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IS MODAL CHOICE MODELLING BECOMING OBSOLETE?

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ABSTRACT:

Increasing emphasis on promoting public transport and restricting the car during the 1960s led to changes in urban transport modelling. Models depicting choice of mode as a consequence of continuous adjustments to differences in modal generalised costs were introduced. Doubts that this concept of choice is valid are growing. Recent studies indicate very little choice of public transport, providing a car is available for use, while theoretical work has stressed the importance of habitual selection. The size of the error term in estimating small amounts of effective choice suggests that little accuracy is gained by using conventional choice modelling. Moreover, the modal choice issue is becoming less important as transport policy evolves and problems are seen in a fresh light.

INTRODUCTION

With the levels of car-ownership anticipated by the North American planning studies of the 1950s it was assumed in these studies that public transport use would become an incidental feature of city life. By concentrating exclusively upon options and alternatives that represented variations on the automobile and highway theme, there was, of course, no necessity for theories on how persons would react to new public transport services and facilities. The rapidly increasing demand for road space was apparent, highway construction funds were readily available and public transport was seen to be, and indeed was, a declining industry.

In this context, the earliest travel modes used by metropolitan transport planners attempted to predict the usage of public transport and all modes in terms of the different charateristics of various areas. These characteristics summarised the social and economic circumstances in such terms as income, car-ownership, population density and the like: the same characteristics which, in fact, were used to predict the number of journeys made in the city.

Since these rather unsophisticated models did not display features of the modes themselves they were unable to predict the response to changes in these mode features. More to the point, since the social and economic measures incorporated were generally increasing (car-ownership, income, etc.), and were inversely related to public transport usage, the models suggested that public transport would be used by ever-decreasing numbers regardless of any attempts to improve the service provided: a situation out of phase with the views and attitudes germinating in the 60s decade amongst those who determined transport policy.

The first step towards rectifying this approach did little to change the situation in any fundamental sense. Some studies carried out minor modifications which represented alterations in detail rather than in approach. These modifications were often the outcome of new attitudes to trip generation rather than the expression of concern that a distinct theory of mode choice was lacking at this time in the transport planners' repertory of method. For example, the shift of emphasis in the analysis of travel generation away from the use of area data meant that public transport travel was now predicted from data on the social and economic characteristics of the household or person undertaking the journey as part of the trip end forecasting procedures.

It was not until the end of the 60s decade that planning studies refined their procedures to an extent where the policy statements then emphasising the role of public transport and calling for restraint on the use of the private car, could be translated into proposals and be subjected to systematic appraisal.

The refinement introduced was an explanation of modal choice; the accent was now on the mechanisms of choice rather than facile accounts of mode use. The new approach consisted of determining, for those people in car-owning households, how they would divide themselves between using their cars and using public transport; people in non-car owning households were regarded as 'captive' users of the bus and the train, for whom no possibility of choice arose. For those travellers more fortunate, less restricted, the basic postulate was that they would choose according to the relative merits of each mode. In practice this often meant the relative travel times by the two competing modes, incorporating time spent walking to or from bus stops and car parks. In this way, the division of travellers by mode of travel was accomplished in two stages: an initial division into those with and without cars (often done as part of the travel generation procedures because of its relevance to the frequency of trip-making) and subsequently, after journeys had been distributed to their respective destination, a further split in the group with a car.

In more rigorous approaches along these general lines, developed for example in the local PERTS 1970 study (Neilson 1971), the performance of competing modes was expressed as a relative disutility or 'generalised cost'. (By knowing the value placed upon travel time, time taken can be expressed as so many cents and added to expenditures on fares, petrol, parking-meter charges, etc., in order to work out which mode is cheaper overall). In addition, when a difference in generalised cost between modes was specified, the probability for an individual to choose one mode in preference to the other was calculated and incorporated into the analysis.

IS THE TRADITIONAL CONCEPT VALID?

This generalised cost approach has now firmly established itself as the orthodox way of analysing modal split and computer packages have been developed accordingly. Indeed, modal choice is now frequently regarded as the cardinal interaction in the transport system. However, a healthy scepticism regarding the validity and the appropriateness of the generalised cost approach is now emerging. Recent doubts have been prompted partially by an apparent stickiness of modal patronage which does not appear to have responded to fare cuts and service improvements in various demonstration or trial projects in quite the way anticipated on the basis of a generalised cost approach to modal split analysis.

Response to the (non-marginal) 20 per cent cut in fares in Sydney analysed by Hensher and Bullock (1977) has been, to say the least, disappointing (cross price elasticity, .09), whilst the response to the Sydney Transit Lane has been

both disappointing and contentious (Hallam 1977, Cox 1977). Analyses of a number of U.K. demonstrations by Heggie (1977) point to very little reaction generally and Howell's (1975) review indicates that any increased patronage that does arise comes from increased trip-making by committed public transport users. Further support for this pessimistic view comes from analysis of the response to the sudden escalation of European petrol prices in 1973/74 - somewhat ironically in view of the renewed interest in modal choice modelling stimulated by the oil crisis.

The other source of doubt stems from further research which, in turn, has led to a number of new ideas. One school of thought has concentrated more closely on defining and specifying the group of travellers that are in a choice situation. The conceptual basis of this approach was spelt out by Hensher (1975), and by Lovelock (1975) whose ideas were reviewed at last year's ATRF by Affleck and Godfrey (1977).

Hensher stressed the notion of habit interrupted by a search and learning process when deterioration in the service from the mode used reaches a threshold. (The threshold itself conditioned by previous experience and expectations.) Lovelock's ideas as elaborated upon by Affleck and Godfrey (1977) emphasised the concept of the 'modal pool'. When people plan a trip they select their mode from a pool of modes thought suitable for that particular trip, a pool which might contain one mode only. The actual process of selection involves comparison of modes in the pool with an 'ideal' mode. Like Hensher's approach the concept recognises the role of habit in the process but, interestingly, familiarity is seen as tendency to reduce the pool to one habitual mode for each type of trip unless something triggers a search process.

The interesting aspects which have so far emerged from those that have pursued this particular line of enquiry is that only a very small proportion of persons appear to actively make an effective choice from a modal pool of more than one mode. For example, Wildermuth and Bettison's (1977) work here in Perth applied filtering techniques with the objective of determining the proportion of existing car users who might be expected on the basis of a set of criteria to include public transport in their pool. (The overall aim of the study was to assess the possibility of increasing public transport patronage via marketing.)

For work journeys the criteria for exclusion included such aspects as varying work place, availability of a company car, journey times by public transport 30 minutes longer than car times, and so on. The end result was that less than 12% of car commuters passed through the sieve and only 6% were thought to be in the short term 'potential market'. Although one may disagree with the details of the filter criteria, the basic message is clear.

Wildermuth and Bettison were, of course, defining the extent to which the modal pool of car commuters might feasibly include public transport in addition to the car. In reality modal pools which actually include public transport as well as the car may be rarer still. At the moment we do not have measures of this, but what we do know is that where a car is available for a journey, on nearly every occasion it appears to perform best when judged against the 'ideal' mode. Affleck and Godfrey's studies in Adelaide point in this direction, as do Lucarotti (1977) and Banister's (1977) studies in the U.K. context.

Banister's study in an urban area of good public transport but comparatively low car restraint (West Yorkshire) is especially interesting for its carefully controlled analysis of individual household data and for its rather startling conclusion. Out of 3,262 trips for all purposes examined, only 69 (2.1%) were made by choice on public transport. Most of these were in the context of the work trip but the percentage choosing public transport for such journeys was still a mere 4.7%.

But, what of large cities with more rigorous traffic restraint policies? Is the modal transfer more significant than suggested by the figures for Perth or for West Yorkshire? We do not have as yet comparable figures but there are reasons for supposing the general picture will not be very different. Statistics which show a greater proportion of trips by public transport the larger the city, by no means constitute conclusive or even firm evidence that large transfers from the car to bus or train are taking place. Car ownership tends to be inversely related to the city size (with better public transport a possible causal factor); more extensive and often better organised public transport encourages more transit trips and longer journeys to work result in less walking and cycling to the benefit of public transport.

Conversely, car trips which are restrained do not on the basis of recent, admittedly sketchy, evidence appear to result in large scale transfers to public modes. Instead these trips are combined, suppressed - the Auckland Transportation Study Review (Pringle 1974) indicated that nearly half were car specific - or informally pooled with the U.K. National Travel Survey 1974 indicating that 40% of all car passenger trips take place in cars of other households.

These effects of city structure on the one hand and modal split adaptive behaviour on the other, are evident even in the Perth context. Women, for example, - less likely to have access to cars - account for approximately 40% of the central area jobs compared with about 30% elsewhere and for two-thirds of public transport commuters to the core. In addition, car sharing is distinctly higher with occupancies of about 1.5 persons per car (Peers 1977). Nevertheless, for the journey to work the option of foregoing

the trip altogether in the face of restraint on the car is generally not feasible, perhaps with the result that, at least for this trip purpose, the transfer from private to public mode is truly significant.

Detailed analysis of the Perth figures suggest some truth in this supposition. 1974 surveys (Uloth 1974) suggested that public transport was used for work journeys to the core of the C.B.D. in 40% of cases by employees in multi-car-owning households and from 10% to 20% of cases for trips to the rest of the C.B.D. But, not all persons in multi-car-owning households automatically have access to a car. Banister's data shows working women especially do not necessarily share in this privilege. The East Central Perth figure (10% of multi-car-owning household residents using public transport in an area poorly served by transit and with a supply of parking spaces matching it not exceeding the local work force) indicates the possible size of this captive component and suggests an effective choice of public transport significantly greater than the Banister indicators only in the very core of the C.B.D.

Before even this modest evidence is judged to support a need for modal choice modelling there are other factors to consider. The theories of Hensher, Lovelock and others raise the possibility that the situation in the core represents a 'fossilised' modal split. That is, workers travelling by good public transport prior to car purchase, maintain their initial satisfactory choice and continue to do so until a deterioration of the service is perceived. If this is the case, the implication is that we should not accept evidence that public transport is chosen in certain circumstances by largish proportions, as constituting additional evidence that improvements to public transport (or even restraint of the car) will induce further significant change in favour of the public mode. Indeed, perhaps it was this particular phenomenon that was evident in the Sydney-siders intransigence in the face of the 1976 rail-fare cuts.

ARE THE MODELS STATISTICALLY ACCURATE?

If it is generally the case that only a very small proportion of those with access to a car will respond to public transport improvements and car restraint by changing to public transport, proponents may reply that, nevertheless, in spite of the small proportions, a more accurate picture is obtained from a post-distributional modal choice model. But, is the claim of increased accuracy spurious with the refinement swamped by the 'noise' of the analytical process?

Unfortunately, modal choice modelling based on generalised cost differences is heavily dependent upon two particularly 'weak' areas of estimation - the representation of walking and vehicle running times. Average walking

times become meaningless with large zone sizes typically used in transportation studies, whilst the relationships between speed, flow and capacity are only superficially understood: in a congested network junction delays are extremely sensitive to small changes of flow.

In this context, Robbins (1978) has provided us with some indication of statistical errors we might expect from the typical modelling process. According to Robbins the accuracy with which individual zone-to-zone improvements can be synthesised is so poor as to defy calculation but, in the case of inter-sector movement by a minor mode, a typical magnitude of 16,000 person trips has an associated error of ± 12% at a 95% confidence limit, rising to ± 26% for flows around 3,000.(1) These errors relate to the modelling of base-year travel patterns; they are the net errors after calibration and allowing for the random distribution of errors (the 'cancelling out' process) and are simply due to inaccuracies within the model in relating inputs to outputs. In addition, there are sampling errors in the original data, there will be errors in forecasting input parameters, and there will be temporal instability in the relationships on which the model is based.

Normally the cross-sectional nature of the typical transportation study model excludes the possibility of taking account of time-related change but, in the few instances it has been considered, modal split has fared badly. It was suggested, for example, that up to a 1 per cent annual decline in the use of public transport in the Belfast area was due to factors such as a general reduction in the length of the working week and the spread of television, reducing travel to outside entertainment (Parker 1969). Potential instability in the model parameters of this order of magnitude would appear to swamp the effects of modal cross-elasticities and suggest that the analytical effort is mis-placed.

Taking account of all these sources of estimating error it is difficult to avoid the conclusion that the introduction of a modal choice component has to date added complexity, an illusion of professionalism but very little, if anything, to do with the overall accuracy of urban transport models.

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1 The PERTS 1970 study referred to earlier, records a coefficient of determination (r^2) of 0.58 for transit work trip interchanges at the 'district' level (n = 148) based on a data aggregation averaging 29 surveyed trips. The expanded inter-district movement averaged 1,276 transit trips.

HOW RELEVANT IS THE CHOICE CONCEPT?

Fashions in transport change. The 1950s, and much of the 1960s, was an age of freeways, perhaps not the building of them but the widespread conviction that with them lay a solution to transport problems. The belief that promoting public transport and restraining the car could provide a better solution replaced that earlier conviction and, as noted earlier, spawned the development of modal choice modelling. In conclusion, therefore, it is perhaps appropriate, having analysed technicalitites of modal choice modelling, to consider its relevance in the light of contemporary transport policy.

Difficult though it is to stand back from immediate events, there are, nevertheless, indications that transport policy is moving away from simply promoting public transport and restricting car use, with the singular intention of altering the modal split. On the one hand there is now increasing recognition and emphasis on the wider role of traffic restraint - for example in reducing environmental pollution. This finds expression in documents such as the local Green Paper, Transport Policies for Central Perth, wherein it is suggested that restraint has a part to play in improving the general quality of life in central cities. On the other hand, it is evident in the notion that public transport has a role in providing increased opportunities for those without access to cars, for the young, the old, the infirm. Indeed, with local figures (Knox 1977, p.26) suggesting that over half the total ridership comprises of children/scholars and pensioners, perhaps the traditional idea that public transport's chief role is to get people to and from places of employment is itself rapidly becoming outmoded.

A change in economic circumstances has led also to a reappraisal of policies bearing upon the modal choice issue. The economic recession has curtailed temporarily the growth of car ownership and use, and has curbed the pressures for restraint. The same economic recession has inadvertently revised ideas on economic theory and policy with the result that large public sector borrowing requirements are frowned upon whilst, at the same time, inflationary pressures have escalated public transport deficits which threaten to get out of hand. There is, therefore, a greater concern with the financial management of public transport, and the possibility that commuters switching from cars to public transport may have a detrimental effect on finances, again has restrained enthusiasm for promoting such a change.

These changes of policy should lead to a reformulation of modelling requirements and there is ample evidence that the recasting of transport planning analysis is indeed taking place. One particular feature of recent trends is that, in comparison with past transportation studies, the analysis is focused on specific or better defined problem areas. In turn, this has led to the increasing analysis of

change through time and a willingness to analyse where necessary at a level of aggregation both smaller and larger than the traditional approach to the modal split issue.

These features of contemporary analysis are exemplified in the context of public transport. On the one hand, gross estimates of public transport revenues and costs (required for public expenditure purposes) are being produced from relationships between city-wide trends in patronage and car ownership, population unemployment (Cole and Tyson 1977), or population structures (Wildermuth 1977). On the other hand, the possibilities of increasing patronage or better serving social needs, in particular (sub) markets, are being analysed using market research (Wildermuth and Bettison 1977) or demonstration programmes.

Trends such as these are shifting the modelling emphasis away from the analysis of modal transfers per se; thereby removing the incentives which first led to the formulation of individual mode choice as a continuous adjustment to differences in generalised cost. Now that the relevance of, as well as the original concept of, modal choice is in doubt, perhaps the time has come to look to alternative ways of producing modal split estimates, and to close the chapter on orthodox mode choice modelling.

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