

Chapter 5

Usefulness of Agent-Based Simulation in Testing Collective Decision-Making Models

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ABSTRACT

Political scientists seek to build more realistic Collective Decision-Making Models (henceforth CDMM) which are implemented as computer simulations. The starting point for this present chapter is the observation that efficient progress in this field may be being hampered by the fact that the implementation of these models as computer simulations may vary considerably and the code for these computer simulations is not usually made available. CDMM are mathematically deterministic formulations (i.e. without probabilistic inputs or outputs) and are aimed at explaining the behaviour of individuals involved in dynamic, collective negotiations with any number of policy decision-related issues. These CDMM differ from each other regarding the particular bargaining strategies implemented and tested in each model for how the individuals reach a collective binding policy agreement. The CDMM computer simulations are used to analyse the data and generate predictions of a collective decision. While the formal mathematical treatment of the models and empirical findings of CDMM are usually presented and discussed through peer-review journal publications, access to these CDMM implementations as computer simulations are often unavailable online nor easily accessed offline and this tends to dissuade cross fertilisation and learning in the field.

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1. INTRODUCTION

In the discipline of political science, there is a range of Collective Decision Making Models (henceforth CDMM) developed to explain how individuals influence each other in a negotiation process to reach collective binding decisions, such as policy or legislative decisions (Thomson et al., 2003; Achen, 2006). The CDMM discussed in this research are based on the assumptions of rational choice theory and distinguished by their formal, mathematical description. The specifications of each CDMM aim to capture the essential features of interactions between individuals involved in political bargaining, where each actor's initial policy position may be modified in the process so that a collective decision is reached. Alongside developing the CDMM, researchers effectively implement these as computer simulations. These computer simulations are used to analyse the data and generate model predictions of the actual collective decisions and thus providing a measure of the accuracy of the CDMM. While the formal mathematical treatment of the models and empirical findings of the CDMM field are usually presented and discussed through peer-review journal publications, access to these CDMM implementations as computer simulations is often not publicly available online through open source code for example and/or easily accessed offline and this tends to dissuade rapid research cross fertilisation and learning in this field. The starting point for this present research is the observation that efficient progress in this field may be being hampered by the fact that the implementation of these models as computer simulations is not easily available.

Most purely textual specifications of simulation models do not provide a full and exact account of how these have been implemented. That is because discussions on a manuscript may not match the level of completeness and clarity that a computer language would require to accurately represent a

model. Thus having access to the implementation source code is often *the* unequivocal way of assessing the proposed assumptions and processes. As CDMM are not readily accessible, these have been replicated into an agent-based model (henceforth ABM) to facilitate the understanding of CDMM via the design of experiments. The flexibility to develop ABM particularly highlights the need for modellers to adopt rigour throughout the specification and implementation of simulation assumptions and processes.

We discuss and demonstrate the importance of these issues in this chapter in the context of an ABM replication in NetLogo of four well-known CDMM from political science. We focus on three research challenges in this chapter. First, how can we generate a controlled environment for reproducible and flexible testing of CDMM hypotheses? Second, using our ABM replication approach, can we identify and explain which of the CDMM are most stable in terms of predicted outcomes? Third, can our ABM replication generate insights about the assumptions and dynamics of a CDMM?

In the following section, the replicated CDMM are reviewed and then the research design and empirical data used in this research are presented. Two case studies are selected for this research. The first case study and dataset discussed in Bennett and Payne (2001) introduces the United Kingdom (henceforth UK) Local and Regional Development Agencies' legislation, a policy intervention for enhancing opportunities for local and regional development. The second case study and dataset discussed in (Thomson, 2011) is a larger collection of policy decisions taken at the European Union level (henceforth EU). In this research, we systematically test the assumptions of these CDMM under different precision (rounding) floating-points (i.e. using different decimal points for performing the same mathematical calculations). Our ABM replication demonstrates how the underlying assumptions of these CDMM present adverse effects for interpreting the dynamics of each model. Our

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