Conclusions

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Abstract This chapter reports the models presented in the previous chapters, comparing them through the identification of some criteria. The latter are factors influencing residential choice; the treatment of dynamics; issues of interdependence and representation of planning policies or zoning controls. The final point is to stress the variety of ways in which residential location modeling (and urban modeling more generally) is advancing. It includes both continuing refinements to model packages which have a long history, and wholly new developments, and demonstrates the very different ways in which the subject is being addressed.

1 Introduction

This book has attempted to draw together a selection of recent work which is reasonably representative of the range of approaches being taken to modelling residential location within the context of developing land-use/transport interaction (LUTI) models. This concluding chapter does not attempt to draw conclusions in the conventional sense of attempting to decide what is right or wrong, good or bad, nor does it try to provide a summary description of all of the models considered in this book. All that we attempt to do is to offer some overall comments guided by the different dimensions of modelling which Professor Wilson identified in his Foreword, and some thoughts about how the development of similar models may evolve in future.

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For brevity we refer to the models or projects described in the previous chapters by the short names listed in the Table 1 reported in the Chapter on "The State-of-the-art in Building Residential Location Models".

In these comments we try to keep in mind that the models described range from one-off projects to software packages with multiple and differing applications. We would emphasise again that this chapter is not intended as a summary of all the models represented in this book; hence if a particular model is not mentioned in discussion of a particular modelling characteristic or feature, it does not mean that the model does not have that characteristic or feature, nor does it imply any criticism of the model in that respect.

2 The Representation of the System

All of the models considered are explicitly spatial, as an essential condition for empirical analysis or forecasting of residential location. There is however a considerable range of spatial detail, and a distinction between the conventional zone-based models and those (UrbanSim, Oregon2) which operate on much smaller grid cells. The latter group are, almost be definition, microsimulation models – though as demonstrated by SimDELTA not all microsimulation models of household location work at the grid cell level. We consider some of the implications of microsimulation further below.

The need to disaggregate households, primarily on socio-economic criteria, is a common feature of the models considered. Within the aggregate models, the number of household categories varies widely, from eight in standard DRAM applications to over a hundred socio-economic/composition/employment status combinations in some DELTA applications. Microsimulation models which simulate the individual persons within households, as well as the household collectively, can to some extent avoid the need to define household categories in their actual location processes, though typically it is still necessary for model coefficients to relate to pre-determined categories.

In most models the total number of households to allocate across zones is exogenously prepared and specified as an input – though in forecasting applications this number is by definition itself a forecast and must come from some other form of model. In the DELTA case there is an intermediate stage in that household changes (formations, changes in composition and dissolutions) are calculated within the model, but using a household change model calibrated to match the results of more conventional demographic models at the study–total level. In Oregon2 and SimDELTA, the formation of households to locate is fully incorporated into the overall system and is driven primarily by the microsimulation of demographic changes (births, deaths, couple formation and dissolution) affecting the modelled population over time. In contrast, in UrbanSim the new households to be located by the microsimulation process in each year are synthesized to match aggregate demographic inputs.

2.1 Factors Influencing Residential Choice

Representation of the availability of housing is obviously central to the representation of residential choice in the most-developed countries where the vast majority of moves are into previously-owned dwellings or dwellings built speculatively by developers. Different factors would apply in economies where significant numbers of households have to create their own "informal" housing. DRAM is an exception amongst the models reported here in that its main supply variable is land rather than housing. Within the other models, the treatment of housing supply varies very considerably, from a single quantity of housing floor space in the DELTA applications through numbers of dwellings by type in many of the models. Tenure appears in some (e.g. TILT) but not all. The microsimulation models (Oregon2, UrbanSim and SimDELTA) inherently have the potential to consider significantly more detail, such as the number of rooms in an individual simulated dwelling, which is a key variable in SimDELTA. Whilst clearly more detail about housing supply should improve the residential location model itself, the addition of such detail implies the need to supply that detail (by zone and for each modelled year) in the forecasting process; as the DRAM paper points out, this can create issues both of practicality and of accuracy; this leads to the development of other sub-models to update all the other variables used (as for example in DELTA and MUSSA).

The influence of transport is present in each model in terms of travel to work (Calgary-Edmonton, DRAM, Oxford, TILT, UrbanSim, SimDELTA), travel to shopping (Calgary-Edmonton, Oxford), travel to school (Calgary-Edmonton, TILT), and less directly in accessibility measures (DELTA, SimDELTA).

Many other variables are considered to have an impact on residential location choice like air quality, street in front of dwelling (Calgary-Edmonton) quality of schools, noise (Oxford), room density (TILT), or zonal quality (DELTA), and neighbourhood characteristics (Albatross, Ramblas). Where fewer variables are used there is a tendency to make more use of the previously located numbers of households by category to imply values for influences which are not made explicit, either by an incremental formulation of the model (DELTA) which assumes that unmodelled variables remain constant, through other comparable formulations (MUSSA) or through the explicit inclusion of previous numbers of households (DRAM).

2.2 The Treatment of Dynamics

In the cases of the Edmonton-Calgary and Oxford models, they represent a state at a base year and therefore they are strictly cross-sectional. All of the other models involve at least some time-lagged terms. DRAM allocates population according to zone attractiveness calculated through period t values and based on zone-to-zone travel costs and the distribution of employment for period $t + 1$. In the case of DELTA, the time-lagged terms are combined with indirect use of a rent term, reflecting the balance of supply and demand in each forecast year, which therefore takes account of the changing demand for the stock of housing.

2.3 Issues of Interdependence

Most of the models calculate the probabilities that households will locate in each zone conditional on the household worker being employed in a particular zone; there is therefore a residential location process for each household type and for each work zone. In these cases, the implications for residential location of households having more than one worker are unclear. In the case of DRAM and the model for Oxfordshire, the location of jobs is itself endogenous to the model. The main exception to the general pattern is DELTA, which at the local level works on the basis that accessibility to work is just one of the characteristics influencing household location, and has a separate area-level migration process which draws workers towards areas with better work opportunities.

2.4 Representation of Planning Policies or Zoning Controls

In general, planning policies and zoning controls act as controls both on the processes of development and on the occupation of the resulting buildings. The processes of development and the physical supply of buildings for housing are essentially outside the scope of this book – authors were asked to focus on the processes by which households are located within a given housing stock. "Planning" policies in the conventional sense do not generally seek to control which households live in which dwellings. However, most Western societies have a range of "housing" or "social" policies which control the use of some housing and influence the use of the stock in general. These include, in particular, the provision of "social housing" which provides subsidised accommodation for households meeting certain criteria, and tax regimes which influence household preferences (sometimes by omission, for example by taxing capital gains on most forms of investment but not on owner-occupied housing). The ability to represent these kinds of policies requires first of all a distinction of housing by tenure, at least so as to define whether households are renting or buying their dwelling, and a substantial disaggregation of households by income/employment and age characteristics. Aggregate models such as DRAM or DELTA are consequently very limited in what they can do to represent such policies explicitly (though some of their consequences can be introduced implicitly, for example through the use of constraints as in the DRAM case. More fully dynamic models such as SimDELTA have the greatest scope in this respect, because the process of maintaining a household "history" over time allows for consideration of variables such as the outstanding value of the mortgage (housing loan) which an owner– occupier household owes on its dwelling.

Another example is represented by Albratoss and Ramblas where both models are primarily activity-based models of transport demand, and not integrated land use – transport models. Their prime goal is to predict activity–travel patterns and associated traffic flows. The distribution of residential land use, in terms of households and persons, is exogenously given. Based on the available data sources, a set of tools has however been developed to create synthetic populations that serve as input to the models.

2.5 Closing Observations

Our final point is to stress the variety of ways in which residential location modelling (and urban modelling more generally) is advancing. It includes both continuing refinements to model packages which have a long history, and wholly new developments, and demonstrates the very different ways in which the subject is being addressed.

One common misconception amongst some other groups of modellers is that LUTI modelling has advanced over the past three decades only by increasing disaggregation of the models originally developed in the "first generation" of operational models. The material presented in this volume, though selective and dealing only with one aspect of LUTI modelling, is more than sufficient to disprove this belief.

Another rather more sophisticated and more debateable view is that the historic trend in LUTI modelling is one of ever-increasing sophistication with large-scale microsimulation modelling as the ultimate approach. Whilst it is true that modelling a real 100% sample of households, persons and dwellings would clearly be an ultimate level of disaggregation, and that we can approximate this by modelling a comparable synthetic sample, the practical issues raised by microsimulation mean that it may not be the most desirable approach for application to forecasting in policy- and decision-making contexts. The points made in Putman's DRAM paper about the usability of models being a major determinant of their practical value remain highly valid. The most sophisticated models may therefore make more indirect contributions to the growing use of LUTI models in planning and government.

As editors we have been privileged to spend some time reading in detail about some of the work being done by our colleagues around the globe, and have been impressed yet again by the level of intellectual and practical effort being devoted to this form of modelling. This is only a partial picture; some of those invited to contribute to this particular volume were unable to participate, and we know that there are many others working in this area or on closely related models whom we were simply not able to consider. Like any such book in this age, this one will inevitably be out of date even before it appears in print; we would very seriously urge readers to seek updated information before relying on this book as describing either the state of the art in general or the state of any one model in particular. Despite these limitations, however, we very much hope that the book will be of value as a snapshot of the range of activity in this field, and that it will encourage others to join us in working on this perennially fascinating topic.

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