REVIEW • FORUM
Thomas K. Burch's *Model-Based Demography*[1]

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The central concern of this book is with the role and status of theory in demography. It gives a very deep overview of the importance of model-based demography, compared with the usual logical empiricism followed in this discipline. While these papers were written during a long period of time (the past three decades), they develop a new, original, and coherent view of demographic research. Professor Burch constructs theoretical models here that consist of clear concepts, with well-specified relations among them. He rejects the heavy reliance on statistical models in mainstream demography, which have no place for unmeasured variables. For him, computer modelling is an essential tool for theoretical work in the twenty-first century.

This book appeared in the same year as the paper I published with Bijak, Franck, and Silverman (Courgeau et al. 2017), and their main titles are the same. This was not at all a casual coincidence, as during the preceding year we had conducted a thorough discussion with Burch on such a model-based demography. I will first give here the flavour of this exchange before proceeding further.

The first point is related to the use of agent-based models in demography. Burch's chapter 2 was written for the Billari and Prskawetz book on this topic (2003) . In their introduction to this book, they said that "agent-based computational models pre-suppose rules of behavior and verify whether theses micro-based rules can explain macroscopic regularities" (p. 2). Burch agrees with this definition, as he writes in this chapter: "A particularly promising genre of simulation is agent-based modelling, which promises to link individual demographic behaviors to aggregate patterns, and to explicate the social—as distinct from stochastic—mechanisms underlying demographics dynamics" (p. 40). Even in his chapter 14, Burch considers agent-based modelling as the final step among the methodological paradigms in demography: from *period analysis* to *multi-level analysis* to *agent-based models*.

We agree that agent-based modelling constitutes an improvement in demography, but feel that it may not necessarily constitute a *new paradigm* for this discipline. First, it does not give a new combination of concepts, like the cross-sectional, the longitudinal, the event-history, or the multi-level paradigms, but only a new way to treat them by computer simulation, even with some arbitrariness. We also agree with Holland's criticism when he writes that agent-based computational models offer "little provision for agent conglomerates that provide building blocks and behavior at a higher order of organization" (2012). Indeed, micro-level rules find hardly a link with aggregate-level rules, and it seems difficult to think that aggregate-level rules may be entirely modelled with a micro-approach, since they transcend the behaviours of the component agents. An emergent entity such as a social network has properties which its component parts—here, the individuals in this network—do not have. For instance, a multi-level analysis on the effects of an

individual characteristic (e.g., being a farmer) and the corresponding aggregate characteristic (the proportion of farmers living in an area) on the probability of internal migration in Norway shows that the effects are contradictory (Courgeau 2003): it seems hard to explain a macro-characteristic acting positively by a micro-characteristic acting negatively.

The second point is related to the difference between a *semantic* and a *mechanistic* view of science. Burch tells us: "My understanding is that your basic approach to science would be similar to that of the 'semantic' school. Yet there is little if any reference to their work" (pers. comm.). So, let us see if the model-based view of demography developed in this book, and in our paper, covers the same philosophic content.

In his first chapter, the author clearly defines his view of model-based science: "This view of theory is known in philosophy of science circles as the 'semantic' view, or more recently and descriptively, the 'model-based' view of science" (p. 3). This semantic theory of models attacked the empirical explanatory models that had dominated the philosophy of science before the 1960s, and promoted formal explanatory models during the following decades. Even if various versions of this approach differ (among, for example, Frederick Suppe, Bas van Fraassen, Ronald Giere, etc.), it continues to be developed nowadays. In this approach, *models*, as abstract representations of some portion of the world, are the central element of scientific knowledge, which reject empirical laws. For the 21st-century researcher, computer modelling will permit the statement, manipulation, and evaluation of more and more complex theoretical models, which can be used to make claims about specific aspects of the world. But how in this case would one identify the relationship between the theoretical model and the empirical observations, and test the fit of a simulation model? There is a real danger in constructing a theoretical model without any relationship with observed data and no way to verify this relationship. As Burch says in chapter 3, "'Correct' predictions can result from a model with incorrect assumptions and inputs" (p. 59).

In order to go further and to enrich this approach, we rely on *model-based science*, which is known in the philosophy of science as a *mechanistic view*, mainly developed for the biological sciences during the 1990s. Again, various versions of this approach exist (William Bechtel, Carl Carver, Stuart Glennan, etc.), but its development nowadays is increasingly not only for the biological sciences but also for the social sciences. In our case, we are working with the version given by Robert Franck (2002), the *functional-mechanistic* approach; and its application to demography we term *model-based demography*. As with the semantic view, the mechanistic theory of models rejects the empirical explanatory approach. This may be the main reason of Burch's confusion of the two approaches, which are in many aspects similar in their rejection of logical empiricism. But while for the semantic approach a theory is a *formal* system, empty of any empirical content, the mechanistic one infers, from the sustained observation of some property of nature, the *functional* structure—in classical terms, the *axiom, form, principle,* or *law*—which rules the process generating this property, and without which this property could not come about as it does. By focusing on the mechanism generating a social property, the functional structure is treated independently of the causal structure and may therefore be generalized. Although this approach has been successfully applied to some social sciences, like archaeology or communications (Pratt 2011), it has not yet been entirely applied to demography, even if the functions of fertility, mortality, and migration clearly delimit its parameter space—in other words, the principle of all demographic growth or decline.

We may conclude that our two model-based demographies cover the same philosophical content, permitting the dismissal of the "covering law" approach and the creation of a formal system from which the facts to be explained can be deduced. However, while the semantic view leaves unanswered the question of *realism* in science, the functional-mechanistic view permits us to introduce simultaneously a *formal* and an *empirical* explanation. As Franck said, "The formal (conceptual)

model is the form of the social mechanism, and the social mechanism is the matter of the formal model" (2002: 296).

Even if I did not tackle all the questions raised in our discussion with Professor Burch, I hope that this short review will permit readers to see its fruitfulness. Our views are quite similar in abandoning the "covering law" approach based on empirical regularities, and in discovering a system's principle from the study of its properties. I hope that these model-based approaches will bring about further opportunities for constructing and verifying their validity.

References

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