drivers, on characteristics of the car, characteristics of the driver and on monthly data about fuel prices and average temperature. Driver characteristics were included because of their presumed effect on driving style. A significant coefficient for the gasoline price indicates that

drivers respond to changes in fuel prices by driving in a more or less fuel efficient way. Continuation of this line of research may be expected to contribute to a more detailed and coherent picture of the determinants of car ownership and the behavioral reactions to changes in fuel prices.

5 OUTLOOK

In the recent past increases in the fuel tax have not been able to slow down the increasing popularity of the private car substantially. There are several reasons that explain this state of affairs. It may be reasonably expected that variable cost per kilometer is the crucial variable influencing driver's behavior. These costs are influenced by the price of crude oil and by the fuel efficiency of the motor, as well as by the fuel tax. Over the past 15 years there has been no significant overall increase in the variable costs, despite several increases in the fuel tax. Moreover, income growth and increased participation of women in the labor force have contributed significantly to the rising number of cars. It must be expected that these forces will still be effective in the near future. It is therefore important to consider the effect of fuel taxes within a broad framework that incorporates the major economic and social trends. In this way the study of the determinants of car ownership and use may be expected to contribute to a better insight into the possibilities and limitations of reducing the emission of greenhouse gases.

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