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Book Review

Michael Laver and Ernest Sergenti: Party Competition. An Agent-Based Model

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> "[D]ynamic models of multiparty competition, especially when voters care about a diverse set of issues, are analytically intractable."
> (Laver and Sergenti 2012, 5)

With different points of reference, 'analytical intractability' is a very common argument for the usage of computer simulations in the social sciences. But in contrast to many authors, the elaborations by Michael Laver and Ernest Sergenti are theoretically profound. The point of 'analytical intractability' is not used to directly justify agent-based simulations, but to assume that party leaders must rely on informal decision heuristics in order to find a policy program that attracts as many voters as possible. However, while the main points are correct, some details of their argumentation are rather vague. One objective of this review is to smooth the authors' justification for the usage of decision heuristics. A second objective is to briefly outline the work as an excellent example of simulation-based research.

First, it must be clarified, what Laver and Sergenti mean by 'analytically intractable'. There is no formal definition of this term. Instead, the authors refer to 'computational intractability', a concept from computer science. Without going into much detail, a problem is categorized as computationally intractable if nobody has yet found an algorithm that can calculate a solution to this problem in polynomial time. This means that, if the problem is solvable at all, the time required for calculation increases exponentially with the size of the input data (e.g. the number of actors involved or the number of nodes in a graph). For some instances, the calculations may take years and the researcher (or politician) might run out of budget, or the results might become irrelevant in the meantime.

The book is about one of these computationally intractable problems. It is about party competition and, in particular, about modeling the dynamics in policy decisions that are made by party leaders in order to increase their vote shares. In contrast to another recent book about party competition and election theory (Bendor et al. 2011), Laver and Sergenti are not concerned with the

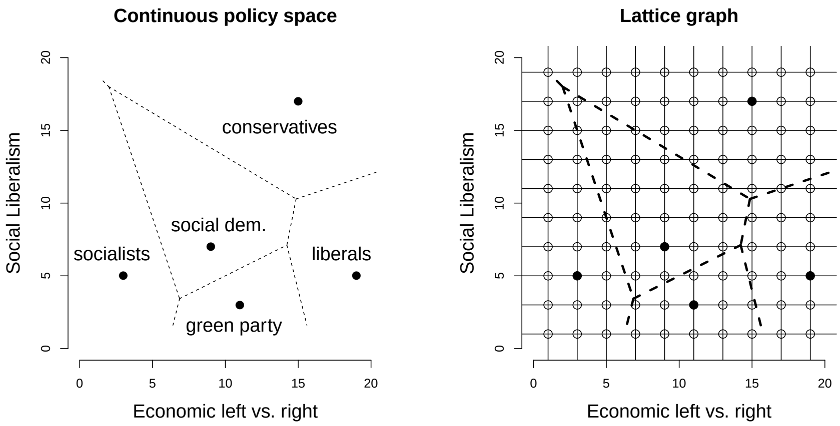

Figure 1: Voronoi Regions of policy space

voters' behavior. Instead, the policy preferences of the electorate are regarded as fixed and modeled by a frequency distribution over a two-dimensional policy space. Each dimension bundles a set of preferences that correlate with each other, e.g. the economic left-right dimension with 'right' standing among other things for minimal state intervention in the economy.

In the model of Laver and Sergenti, multiple parties align their programs along the two policy dimensions, and each voter's support is assigned to the party that is the closest in regard to policy preferences. As the authors point out, this division of the policy space correlates to a Voronoi diagram, which is a special form of partitioning a metric space where each partition is associated with a generating point. *Figure 1* shows an example of a Voronoi diagram in policy space (generated with data from Benoit and Laver 2006). The generating points represent political parties and the Voronoi regions, which are the parts of the policy space that are closer to the corresponding generating point than to any other one, constitute the parties' vote shares.

For simplifications, we can assume a lattice graph with a finite number of nodes instead of the continuous policy space (*figure 1*). Each vertex is weighted by the proportion of voters, whose political preferences correspond to the position of the vertex in the graph. Each party marks a single vertex as its policy program and receives the votes of the surrounding Voronoi region. Assuming that party leaders try to maximize their support by choosing a program that attracts a majority of the voters, the leaders' decisions can be modeled as a Voronoi game on graphs with n nodes and k parties.

Given that $k-1$ parties have already chosen their policy program, the kth party can optimize its choice by considering every unoccupied node of the graph and by calculating the corresponding Voronoi region. Obviously, the larger n, the more time is needed to find an optimal place in the policy space. But the time that is required to calculate the best solution increases only as a polynomial function of n. Hence, it is not computationally intractable to compute a best response given the $k-1$ positions of all other parties. Nevertheless, it is, indeed, intractable to decide the existence of a Nash Equilibrium of a Voronoi game on a general graph (Dürr and Thang 2007). As a consequence, it is computationally intractable to find an optimal move in the policy space assuming that the other parties behave similarly (common knowledge of rationality). Additionally, the Voronoi games as implemented by the authors are not strictly discrete. The voters are indeed embedded in a (discrete) grid structure. But the parties move along a continuous space above the grid. There are only few studies about Voronoi games on the continuous domain, and they are either restricted to one dimension or to the one-round game (e.g. Ahn et al. 2004). But the general accord is the intractability of finding an optimal move.

In sum, finding an optimal policy move is not guaranteed or at least very time- and resource-consuming in a dynamic party competition game with at least three parties and two policy dimensions. Because no real politician is likely to find a best strategy in reasonable time, the authors assume that party leaders use informal decision heuristics: “These are decision-making rules-of-thumb which can in practice be very effective but can never be proven formally to be best responses to any conceivable state of the world.” (Laver and Sergenti 2012, 44) The authors further assume that different politicians use different heuristics. However, the assumption of heuristics do not require agent-based simulations as a tool for theoretical research. It is rather a convenient alternative and saves time and energy that are needed to look for or research analytical methods that can deal with the given task.

The decision heuristics are arbitrarily chosen by the authors and justified as plausible and as frequently occurring in real-life politics. For example, *Sticker* describes a party that never changes its policy program and sticks with its initial ideal point. An *Aggregator* tries to optimally represent the policy preferences of its current voters. This rule stands for real parties that employ internal polling processes to identify the party members’ ideal points. Additionally, the authors include a number of vote-seeking parties, such as the *Hunter* and the *Explorer*. These parties continuously change their policy program in order to increase their vote shares by every move.

The main part of the book deals with the different decision rules when confronted with a range of parameter settings of the competitive environment. A number of techniques of simulation-based research are employed. The decision rules are investigated by themselves and in competition with each other. The authors also develop an evolutionary process in form of a replicator-mutator dynamic: parties ‘die’ if they cannot uphold a certain threshold of party supporters, and new parties are ‘born’ in places of the policy space that are currently underrepresented. In a paper that is not included in the book, Fowler and Laver (2008) even arrange a computer tournament of party decision rules.

While there is no rule that outperforms the other ones in any setting, there are several lessons that can be learned from the simulations. For instance, if all parties use the *Aggregator* rule, the policy preferences of the electorate will be optimally represented. But generally, an *Aggregator* performs poorly in competition with vote-seeking rules. In contrast, while it is beneficial to look for policy positions with higher vote shares, insatiable vote-seeking party leaders "are systematically outperformed by satiable leaders" (Laver and Sergenti 2012, 156). Furthermore, the success of a rule depends on the underlying assumptions about the distribution of the voters' policy preferences. Some decision rules thrive in homogeneous societies but loose some of their superiority in societies that are segregated in two groups with fairly different preferences.

A last chapter of this book attempts to confront the results from the simulations with empirical data. Because of the lack of data for many parameters that have been introduced to the model, the authors are not able to test most of the hypotheses that have been derived from the simulations. Instead, they fix some of the input parameters to plausible values, and calibrate the remaining parameters to values that yields the best fit of the model to the data. For calibration, the authors use expert surveys that estimate the policy movements of political parties from ten different European countries between 1989 and 2002. Subsequently and assuming the validity of their model of party competition, Laver and Sergenti state which kind of decision rule is most likely to have been used by party leaders during this time. The empirical validation of these conjectures is offered only in forms of anecdotes and empirical observations. While this chapter is probably the most fragile one of the book, it is still an important step to approach the point where the implications of the simulation model can actually be tested empirically.

Besides political scientists who are interested in the topic, this book is well suited for any social scientist who looks for an exemplary introduction to basic techniques of simulation-based research. But also researchers who already use simulations might profit from reading chapter two, which was discussed above, and chapter four. The latter contains an insightful tutorial to the usage of Markov chain analysis to draw general conclusions from the output data. The authors are very aware of the limits of simulations, for the results only hold for the parameter range that have been used as input values. In order to obtain a similar scope and precision as analytical models, they apply systematic sweeps, Monte Carlo parameterization, and statistical methods to interpolate for input values that have not been tested. By doing this, the authors hope to set "new standards of intellectual rigor for specifying and exercising [agent-based models] in a manner analogous to classical analysis" (Laver and Sergenti 2012, xii).

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