

Model-Based Demography: Essays on Integrating Data, Technique and Theory. 2018. By THOMAS K. BURCH. Demographic Research Monographs Series. Cham: Springer. Pp. xviii+200. Open access (online) / £44.99 (hardcover). ISBN: 978-3-319-65433-1.

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The book, published in the open-access Demographic Research Monographs series, contains timely, philosophical reflections on the theoretical void in demography as a discipline, and on potential remedies included in a proposed model-based research programme. The volume collects many of Thomas Burch's papers written on these topics since the 1990s, which until recently have not been receiving the attention they deserve, given the importance of the issues at stake. However, recent developments in statistical and computational modelling in demography have turned Burch's philosophical work from *the voice of one crying in the wilderness* to a seminal reflection on the state and future direction of demography, offered by a critical friend.

The book is composed of 14 chapters, grouped into three parts. The first part is devoted to the underappreciated role of—and unmet need for—formal theory in demography, with a focus on the prospects of using computer simulations, statistical modelling, and mathematical modelling for theory-building. The second part provides specific examples, covering a broad spectrum of topics, such as marriage and kinship models, life tables, and cohort component projections. The third and final part includes reflections on the teaching of demography at universities, as well as general remarks.

The key arguments regarding the barren theoretical landscape of demography and the untapped potential of model-based enquiries are laid out in the first two chapters. Formal models are equated with theories, with their desirable features including sufficient resemblance of reality, description of underlying social mechanisms, and usefulness for particular purposes. These ideas are subsequently developed further: if models are formal tools for theory-building, those of complex social systems need to rely additionally on computer simulations. Describing complexity, rather than

striving for simplicity in a reductionist way, becomes an important analytical goal in its own right, and one that can be only achieved through computer-based modelling.

At this point, the discussion contrasts computational and statistical modelling, suggesting tensions between the two approaches. Still, it largely omits several methodological developments aimed at reconciling them, such as the Bayesian melding of Poole and Raftery (2000), or statistical metamodels (emulators), including those proposed by Kennedy and O'Hagan (2001). A few applications of such methods in demographic computational models do exist (Bijak et al. 2013), although their potential still remains largely underused in general.

Concluding the first part, Chapter five makes the case for a greater use of differential equations in demography, citing the examples of the predator–prey model (the legacy of Alfred J. Lotka) and the marriage model of Gudmund Hernes, barely known among population scientists. System dynamics approaches are also discussed, alongside their criticism, mainly related to the *Club of Rome* work (Meadows et al. 1972). Regrettably, in the context of the Malthusian model, there is no discussion of its modern extension by Lee (1986) (that is, admittedly, also not widely known—see note 2 in Acknowledgments). Why mathematical models remain in use in population ecology, while being largely shunned by human demographers, also remains outside the scope of the debate.

The examples included in the second part of the book include marriage models, which are presented in Chapter six and accompanied by a criticism of fitting curves to particular datasets just to approximate underlying relationships, which is seen as a clerical, rather than a scientific task (p. 106). The more general role of curve fitting (and related software) in demographic theory-building is discussed in Chapter seven, and illustrated through examples of kinship models. The discussion offered in this chapter is largely standalone, and can be seen as an *intermezzo* in the main thread of the book. Some open questions remain regarding the choice of the proprietary software presented in this chapter: today, in the age of ubiquitous R and other high-level, free statistical languages, neither MathCad nor TableCurve would be the programmes of choice for applied demographic modellers.

On the other hand, the remainder of Part II contains very useful insights into some of the best known demographic models. Chapter eight is devoted to the life table, seen as a ‘general theoretical construct’ (p. 122) not limited to one application—the potential for its uses in other contexts being

limited mainly by the imagination of demographers. Chapters nine and ten, in turn, discuss various aspects of the cohort component projection model, with insights into the pervasive popularity of the method, its links with policy, and its potential for prediction, explanation, and prospective analysis.

The projections chapters seem to overrate the dichotomy between cohort component (multistate) projections and microsimulations: different levels of analysis aside, these approaches serve the same purposes, and microsimulations are already quite firmly established within the field of applied demography. Besides, projections (or forecasts) can also have stochastic inputs, to invoke the current United Nations (UN) World Population Prospects as one prominent example (UN 2017). Still, the discussion concluding Chapter nine, on qualitative predictions, is illuminating; and could even be strengthened by invoking similar examples from other disciplines, such as *Imperfect Knowledge Economics* (Frydman and Goldberg 2007).

In the third part of the book, theory is identified as a key element missing from the demographic pedagogy. In Chapter eleven, rather than supporting the omnipresent distinction between formal and substantive demography, the author suggests putting greater emphasis on the general principles driving demographic phenomena, which can be explored using formal models and visualizations. These ideas are explored further in Chapter twelve, which encourages those teaching to prioritize depth of understanding over the breadth of material covered in courses on demographic fundamentals. Formal models are advocated as thinking aids, helping demography to achieve a fully scientific status through firmly embedding theories in standard curricula.

The last two chapters of the book almost stand alone. Chapter 13 offers a summary of the teaching programme proposed earlier. In contrast to the principles of the much criticized logical empiricism, model-based approaches are argued to offer demographers unique analytical and pedagogical tools. The author underlines the important role of empirical data in demographic enquiry, yet the main aim of modelling endeavours continues to be aiding our understanding, rather than searching for unattainable and elusive Truth.

In Chapter 14, the final chapter, the potential of several modelling avenues is explored further; these include system dynamics, microsimulations, and agent-based approaches. One important addition would be the discussion of cumulativity and complementarity of the multiple

approaches to demographic analysis (Courgeau 2012)—models will not replace more traditional methods of analysis, but will be used alongside them, offering yet another perspective on population change.

The book concludes with a suite of recommendations, including pleas for a greater use of computer modelling in research, as well as in teaching; for collecting and documenting existing theories and models; for replication and refinement of existing models; and, finally, for their wider use in policy.

Overall, as honestly admitted by the author in the Preface, there is a fair amount of repetition in the book, but at the same time, most of the chapters are largely self-contained. Many parts have already been published elsewhere, but the current collection includes them in one convenient reference volume. A selection of the presented material could make very informative core reading for introductory courses in demography, especially at the postgraduate level, offering students a high-level view into the strengths, weaknesses, and potential of our fascinating discipline. One slight issue, though, is its timeliness: some of the more recent developments in computational social science and demographic simulation modelling are not prominently featured.

Nevertheless, in the era of *Big Data* and fascination with fast computing, the key messages of this book are more valid than ever. Given recent methodological and computational developments, the theoretical void in demography is becoming even more apparent. Overall, the demographic community owes thanks to Thomas Burch for reminding us about some inconvenient truths, and to the Max Planck Institute for Demographic Research for making the e-book open access.

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2 For the Lee (1986) reference, I owe credit to my colleagues in Southampton, most notably to Andrew Hinde, from whom I have inherited an undergraduate course on ‘Population and the Environment’, with one lecture specifically devoted to explaining Lee’s model, based on differential equations, in layperson’s terms.