8. Summary and recommendations on new car ownership model

Background and objectives

RAND Europe has carried out a research project on car ownership modelling, called ‘Audit of car ownership models’, for the Transport Research Centre (AVV) of the Dutch Ministry of Transport, Public Works and Water Management.

In this report, a review was presented of existing models for car ownership. This review contains a description and comparison of existing Dutch car ownership models and a review and comparison of recently developed models in the international literature and models used in practice. The provision of this review was one of the objectives of this project. The other objective was to recommend on directions for potential development for improving the AVV car ownership models.

The car ownership model that AVV uses for most applications is the so-called FACTS model (Forecasting Air pollution through Car Traffic Simulation). FACTS also provides the future total number of cars that is used as an external total in the Dutch national Model System (LMS) for traffic and transport.

The background of this audit is the desire of AVV to obtain information on the basis of which a well-founded decision can be made on the development of an improved car ownership model, that can produce robust and sensible car ownership forecasts for all kinds of variants of variabilisation of the road tax (MRB) and car purchase tax (BPM).

As part of this project, a number of policy advisers was interviewed about what types of outputs are required from a car ownership model, what should be the forecasting horizon and what should be the policy variables to be simulated.

AVV’s current car ownership model

FACTS is a model that can provide car ownership (number of cars and 18 car types) and car use, with short run times. In a backcasting exercise, the total number of cars was backcasted adequately, but the composition of the fleet, especially in terms of fuel types, was predicted rather badly. The forecasts for future years for the total number of cars were also in line with those from other models. The ‘psychological car cost’ which was included in FACTS after this exercise, might have solved the car fleet composition problem to some degree, but causes other problems in predicting the composition of the car fleet by household type. The number of car types that can be distinguished in a model and selected on the basis of variable and fixed cost only is limited. It might well be that FACTS has already passed the threshold for the number
of car types that can credibly be handled in this way. This means that the car type choice component in FACTS can not be extended to include more distinctions, whereas the policy advisers require many more distinctions within the car fleet. Furthermore FACTS uses assumptions that might turn out to be over-restrictive for simulating more radical policy measures. A number of variables are not at all or scarcely policy-sensitive: car use for a given car, business car ownership, scrappage. Making these variables policy-sensitive would make the model more interesting for policy makers and increase its range of possible applications. In summary: FACTS seems to work well enough for the total number of cars owned (whether this is sufficient for future runs with large cost changes remains questionable), but improvement is needed for the composition of the fleet, business car ownership and car use.

Recommendations: the preferred model

We recommend to develop a new model system. The preferred model system consists of:

- Duration models for the time between vehicle transactions (and the type of transaction: disposal, replacement, acquisition, also scrappage) to explain the total number of cars. An alternative option for this would be a Markov-type panel model.

- Vehicle type choice models for the choice of a brand-model-vintage alternative for all vehicle transactions that involve purchasing another car. These choice alternatives can be aggregated to get the composition of the fleet in terms of most of the required distinctions. Some less important distinctions need to be made by a post-processing procedure.

- Regression equations for the use of every car in the household, measured in terms of annual kilometrage, or through a logsum linkage with the LMS.

- A micro-simulator for ‘birth’ and ‘death’ of households and transitions between households types over time; a simpler but less consistent (in terms of dynamics) alternative would be to reweigh a given sample of households in each time period.

- Possibly a model for the number of business cars (company-owned and lease cars), depending on (sectoral) economic development, which need to be allocated to households. Private car ownership could be made conditional on the outcome of this.

- An allocation procedure to the 1308 LMS zones (also post processing).

Such models have been developed before, particularly as components of the Dutch Dynamic Vehicle Transactions Model (DVTM) and/or the model for the likely penetration of electric and hybrid cars for California.

This preferred new model could be used for a large number of applications:
• It can explain the number of cars in the Netherlands and the distinction between households with 0, 1 or 2 and more cars, as well as the sensitivity of car ownership to fixed and variable car cost over time.

• The alternatives in the vehicle type choice model can be aggregated in many different ways to give the composition of the fleet in terms of: fuel type, weight, vintage, new or second hand, industry type code, year that the type was officially approved, energy consumption label and safety label. Other distinctions could be obtained by post-processing the outcomes. If data allows, vans can be added here too.

• The model can be used to predict the likely penetration over time of new vehicle technologies, such as electric and hybrid cars and cars using other fuels (e.g. hydrogen).

• The model can also provide forecasts of the fleet distinguishing between privately owned cars and business cars.

• The model can give forecasts for the short run (such as government revenues and income effect on different population groups, one year ahead, two years ahead, etc.) and long run (such as emissions more than 10 years ahead).

• The model can predict car use as well, including effects of fixed and variable car cost on car use.

• The model can be linked with available emissions modules and with the national traffic and transport model system LMS.

• The impacts of variabilisation, subsidies and fuel tax policies could be tested with the preferred model, as well as accelerated scrappage subsidies and fiscal policies affecting the lease car.

Recommendations: fall-back option 1

Developing the above model would require a major effort, especially since new data on car ownership and car types owned by households would need to be collected. This data collection will include at least two waves (panel data) and both revealed and stated preference data. A fall-back option would be a further extension and major adaptation of FACTS.

It may be possible to add a policy-sensitive car use equation (also with a random component) to FACTS, to replace the random procedure. This would make car use more sensitive to policy changes. The possibility of linking to the LMS, with the advantages and disadvantages discussed above, remains.

Also, it might be considered to replace the FACTS car type choice component by a disaggregate type choice model, and let the existing FACTS structure explain the number of cars owned. FACTS has been quite successful for this and less so for type choice (but please note that the possibilities of FACTS for future runs for large cost
changes will be rather limited). This type choice model then could give more detailed outcomes than the present 18 car types and cost and other influences on type choice would be separated. This is in our view the most urgent improvement needed for FACTS. Most of the resources required for developing the preferred model (especially collection of new data, both RP and SP; estimation of the type choice model) are also needed for the type choice model in fall-back option 1. In other words, the most expensive part of the preferred option is also included in this fall-back option. This makes fall-back option 1 easier and somewhat faster to develop and less sophisticated than the preferred model, but not much cheaper than the preferred option.

The main difference between the preferred model and fall-back option 1 is that the former contains a disaggregate dynamic component for the number of cars (the duration or Markov models) and the latter does not: the number of cars follows from the FACTS mechanisms. Both models will have a new vehicle type choice model. The preferred model will be more suitable than FACTS for giving the short run (1–5 years) impact over time and will also be able to produce more policy sensitive forecasts of the number of cars than FACTS.

Recommendations: fall-back option 2

Both the preferred option and option 2 require the acquisition of new data on choice of vehicle brand-model-vintage combinations, which would lead to considerable survey cost. The basic idea of fall-back option 2 is to start from presently available data, notably the OVG, and construct new models that can be based on these data sources and nevertheless will lead to an improvement of FACTS in the main problem areas. The current OVG questionnaire contains the following questions on the car, which the main user of the car should answer:

- Fuel type (LPG, diesel, petrol)
- Approximate annual kilometrage
- Vintage (year of interview, 1 year before, 2 years before, …11 year before, older)
- Weight in kg
- Private or company ownership
- Lease-car or not.

We would prefer a vehicle type choice model with brand-model-vintage as choice alternatives, for reasons described above. However, the OVG does contain all the distinctions that are of the highest priority (see chapter 6) for a new car ownership model. It will be difficult if not impossible to add the ‘priority 2’ distinctions when using OVG, because these rely on finer segmentations than the OVG can give.

In fall-back option 2, the OVG would be used to estimate a fuel type-weight-vintage-ownership choice model. FACTS would be retained to produce the number of cars in the household. For car use, FACTS would be enhanced or the LMS would be used.