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BOOK REVIEWS

Dimensions of Automobile Demand (Studies in Regional Science and Urban Economics, Vol. XXII)

*By David A. Hensher, Nariida C. Smith, Frank W. Milthorpe
and Peter O. Barnard
(Institute of Transport Studies, The University of Sydney)
Amsterdam and New York: Elsevier/North Holland, 1992*

This book describes work carried out under a decade long project (1981-1991) which led to the development of a set of empirically constructed econometric demand models of household demand for automobiles (by number and type) and the rate at which such vehicles are utilized. Data used in the work was drawn from a four-wave panel of households in Sydney, Australia. The models are used to predict the levels of energy consumed by the household sector's automobile fleet under different fuel and vehicle price, vehicle technology and different socioeconomic scenarios.

The book is divided into ten chapters, plus a number of appendices describing different aspects of the panel survey instrument used to collect the household data used in model developments. The introductory chapter does a good job of describing the book's (and project) objectives, followed by a review of the extant literature on auto ownership and use. Chapter 2 describes the authors' theoretical approach to the problem, highlighting the role of economic theory, and providing an economic rationale to support a dynamic analysis of household automobile choice and utilization. Chapter 3 then defines the mathematical (econometric) system of equations underlying the authors' approach to discrete vehicle choice and continuous vehicle use modeling. A nested logit model is presented which breaks down the choice of which vehicles a household "holds" into a selection of different auto body types, different automobile models/vintages, and different fleet sizes (i.e. number of autos owned by the household). Here the work demonstrates many recent methodological developments in logit-based modeling, including the use of full information maximum likelihood estimation, judicious definition of vehicle type and body type alternatives, practical means for generating

representative choice sets from a large number of vehicle types, body types and fleet size combinations, and the appropriate use of inclusive value terms to pass information from one dimension of the choice process to the next. For calibration purposes a vehicle type model is nested within a simultaneously estimated vehicle body and household fleet size model. Where multiple vehicles are owned by the household appropriate mixes of these vehicle and body types need to be handled by this modeling process.

Next the static vehicle use model is described. The technique used here is three-stage least squares. Both a household's socioeconomic attributes and its vehicle fleet attributes are allowed to enter as explanatory variables. This model provides a separate equation for each vehicle in the household, but allowing such use to depend on the use made of any other vehicles also present. Sections 3.3 and 3.4 then take the reader through dynamic extensions to these two models. Within the vehicle choice model lagged variables are used to represent either "experience effects" or "expectation effects" which are in turn linked conceptually to the notion of rational habit formation. To accommodate dynamics explicitly within the vehicle use model, lagged endogenous vehicle utilization variables are combined with both time-varying and time-invariant exogenous influences.

Chapter 4, titled Pre-Analysis of Panel Data, provides a conceptual and subsequent technical discussion of why longitudinal (i.e. multi-wave panel) data are important to an analysis of changing behavior. This is followed by a discussion of attrition in such panel data sets. Chapter 5 then describes the four wave (1981-1985) Sydney Household Panel data. Final sample sizes for each wave ranged from 1444 to 1197, with a period of 70 months

separating the first and last data collection exercises. Considerable detail on household and vehicle characteristics were collected over the period, providing a rich data set from which to work. An extensive "pre-analysis" of the stability and change in selected explanatory variables is reported, including a look at the empirical relationships between vehicle age and fuel efficiency, and vehicle age and vehicle use. This is followed by a quantitative assessment of attrition bias in this longitudinal data set.

Chapters 6 through 8 present the empirical results from the static vehicle choice models, the static vehicle use models, and the dynamic vehicle choice and use models, respectively. This includes derivation of the associated choice elasticities. Chapter 8 on dynamic models contains the major empirical results from the study. Among the many results discussed is the important role played by both expectations and experiences in the overall explanation of choices made. Separate equations for each within-household vehicle use, as used in the static models, are replaced in the dynamic vehicle use models by single equations which take as their dependent variable the total household kilometers of use.

In Chapter 9 the authors describe the use of this empirically developed, dynamic modeling system in forecasting mode. They provide a thorough description of the many additional steps and considerations required to generate a rigorous and useful sets of predictions using this or similar modeling systems. This includes the technical issues associated with generating a synthetic sample of household responses from cross-tabulated data, from which to generate model-based predictions. It also includes re-calibrating the constants in the choice models to match the base year assumptions in this sample data (if applied some time after the original calibrations), as well as projecting the relevant exogenous variables. Both top down and bottom up projection methods are described. A brief discussion of suitable model validation methods is also provided. Following these discussions, the authors describe the specific assumptions imposed on what they dub the automobile market equilibrium forecasting model.

In Chapter 10 this forecasting model is used to generate alternative 1995, 2000 and 2005 automobile energy demands. Here they use 1985-88 data on Australia-wide socioeconomic

and vehicle fleet characteristics to develop a base year profile. As with the other chapters in the book, the authors take the time to explain carefully the issues, the data and the methods they are dealing with. In this instance they supplement this discussion with extensive use of tables and figures covering the key variables of interest: including market shares by vehicle class, vehicle mix and associated new and used fuel consumption rates, vehicle weights and vehicle purchase prices. The modeling system is then applied to scenarios which combine potential vehicle technology modifications with possible government imposed financial instruments. The first technology option represents those plans which the vehicle manufacturers appear to have made for fuel efficiency improvements through year 2005. The second technology-based scenario is developed to reflect further improvements in vehicle fuel economy, to an extent considered technologically feasible. These technologies are then modeled in combination with selected sales tax elimination and fuel tax policies. Illustrative findings are discussed, including changes in consumer surplus, in government revenues and in fuel consumption. For example, the authors use the modeling system to compute the fuel tax increase necessary to offset a sales tax elimination on new vehicles, where such a tax break is being used to encourage the early disposal of older, less fuel efficient vehicles in favor of more fuel efficient new ones.

The text is consistently well written, and the publishers (North Holland) have also done a good job with the production of the book. The project described, and therefore the book, provides the reader with a well argued, technically detailed and in some important respects path-breaking microeconomic approach to automobile demand and associated fuel use forecasting.

To make use of the text the reader should have at least a basic understanding of the econometric methods being applied. The emphasis, and indeed the strength of the text, rests in its rigorous and detailed technical development of a tractable analytic method. For this reader the key elements of the work to stand out are its attention to technical details at each step in the model development and subsequent model application process, and its demonstration that such models are now candidates for use in support of real world

policy analysis. The book is highly recommended for anyone interested in forecasting automobile choice and/or automobile use, or in forecasting energy consumption based on such use. It seems certain to be regarded as an important addition to this literature.

While developed on Australian data the empirical results should also have considerable general interest to researchers in both Europe and North America, where similar aspirations with regard to mobility, and similarly detailed

data sets could be created. Finally, the work demonstrates both the need for and technical challenges associated with use of longitudinal travel survey data. Here the book's availability is most timely. The use of panel data is now one of the hottest topics in travel behavior analysis. This text is likely to add further to such interest.

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