An Evidence-Driven Model of Voting and Party Competition

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Abstract. In this paper we report on the development of an agent-based model (ABM) simulating the behaviour of voters and the positioning of political parties in Austria. The aim is to create what-if scenarios taking into account contextual changes, such as political crises as well as changes in parties' policy positions and voters'attitudes. Drawing on data from the Austrian National Election Study (AUTNES) and the Chapel Hill Expert Survey (CHES), we are able to map both demand- and supply-side characteristics. We present first results of the simulation analysis of applied strategies of voters and parties. This way, we are able to create first what-if scenarios that show how results of elections would change, if voters applied different strategies when deciding which party to vote for. In developing a simulation for the case of Austria as a reference model, we lay the foundation for more universal applications of ABM in political science.

Keywords: voting behaviour, party competition, agent-based simulation.

1 Introduction

Simulating agent behaviour in the face of threats to liberal democracy is a novel approach to understanding the challenges posed by radical populism and associated ideologies. Survey research and existing data can provide a snapshot of the attitudinal disposition of voters and provide us with causal explanations of how attitudes and political preferences are connected. Yet, such research can neither provide us with what-if scenarios, nor model effectively people's behaviour under a variety of conditions and input factors, which would be necessary when wanting to develop and evaluate response strategies.

The objective of building a social simulation in the PaCE[1] project is to study the phenomenon of populism by mapping individual-level political behaviour and explain the influence of agents on, and their interdependence with, the respective political parties. Voters, political parties and – to some extent – the media can be viewed as forming a complex adaptive system, in which parties compete for citizens' votes, voters decide

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on which party to vote for based on their respective positions with regard to particular issues, and the media may influence the salience of issues in the public debate.

Our approach has been to develop a set of valid simulations for one relevant case that we are able to evaluate based on survey data and available expertise on that political system. The following reasons led to our decision for Austria as a case study:

1. *Availability of data*: The Austrian National Election Study (AUTNES) [1] is one of the most comprehensive national election studies. It covers a wide range of variables, including socioeconomic data, media content and media consumption data and specific attitudinal variables of political psychology. This enables us to base the modelled voters on data collected following the 2013 national election in Austria. With the Chapel Hill Expert Survey (CHES) [2] administered in 2014 supply-side data for the time shortly after the election is available.
2. *Relevant political events*: The phase of increased migration to Europe in 2015, which also affected Austria in particular, falls into the period between the two national elections of 2013 and 2017.
3. *History of populism*: Austria includes one of the longest established and most successful radical right populist parties, the Freedom Party of Austria (FPÖ), which not only had to contend with challengers from the radical right (BZÖ, Team Stronach) but also from the centre-right (ÖVP). Even more importantly, the FPÖ served two periods in government, including holding important ministerial portfolios, and successfully negotiated two leadership changes attesting to the party's organizational depth and entrenchment in the Austrian political system.

2 Model Description

Within political science, agent-based simulations are still a rarely used methodology [3,4]. Most agent-based models of elections and party competition refer to spatial and rational choice models going back to Downs [5]. The dimensions of the political space in these models are usually interpreted as policy issues, e.g economic left–right or social liberal–conservative. Research on the strategic behaviour of parties and voters started in the early 1990s with Kollman et al. [6] who investigated how two competing parties position themselves in a space defined by 15 issues when they are uncertain about the position of voters. Laver [7] reduced the political space to two dimensions but extended the number of parties to five, which is important for analyses of European party systems that are typically defined by patterns of multi-party competition. Like [6], he assumes voters' issue positions to be stable. All parties want to increase their share of votes by positioning themselves strategically following one of four different strategies. The model was adapted [8] to allow for the emergence of new and the disappearance of old parties.

While [7] tested his model using electoral data from Ireland, most studies of party competition using ABM were for a long time "an exclusively theoretical exercise" [9]. Muis' study on party competition in the Netherlands [9] paved the way for combining simulations with real world data. Moreover, he extended the previous models by including the role of the media. The first study to apply ABM in research on party

populism [10] explored how populist radical right parties position themselves in a political space to find their "winning formula". The model includes the importance voters attribute to various issues and differentiates between a limited number of party strategies, mostly following [7].

The Austria model expands on this by combining empirical data with theories of voting and party behaviour to represent voters, parties, and their interaction in a political space. From the AUTNES and CHES surveys we identified seven common issues that are used as the dimensions of this space:

- economy (pro/against state intervention in the economy),
- welfare state (pro/against redistribution of wealth),
- budget (pro/against raising taxes to increase public services),
- immigration (against/pro restrictive immigration policy),
- environment (pro/against protection of the environment),
- society (pro/against same rights for same-sex unions),
- law and order (against/pro strong measures to fight crime, even to the detriment of civil liberties).

As the surveys use different scales to code responses (0-10 vs. 1-5 for most questions) the relevant CHES variables had to be re-coded to match the respective AUTNES variables to be able to map the positions of parties and voters into a joint space. For the visualisation of this political space the model user can choose 2 dimensions to be mapped to the x- and y-axes via model parameters.

The model distinguishes two different types of agents: voters and parties. Voters are characterised by demographic attributes (age, sex, education level, income level, area of residence), political attitudes (political interest, party they feel closest to and degree of that closeness, propensities to vote for either of the parties) and their positions on all seven issues. They identify up to 3 of these issues as most important and assign weights to them according to their importance. Political parties are characterised by their name and their party programme, which is expressed as their stances towards the seven modelled issues. They all identify two to three of these as their most important issues and assign a weight to them.

The behaviour of voters and parties is based on theories from the political science literature. Each party applies a strategy to position itself in the political landscape (see section 2.1) to attract voters, whereas voters use strategies to decide which party to vote for (see section 2.3). In addition, voters may change their opinions on any of the policy issues, i.e. adapt their position in the political space. The opinion formation process used in this version of the model is detailed in section 2.2.

Informal political discussions with family, friends or other acquaintances have been found to influence political attitudes and behaviours of voters [11,12]. The social network of voters is thus an important component of a model of voting. While empirical data on networks is rare, studies have shown that the size of political discussion networks is small: people tend to talk to 0-5 other people about politics [13]. In absence of explicit data for the Austria case study, our model adopts a plausible algorithm with both random and homophilic aspects: each voter forms links with 0-2 other voters, choosing the most similar in age, education, and residential area from a pool of

randomly chosen individuals. Since links are bi-directional, this results in a social network where nearly all voters have between 0 and 5 connections to other voters.

The initial state of the model represents the political situation in Austria at the time of the national election 2013. All agents are initialised with empirical data from existing surveys: the 2013 AUTNES for the voters and the CHES administered in 2014 for the parties. The former consists of the responses of 3266 participants whereas the latter includes expert opinions on the positions of the seven major Austrian political parties (SPÖ, ÖVP, FPÖ, Grüne, NEOS, BZÖ, and Team Stronach) at the time. The model assumes discrete time steps, with one step equaling one week in real time. To be able to compare model results with real data from the Austrian national election 2017, we ran all simulations for 208 steps (4 years). Each step the following processes are carried out in the same order:

1. Parties calculate their current vote share and how this changed in comparison to the previous step.
2. Voters have political discussions with other voters, which may result in changing their positions on one or more issues. They also adapt the importance the discussed issues have for themselves.
3. Voters are 'polled', i.e., they decide on which party they would currently vote for according to their strategy.
4. Parties decide to adapt their positions according to their strategy.

2.1 Party Strategies

Parties strive to increase their share of votes by positioning themselves strategically in the political space. To do so, they may apply different strategies to adapt their positions on policy issues. We implemented the four strategies outlined by [10]:

1. An *Aggregator* moves towards the average position of their current supporters in all dimensions. It thus adapts to the ideological stances of their supporters.
2. A *Satisficer* behaves like an Aggregator but stops moving once the aspired vote share is reached or surpassed and only starts moving again if the loss of votes passes a certain threshold.
3. A *Hunter* keeps moving in the same direction if they gained vote share with their last move, otherwise they turn around and choose their next direction with some variability. The version of this strategy implemented in the model restricts movement to the two most important issues of the party.
4. A *Sticker* does not change any of their positions and sticks with their party programme.

Each party is assigned one of these strategies at model initialisation. In the simulations reported here, the two major parties (SPÖ, ÖVP) use the 'Aggregator' strategy, the populist FPÖ applies the 'Hunter' strategy, and all other parties are 'Stickers'. The party roles were assigned based on the following rationale: The large centre parties pursue median voter strategies and thus tend to aim for broad appeal trying to "aggregate" voters and build broad centrist electoral coalitions. Smaller parties are associated with

a particular issue that works for them and maximize the support in certain voter segments. They tend to stick with the policies that work for them and match their brand image. The FPÖ is neither a centre party nor a small party. Thus, it can neither be content with a niche strategy nor with pandering to its supporters but keeps foraging for votes.

In experiments with an earlier version of the model the Aggregator strategy could lead to the two major parties (SPÖ, centre-left, and ÖVP, centre-right) swapping ideologies in one or more dimensions. This is possible because the strategy purely searches for the centre position of the current supporters without constraints. We therefore adapted this strategy so that parties only change positions on their most important issues.

2.2 Opinion Formation

While parties may adapt their positions in the n-dimensional policy issue space according to their strategy (see previous section), voters in current agent-based models of party competition usually remain in place. It is common practice to assume that public opinion on policy issues follows a normal distribution [14] and does not change over time. [10] is a rare example of an ABM using empirical data – in this case, a survey of the Dutch voting population held before the 2006 parliamentary elections – to initialise voters' positions in the policy issue space, but even their voters do not change their opinions during the simulation. Our model is innovative in that it both uses empirical data to initialise the voter agents and implements social processes to allow voters to adapt their positions over the simulated time.

Change of opinion happens through political discussions with other voters. In the model version reported here we apply a modified multi-dimensional opinion dynamics approach [15], which stipulates mechanisms for voters to (a) select interaction partners and (b) adapt their position on the issue under discussion. While interaction partners are selected randomly from the total population, the two will only interact if their ideological distance falls under a certain threshold (bounded confidence model). We follow [15] in that this threshold is different for each voter, depending on their 'affective level' or emotional involvement in policy issues. To avoid random allocation of values to voters we decided to use their level of political interest to represent this attribute, which is available from the empirical data. We measure ideological distance as Euclidean distance of voters' positions on the issue under discussion.

As the result of an interaction, voters may adapt their opinions. The mechanism proposed by [15] involves both interaction partners changing their opinions on all modelled dimensions. We find this assumption unrealistic. Instead, we assume that each discussion only involves one dimension (policy issue) and that any change therefore only applies to this issue, following [16]. There are two possible outcomes of an interaction:

- *Compromise*: If the two voters agree on a majority of the other issues, they will move towards each other's position on the discussed policy issue. The total distance moved grows with the voters' ideological distance but is never greater than a certain maximum value set via a model parameter.

- *Repulsion*: if instead the voters disagree on most of the other issues, they will move further apart from each other on the discussed dimension.

2.3 Voter Decision Strategies

One area that our model improves on is the incorporation of different decision strategies for voters regarding party choice. It is common practice in existing agent-based models of the complex system of voters, parties and their interactions to assume that (a) all voters use the same strategy and (b) this strategy is choosing the ideologically most proximate party, i.e. the party closest to them in all modelled dimensions. In the terminology of Lau et al. [17] this is called Classic Rational Choice. The authors propose and test a set of five types of strategies that are applied when reaching a decision about party choice.

Classic Rational Choice defines voters as actively searching for information on all issues and parties. Voters compare all parties and decide after careful considerations. Whereas rational choice decision making starts at zero, *Confirmatory* decision-making is heavily influenced by voters' long-term relations to parties, such as their party identification. For example, if the election is run by individual candidates, such as presidential elections in many European countries, these voters need only to find candidates' party affiliation to decide which candidate they prefer. *Fast and Frugal*, by contrast, assumes that voters are primarily motivated by efficient decision making. Voters do compare the positions of parties but restrict this effort to the most important issues. The *heuristic-based* fourth strategy is similar, but decisions can be taken based on various heuristics provided by numerous sources such as discussions with friends and neighbours – not only by a direct comparison of, for example, policy positions. *Gut* decision-making, finally, is strictly affective; voters do not search for any kind of information, at least not systematically.

We operationalized these strategies for our model as follows:

- *Rational choice*: A voter chooses the party closest to them on all modelled issues (Euclidean distance in seven dimensions).
- *Confirmatory*: A voter chooses the party they feel closest to (taken from the AUTNES 2013 data).
- *Fast and frugal*: A voter chooses the party closest to them on their most important issues (weighted Euclidean distance in two dimensions).
- *Heuristic-based*: A voter follows recommendations of people they trust and chooses the party most of their friends will vote for.
- *Going with gut*: A voter chooses the party they have the highest propensity to vote for (taken from the AUTNES 2013 data).

At model initialisation, each voter is assigned one of the strategies. For this we must solve the problem of how to fit voters to strategies. First experiments with random allocation according to specified proportions of strategy types were deemed unsatisfactory. While [17] report some correlations of demographic or political variables with strategy types (e.g. "rational choice is particularly high among women, young people

and respondents with high levels of political interest") these are relatively vague and not unambiguous. To attempt an improved allocation of strategies to voters we restricted the pool of AUTNES participants to the subset who voted for one of the parties represented in the model (1060 respondents). We then allocated the rational choice strategy to those who actually voted for their 'rational choice' (party closest to them in all seven dimensions at model initialisation). The confirmatory strategy was allocated to voters who voted for the party they felt closest to, whereas fast and frugal was allocated to those voting for the party they deemed best able to solve their most important issue. The heuristics-based strategy (following recommendations of friends) was allocated to voters who are generally trusting in people, do discuss politics sometimes and have family and friends who are interested in politics, while the gut decision making strategy was allocated to all voters with low political interest and knowledge.

As anticipated, this did not solve the problem as only 31% of voters ended up with exactly one strategy. Another third had two strategies, 15% had three and 2% even had four possible strategies allocated to them, while about 18% of respondents could not be assigned at all via these categories. Nevertheless, we decided to utilize this – albeit slight – improvement over a completely random strategy allocation. All simulations reported here are run with the subset of 1060 voters and strategy allocation at model initialisation employs a mixture of direct assignment (the one pre-determined strategy for a third of the voters) and random selection (pick one of the pre-determined strategies for about half of the voters and any one of the five strategies for the rest) under the constraint that the specified proportions of strategies (a model parameter) is met.

2.4 External Influences

Given that voters and parties do not exist in a vacuum only concerned with themselves or each other but are influenced by events happening in the world around them, it is necessary to take extraneous influences into account. The events deemed most influential during the period 2013 to 2017 that we are covering with the simulation are the refugee crisis of 2015/16 and the leadership change in the ÖVP shortly before the election in 2017.

As the new leader emphasised the topic of immigration above all else, we represent this change in leadership by adapting the most important issues of the ÖVP accordingly at the correct time during the simulation. This has the effect that the ÖVP will then start moving on the 'immigration' issue in addition to the 'economy' and 'spend vs. taxes' issues. To also account for the sharp change in leadership style with the new party chair reorienting the ÖVP, we introduced ideal positions for parties, defining where the party wants to head in the policy issue space. The 'Aggregator' strategy can then be adapted to pursue a path weighing its supporters' positions against the party's own ideological ideal positions as suggested by [14]. The new ideal positions are taken from the 2019 CHES dataset.

To cover the effects of the refugee crisis on the political landscape we need to account for a change in issue salience in the public opinion over time. While some topics stay close to the heart of people (for Austria e.g. unemployment), others gain and lose in importance in the public opinion. The media is involved in this process and may act

as an amplifier or filter by applying their agenda-setting power [18]. In the absence of detailed media analysis data for the specified period in Austria we have chosen to use issue salience in the public opinion as available in the Eurobarometer series of surveys published by the European Commission as a proxy. The Eurobarometer contains two to three data sets per year for the time period in question. We are focussing on the answers to the question "What do you think are the two most important issues facing (OUR COUNTRY) at the moment?" for Austria. After matching the Eurobarometer categories to the seven issues represented in our model, we rescaled the data so that the sum of all issues equals 100%. Fig**.** 1 shows the resulting time series. The sudden spike in the salience of the 'immigration' topic coinciding with the refugee crisis of 2015/16 is clearly visible.

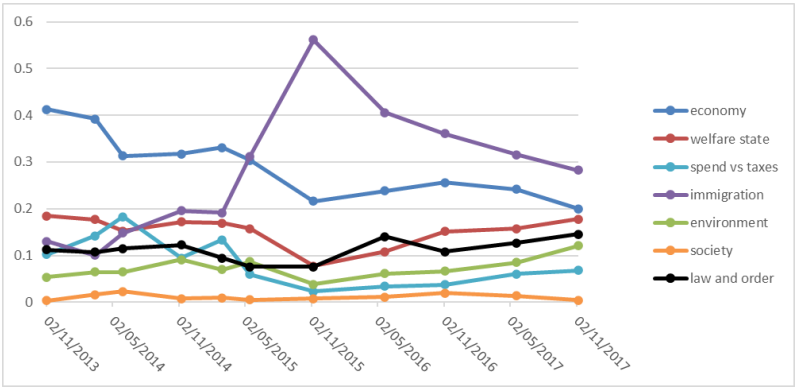

Fig. 1. Salience of the modelled seven issues in the Austrian public opinion over time (adapted from Eurobarometer survey data).

The salience values for each issue along with the respective dates converted to simulation time are stored in a suitable data structure at model initialisation so that they are easily accessible during the simulation. The model keeps track of the currently 'valid' salience values for the seven issues and changes them at the pre-determined points in simulation time to the new values for the next period. To emulate the media's influence on voter opinion, these values are applied as probabilities to select the topic to talk about during voter interactions.

3 Simulated Scenarios

We have undertaken experiments with our model to investigate the effect of different voter decision strategies. Specifically, we looked at the following scenarios: (a) all voters using rational choice, (b) all voters using fast and frugal, and (c) the electorate is divided into five groups, each using a different strategy. All simulation runs use the same model specification:

- 1060 voters, initialised from the AUTNES dataset

- 7 parties, initialised from the CHES dataset
- Party strategy assignation as follows: SPÖ and ÖVP use ‘aggregator’, FPÖ uses ‘hunter’, all other parties (Greens, BZÖ, NEOS, Team Stronach) use ‘sticker’
- Opinion formation process with set voter adaptation threshold (1.0), discussion frequency (1), maximum distance per position change (0.5) and maximum salience change (3).
- A time step represents a one-week period, the simulation thus runs for 208 steps representing 4 years.
- 20 runs per scenario, with the same set of 20 different random number seeds.

The following figures show time series of the parties’ vote shares taken from typical runs. As can be clearly seen, the type and mix of voting decision strategies present in the population of voters have a huge impact on the outcome of the simulated elections. If all voters apply the ‘Rational Choice’ strategy as is usual in other models, the SPÖ wins a comfortable majority of the votes, while the populist FPÖ comes in as the second largest party (see **Fig. 2**). The conservative ÖVP, however, is relegated to the small parties instead of being one of the two major ones. The change in leadership shortly before the 2017 elections (at simulation time step 189) does nothing to prevent this outcome; on the contrary, it results in losing the party some additional votes. Surprisingly, the sudden rise in salience of the ‘immigration’ topic does not seem to have any influence on the vote shares. Single runs differ slightly in the exact shape of the time series and the percentages parties achieve at the end, but the overall results are the same and diverge greatly from the actual election results in 2017. This indicates that the assumption all voters can correctly be modelled as “being rational” does not hold, at least not for Austrian voters.

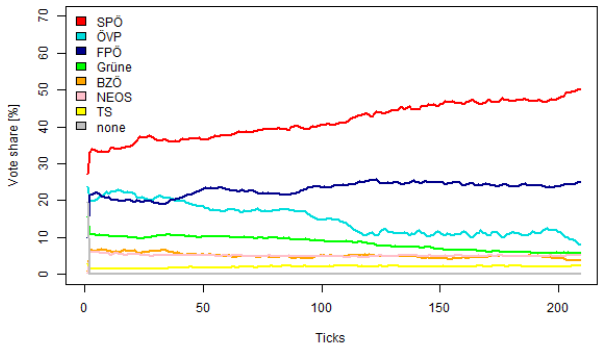

Fig. 2. Evolution of vote shares over time with all voters using ‘Rational Choice’.

Experiments with ‘Fast and frugal’ as the single voter strategy show a very different outcome. This strategy lets voters concentrate on their two most important issues and weigh their distance to the parties’ positions with the importance they give these issues. As can be expected, the change in issue salience in the public opinion – and consequently, in individual voter’s assessments – has a dramatic effect on the vote shares of

the different parties. While in more than half of the runs the ÖVP wins an absolute majority (see an example in **Fig. 3**, left), in a few cases (two runs) the FPÖ happens to be the lucky winner, while in the third category (six runs) ÖVP and FPÖ battle it out between them (see **Fig. 3**, right). All other parties are relegated to inconsequent participants in the political arena.

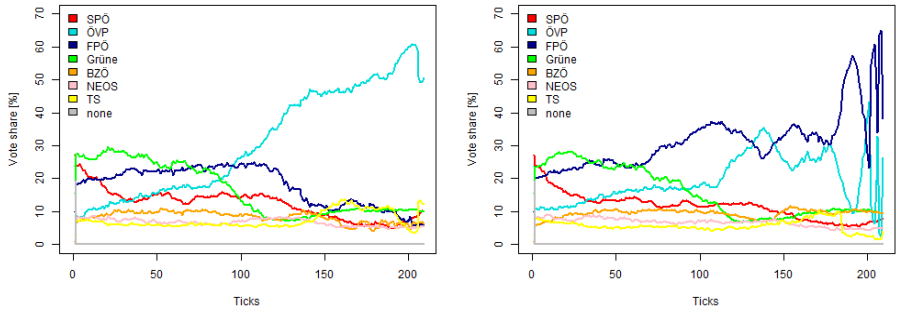

Fig. 3. Evolution of vote shares with all voters using the 'Fast and frugal' strategy.

In a last scenario, we applied a mix of strategies: 18.3% rational choice, 29.8% confirmatory, 38.5% fast and frugal, 4.9% heuristics-based, and 8.5% going with your gut. The proportions have been derived from our analysis of the AUTNES data (see section 2.3). In this scenario, the SPÖ consistently comes up as the second largest party, losing either to the ÖVP or the populist FPÖ. The sudden rise in salience of the 'immigration' issue (starting about half way through a simulation) is clearly visible in the rise of the vote shares of the party managing to claim the 'sweet spot' in the voters' opinions for themselves. The different runs can be categorized into three different cases: (i) The ÖVP rises together with the 'immigration' issue and beats the FPÖ, who cannot maintain its impetus (majority of runs, see an example in **Fig. 4**, left); (ii) the reverse case, in which FPÖ and ÖVP swap roles (one run); (iii) ÖVP and FPÖ take turns in profiteering from the 'immigration wave' and battle for the top spot (five runs). The example shown in **Fig. 4** (right) is particularly interesting in that it manages to qualitatively reproduce the trends in opinion polls between the 2013 and 2017 elections[2], where after a long period of a stable lead for the FPÖ the ÖVP sees a sudden gain (due to the change in leadership), which secures them the election win.

These results demonstrate that the empirically based mix of strategies is a necessary but not sufficient requirement to obtain results close to the observed historical data with our model. Our next steps will be to undertake further investigations of the conditions leading to "successful" runs.

[2] https://en.wikipedia.org/wiki/Opinion_polling_for_the_2017_Austrian_legislative_election

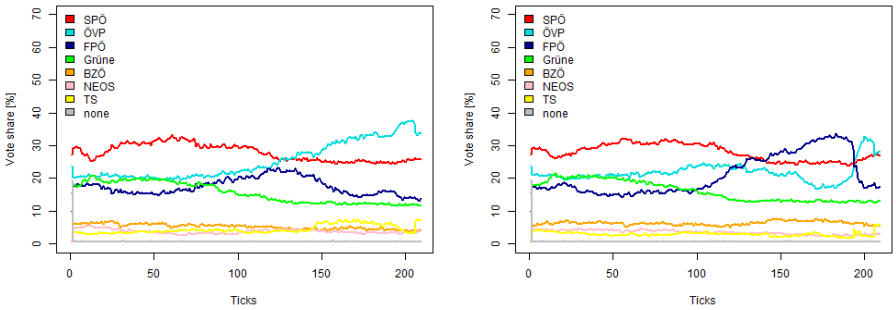

Fig. 4. Evolution of vote shares with a mix of voter decision strategies.

4 Discussion and Conclusion

As our simulations show, the type and mix of voting decision strategies present in the population of voters have a huge impact on the outcome of the simulated elections. The mix of strategies understandably leads to the most realistic outcomes. While none of the experiments exactly replicate the election results of 2017, this is to be expected from a model that – even though based on comparatively rich empirical data – has to make assumptions where data and behavioural theories leave gaps. Coming qualitatively close to real-world opinion polls is therefore quite an achievement.

Simulating voting behaviour accurately and in the context of a rapidly changing political environment is extraordinarily difficult and has thus rarely been attempted. The literature bridging the gap between simulations and empirical election research is exceedingly thin as there are numerous hurdles to overcome -- both in terms of the subject matter to be simulated and the theoretical as well as epistemological assumptions underlying the different fields involved. Primarily, we want to test the feasibility of applying agent-based modelling to the research of voting behaviour, especially in the context of demand for, and supply of, populism. In doing so, we hope to go beyond the traditional tools of political science and thus generate insights of voting research as is practised so far.

Why is this useful given that empirical voting research can generate relatively accurate predictive and explanatory models on voting behaviour? There are two major reasons: First, we hope to be able to shed light on what-if scenarios, which is otherwise notoriously difficult in normal social science research because it is not equipped to handle counterfactuals, as these would be considered speculative. Second, the PaCE project aims at developing counter strategies, which may require (the simulation of) purposefully changing certain input factors to see their effect. This is something we hope the computer simulation can accomplish better than the traditional analysis of causal relations.

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