

Chapter 2

Background Research

2.1 Chapter Overview

This chapter describes the research inspired motivation for the project.

2.2 Agent-Based Models

An Agent-based model enables the exploration of how individual behaviours and interactions produce emergent phenomena [7]. Their qualities are useful in the fields of social and political science, in which studied phenomena cannot be simply explained by aggregation of individual behaviours.

2.2.1 A Generative Approach

Epstein suggests that agent-based models facilitate a generative approach to social and political science [14]. That is, to explain some emergent phenomena, one must generate it. The essence of the argument is that if a micro-specification of an agent-based model can generate some phenomena, then it is a candidate explanation of it. Of course, the strength of said explanation depends on the real world validity of its assumptions.

2.2.2 Validity

Agent-based models have high levels of internal validity because the data they produce can be traced back to the code. However, the real world is far too complex to be modelled in full, hampering the ecological validity of the results produced. Ecological validity describes whether the results of a study can be generalised to real-life settings [3].

2.2.3 Theory Stressing

Due to the low ecological validity of agent-based models, the explanatory power of them is limited to be merely suggestive. However, they are powerful in a theoretical sense. A theory that explains some phenomena holds a number of assumptions, some of which are not explicitly stated. If the theory is translated sufficiently to an agent-based model, the implicit assumptions can be relaxed to determine if the theory is robust to their modification [14]. This isn't necessarily negative, as the discovery of important assumptions of a theory can expand the understanding of what the theory is describing. This motivates building an agent-based model framework that allows the modelling and modification of the underlying assumptions of theoretical explanations of social phenomena.

2.3 Party systems and their determinants

2.3.1 Two-Party Systems and Duverger's Law

Two-party systems, in which two political parties dominate a vote share [1], are observable in modern democracies such as the United States of America's and the United Kingdom's. It can be argued that such conditions devalue democracy, for example Drutman suggests it erases the ambivalences of voters [12]. The notion that a two-party system influences the quality of democracy bear justification for the exploration of the determinants of its formation.

Duverger hypothesises that the number of parties in a democracy is related to its electoral system. Specifically, he proposes a law that 'the simple majority, single ballot system favours the two-party system.' [13]. The essence of the argument is that a majority rule system encourages strategic voting, which disadvantages parties outside of the largest two. While it is difficult to deny truth in the relationship described, there are historical deviations from this law that call into question its rigidity [6]. This suggests there are implicit assumptions pertaining to Duverger's explanation of strategic voting, and uncovering them may hint at other determinants on the formation of a two-party system.

2.3.2 Strategic Voting

A Strategic (or tactical) vote is broadly defined as a vote for a party that is not the preferred one, motivated by the intention of affecting the outcome of the election [19]. A more concise approach to this topic is to understand it as vote that it is not determined solely by ideology, influenced by the potential success of its receiver. It is clear such behaviour benefits the largest parties in an election. Of course, the quality of a strategic vote is determined by how accurately the voter can predict the relative success of each party.

Clough built an agent-based model in which agents infer 'poll data' by asking other agents in their neighbourhood which party they voted for in the previous election [9]. The completeness of said data is therefore subject to the size of the agent's neighbourhood. Combining this data with their ideological ranking of the parties, they place a strategic vote. The model produced results that defied Duverger's Law under conditions of incomplete information, thereby suggesting information completeness to be an implicit assumption of the theory and a potential determinant on the formation of two-party systems.

An assumption of the model is that the agents treat their neighbourhood samples as representative of the electorate, failing to recognise the uncertainty inherent in their incomplete sampling. Interpretation of 'poll data' forms the basis by which one strategically votes, the way in which one handles the uncertainty of its potential incompleteness has a clear impact on the formation of said basis. This motivates extending Clough's model to prove that the way in which voters process uncertainty is an assumption that affects the results of the model, thereby suggesting it as a potential determinant on the formation of two-party systems.

2.4 Bayesian Inference

One approach to representing the handling of uncertainty is with Bayesian inference. Bayesian inference can be described as the process of updating the probability distribution of a set of hypotheses, as data relating to the hypotheses becomes available [2]. This is achieved using Bayes Theorem [15]. A simplified explanation is that the likelihood of observing some data given a hypothesis, naturally relates to how likely the hypothesis is if said data is observed. It follows then that it is sensible to re-weight the probability distribution with this likelihood with every observation. For example, given the hypothesis that five out of a possible five balls in a bag are red, the likelihood that a green ball is observed is 0. Therefore, if a green ball is observed, the hypothesis must be deemed impossible and re-weighted as such.

2.4.1 Prior Beliefs

A key quality of the Bayesian approach is the incorporation of the initial prior distribution, representing ones beliefs before observing any of the data. In particular, the implication that this therefore must be derived from information beyond the data [20]. This notion of probability is a natural one, especially when considering inferring from incomplete samples. Consider a boxing match consisting of 12 rounds, between a highly decorated boxer and an amateur, in which the amateur has won the first 3 rounds. The agents described in Clough's model, using exclusively the sample of rounds, would predict the amateur to win the match. However, a boxing fan incorporating their prior beliefs about the ability and success of the highly decorated boxer, would most likely still expect the amateur to lose. It is fair to say the boxing fan's expectations are more rational, demonstrating the disadvantages of inferring strictly from the observed data in question.

2.4.2 Voter Optimism

With the Bayesian approach, the way in which uncertainty (incomplete sample data) is handled, is defined by ones prior beliefs. The subjective nature of these beliefs inspire criticism of the approach [22], however subjectivity is human, which the agents of the model are aiming to represent. So what prior beliefs do the agents hold? Examining a study of the 1988 Canadian election, which did not result in a two-party system, Blais argued that voters were overly optimistic about the chances of their favoured parties success [5]. This provides some empirical validation to modifying Clough's model to include agents with optimistic prior beliefs.

2.5 Summary

To summarise, while agent-based models lack the ecological validation to decisively explain phenomena, they enable the exploration of the assumptions inherent in existing theoretical explanations. Exploring said assumptions is important, as they define the boundary conditions of a theory, and may provide further insight into the subject of the explanation. For example, by relaxing the assumption of information completeness, Clough found Duverger's Law to only hold under certain conditions. This then provides the insight that information completeness may be a determinant on the formation of two-party systems.

With the suggestive and deductive strength of assumption modification laid bare, the creation of a framework that enables it in an electoral context is justified. Said framework can then be used to modify the assumption of Clough's model, which has some empirical grounding as per Blais's examination of the 1988 Canadian election. If the new model produces different results, it can then be inferred that the lack of optimism of an electorate may be a relevant assumption of Duverger's Law. This then suggests that the level of optimism of an electorate is a potential determinant on the formation of a two-party system. While Blais derived optimism as a potential determinant via examination of the Canadian election, the model takes a generative approach.