D2.5:

Lessons learned from the simulation analysis

WP2 – Simulation Analysis

About this document

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Contents

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: cannot provide us with what-if scenarios, it cannot capture how people's behaviour might vary under a variety of conditions and input factors (which would be necessary when wanting to develop and evaluate response strategies), and it misses out completely the micro-level dynamics that result in the observed macro-level changes.

The objective of building social simulations in the PaCE project was to study the phenomenon of populism by modelling individual-level political behaviour in order to better understand 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 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. The interaction between the various processes and structures in complex adaptive systems are very hard to understand in any other way.

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. We therefore started with Austria with its long-established populist Freedom Party of Austria (FPÖ) and focussed on the period between the two national elections 2013 and 2017. This includes the 'migrant crisis' of 2015/16, during which the FPÖ gained influence. This choice was determined by a combination of a rapid rise in a nativist party and the availability of good data.

Our second case study is Germany with its right-wing populist party Alternative for Germany (AfD). Founded in 2013 it failed to make it into the Bundestag (federal parliament) at the national elections that same year but subsequently succeeded at the elections to the Länder parliaments in 2016 by capitalising on the immigration topic. In contrast to Austria, the German political landscape also includes a left-wing populist party (Die Linke) descended from the former Socialist Unity Party of Germany (SED). The data for this case is not as good as in the Austrian case, so we have had to use some additional assumptions here.

This is cutting-edge political science. Models of voting behaviour tend to *either* remain at the macro-level matching observed data but without explicitly representing aspects of individual behaviour (e.g. how people might socially influence each other) *or* they remain abstract models that do not relate directly to observational data or other real-world evidence. In PaCE we are attempting to include the co-adaptive processes at the voter and party levels, whilst also being based on the available evidence (both in formulation and validation processes).

The research questions are:

- To what extent can we capture the underlying dynamics displayed in the Austrian case?
- Can the observed outcomes be explained by pure 'Rational Choice' or 'Fast and Frugal' voting strategies?
- Does the underlying influence network matter to what governments might be elected and, if so, how?
- To what extent can 'positive party identification' be a contributory explanatory factor of the observed polling results?
- To what extent can the same model structure be used to explain both Austrian and German polling data?

2 The Austria Model

The Austria model is an agent-based model, i.e. it simulates the actions and interactions of autonomous agents, which may represent individual actors (e.g. voters) or collective entities (e.g. parties). Within political science, agent-based simulation is still a rarely used methodology (Johnson 1999, Kollman & Page 2005). Most agent-based models of elections and party competition (e.g. Kollman et al. 1992, Laver 2005, Laver & Schilperoord 2007, Muis 2010, Muis & Scholte 2013) refer to spatial and rational choice models going back to Downs (1957). The Austria model expands on this tradition by combining empirical data with theories of voting and party behaviour to represent voters, parties, and their interaction in a political space. Figure 1 illustrates the different elements of the simulation model.

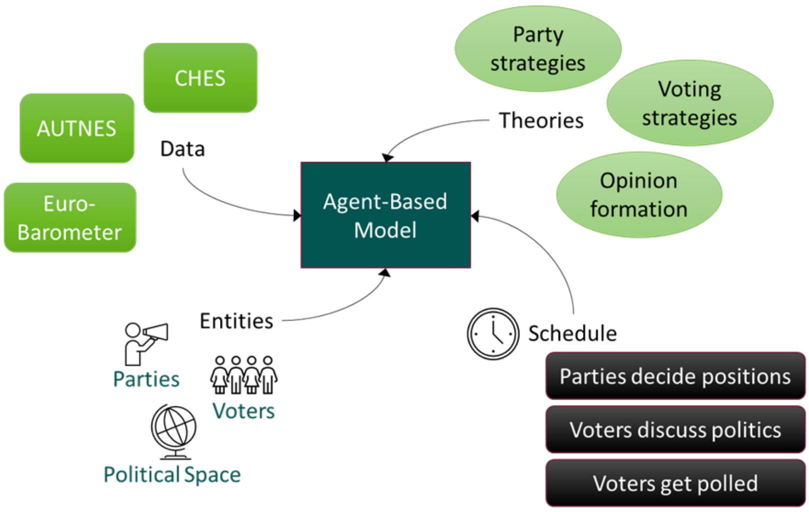

Figure 1: An illustration of the main simulation elements.

Parties and voters are agents whereas the political space is spanned by seven policy issues ranging from economical, societal, and environmental topics to immigration policy. Each of these is interpreted as a spatial dimension within a left-right ideological spectrum. Parties and voters take positions on particular issues with lower values indicating they are ideologically left-leaning and higher values indicating they are ideologically right-leaning. The respective values for each voter and party agent are initialised from empirical data: the 2013 Austrian National Election Study (AUTNES) (Kritzinger et al. 2013) for the voters and the Chapel Hill Expert Survey administered in 2014 (Polk et al. 2017) for the parties.

Other attributes of the agents are also defined by the data. For the voters these are demographic characteristics (age, gender, level of education, residential area, income situation), political attitudes (closest party, level of political interest, propensities to vote for any of the parties, probability to vote in the election) and up to three issues of the political space they find most important. For the parties these are their names (included are the seven major Austrian political parties at the time, namely SPÖ, ÖVP, FPÖ, Grüne, NEOS, BZÖ, and Team Stronach) and equally up to three issues identified as most important. Both parties and voters assign weights to them according to their importance. A detailed list of how the data was matched to agent variables can be found in the appendix.

Empirical data on issue salience in the public opinion available from the Eurobarometer series of surveys is used as a proxy to model the influence of the media. After matching the relevant Eurobarometer categories to the seven issues represented in the model and rescaling the data, the respective values are applied as probabilities to select the topic to talk about during voter interactions to emulate the media's influence on voter opinion.

The behaviour of voter and party agents is based on theories from the political science literature. To attract voters, parties apply one of a variety of strategies to position themselves in the political landscape (Laver 2005, Muis and Scholte 2013); they can choose from "Sticker" (stick to their ideological positions), "Aggregator" (move towards the centre of supporters), "Satisficer" (move like an aggregator until the aspired vote-share is reached), or "Hunter" (seek votes opportunistically by changing direction whenever the vote-share drops) . The movement of both "Hunter" and "Aggregator" are restrained to the party's most important issues.

Voters use another set of decision-making strategies to decide which party to vote for. The five strategies identified by (Lau et al. 2018) comprise "Rational choice", which chooses the party closest in all seven dimensions; "Confirmatory", which picks the party a voter feels closest to (taken from AUTNES); "Fast and frugal", which only looks at the two most important issues to determine the closest party; "Heuristic-based", in which a voter follows recommendations from friends; and "Go-with-your-gut", where voters follow their instinct. Both party and voter strategies are the same as in the previous model version and are presented in more detail in D2.3 while (Meyer et al. 2022) includes a discussion on how to assign strategies to voters.

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 is different in this latest model version and is described below.

The initial state of the model represents the political situation in Austria at the time of the national election in September 2013. The model assumes discrete time steps, with one step equalling one week in real time. To be able to compare model results with real data from the Austrian national election 2017, all simulations are run 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. Media influences the public debate.
3. 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.
4. Voters are 'polled', i.e., they decide which party they would currently vote for according to their strategy.
5. Parties decide to adapt their positions according to their strategy.

2.1 Voter Opinion Formation

Change of opinion happens through political discussions with other voters. These are realised based on a modified multi-dimensional opinion dynamics approach (Schweighofer et al. 2020), 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). 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 the Austria model uses their level of political interest to represent this attribute, which is available from the empirical data. Ideological distance is measured as Euclidean distance of voters' positions on the issue under discussion.

As the result of an interaction, voters may adapt their opinions. Instead of the mechanism proposed by Schweighofer et al. (2020), which involves both interaction partners changing their opinions on all modelled dimensions, the Austria model assumes that each discussion only involves one dimension (policy issue) and that any change therefore only applies to this issue, following (Baldassarri & Bearman 2007). 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.

Whenever voters adapt their positions as an outcome of an interaction, they will also change the issue salience. We assume that talking about a topic raises its salience slightly while the importance of seldomly discussed topics decays. This is implemented in the model as adding an amount between 0 and *max-salience-change* (model parameter) to the importance of the just discussed topic and taking the same amount away from one of the other topics so that the sum of all saliences always equals 100%. A change in salience might subsequently lead to a change in which issues a voter finds most important and thus directly influence the outcome of the "fast and frugal" decision-making strategy.

3 Results of the Simulation Analysis

3.1 Effect of Voter Decision Strategies

To investigate the effect of different voter decision strategies we looked at the following scenarios: (a) all voters use 'rational choice', (b) all voters use 'fast and frugal', and (c) the electorate applies a mix of the five different strategies with proportions derived from an analysis of the AUTNES data. All simulation runs use the same model specification:

- Voter agents: 1066 voters, initialised from the AUTNES data set
- Party agents: 7 parties, initialised from the CHES data set
- Party strategies: The two major parties SPÖ (centre-left) and ÖVP (centre-right) use 'Aggregator', the radical-right FPÖ uses 'Hunter', the small parties Greens, BZÖ, NEOS and Team Stronach use 'Sticker'
- Opinion formation process with set model parameters: voter adaptation threshold (1.0), discussion frequency (1), maximum distance per position change (0.5) and maximum salience change (3).

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 with the conservative ÖVP relegated to the small parties (see Figure 1Figure 2). 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.

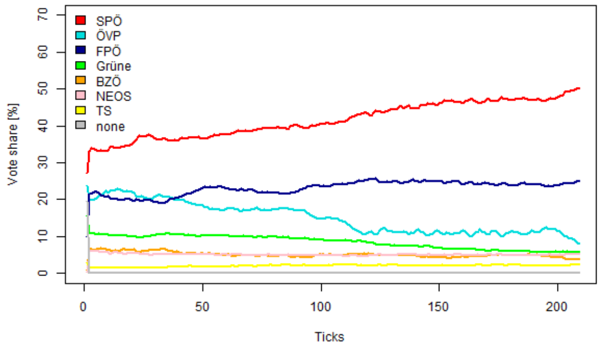

Figure 2: Evolution of vote shares over time with all voters using 'Rational Choice'.

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 Figure 3, left), in a few cases the FPÖ happens to be the lucky winner, while in the third category ÖVP and FPÖ battle it out between them (see Figure 3 right).

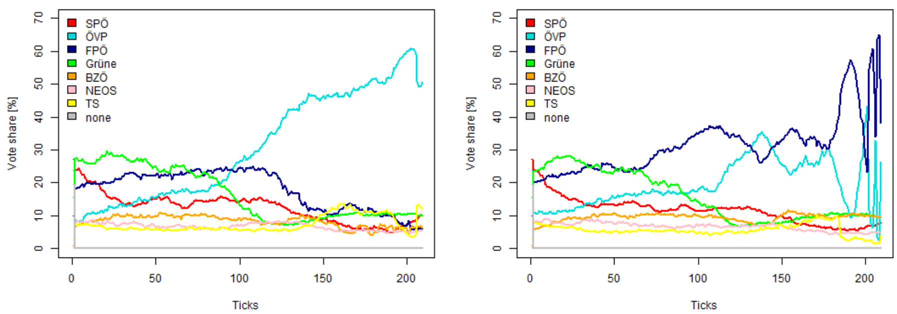

Figure 3: Evolution of vote shares with all voters using the 'Fast and frugal' strategy.

In a third 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. In this scenario, the SPÖ consistently comes up as the second largest party, losing either to the ÖVP or the populist FPÖ. A small number of runs with this mix of strategies, however, managed to qualitatively reproduce the trends in opinion polls between 2013 and 2017. Figure 4 shows a comparison of the real-world data (top) with the best model results (bottom).

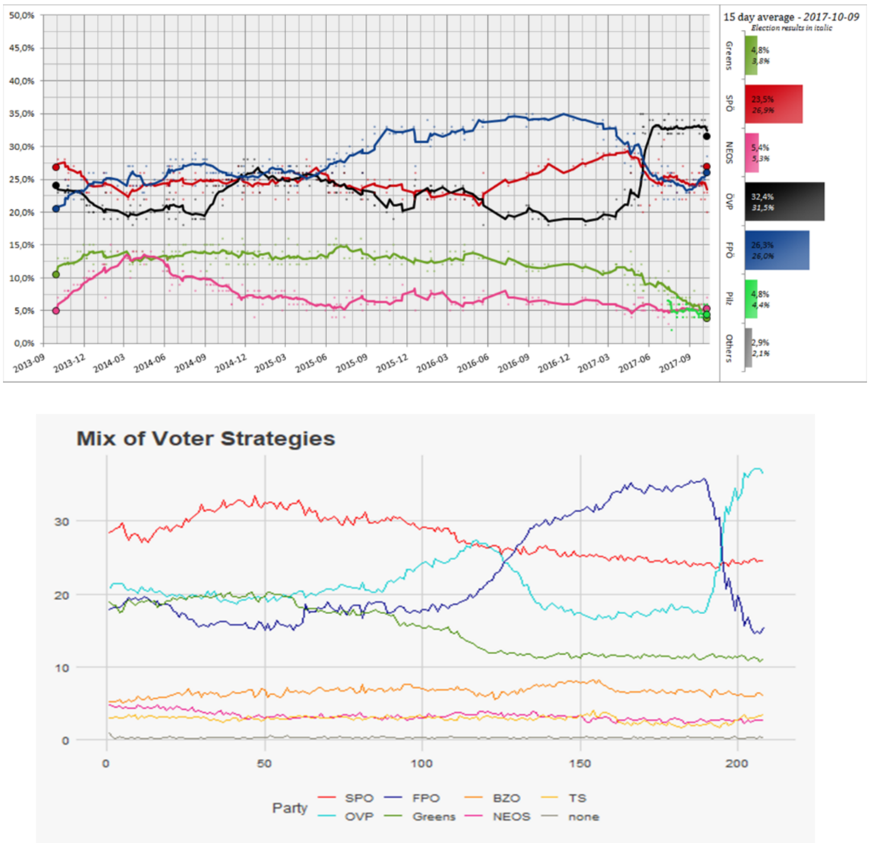

Figure 4: Real opinion polls[1] vs. model results

These simulations demonstrate that 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.

3.2 Effect of Social Networks

3.2.1 Fixed Networks

Informal political discussions with family, friends or other acquaintances have been found to influence political attitudes and behaviours of voters (Huckfeldt & Sprague 1991, McClurg 2003). It can therefore be argued that the social network of voters is 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 (Lake & Huckfeldt 1998). In absence of explicit data for the Austria case study, the 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.

Due to the nature of the opinion formation process implemented in the latest version of the Austria model described above, this social network is only used for the heuristic-based decision strategy, in which a voter follows the party decision of the majority of their social links. Interaction partners for political discussions are instead chosen randomly from the total population (random mixing). Thus, everybody is potentially talking to everybody else under the constraint that their opinion on the discussed issue is not too different (bounded confidence).

[1] Source: https://en.wikipedia.org/wiki/Opinion_polling_for_the_2017_Austrian_legislative_election

An analysis of the interactions taking place in a typical model run shows that any two randomly chosen voter agents talk to each other at most 5-6 times over the course of the simulation. However, this is very rare; most will never interact (>70%) or only once (about 22%).

To investigate if the model can be improved by choosing discussion partners from a voter's social links as suggested by political science research, we consider four different network topologies:

- The homophily-based network as already implemented in the model.
- A regular random network, where each voter is connected to exactly *n* randomly chosen other voters (with *n* specified by model parameter number-of-friends).
- An Erdös-Rényi random network, where each configuration of a network with the given mean degree is equally likely; the algorithm used to create this network keeps adding links between randomly chosen pairs of voters until the mean degree (model parameter number-of-friends) is reached.
- A scale-free network obtained from preferential attachment, i.e., the probability to connect with a voter rises with the number of links this voter already has.

To achieve networks as close as possible to the specification of political discussion networks with 0-5 discussants for every voter, we set the parameter *n* to 3. Table 1 shows the resulting typical values for the different topologies and a population of 1060 voters. The chosen social network is created at model initialisation and remains fixed during a simulation run.

Table 1: Social network characteristics

Network type	*Total number of links*	*% voters with 0-5 links*	*Mean degree*	*Max degree*	*Min degree*	*Number of unconnected voters*
Homophily-based	1064	99.3	≈2	7	0	123
Regular random	1590	100	3	3	3	0
Erdös-Rényi	1590	91.3	3	11	0	50
Scale-free	1059	95.5	≈2	58	1	0

3.2.2 Dynamic Networks

Keeping the network fixed means that interactions outside the existing social links are not possible. Since these links are still mostly assigned randomly, however, some connections may function less well than others. Some linked voters might be ideologically too far apart on one or more issues for them to ever engage in a conversation on that topic, whereas others might interact but disagree repeatedly. The simulated time frame of four years is also long enough for it to be possible that voters make new acquaintances to have political discussions with.

We therefore consider an alternative scenario with dynamic networks, where agents may form new random links, friend-of-friend links or drop links with those they disagree with a lot. To this end we introduce two new model parameters: the maximum number of disagreements before the link is dropped (drop-threshold) and the chance to make a new link (new-link-prob). The outcome of any interaction between two voters is recorded on the link that connects them and stored in a list (-1 for disagreement, +1 for agreement). At the end of each simulation step, a process to evolve the social network is added. This first deletes all links where the number of disagreements exceeds the drop threshold. Then each voter has the chance to form a new link with either a friend of a friend (80%) or a randomly chosen other voter (20%).

In the experiments reported here, the drop threshold was set to 10 and the probability for a new link to 0.007. While the latter number looks rather small, it avoids an excessive increase in the number of links, keeping the overall ‘shape’ of the network close to the requirements for political discussion networks.

3.2.3 Comparison of Results

Fixed and dynamic networks are explored through a set number of different scenarios, defined by varying a few chosen model parameters. These govern how often political discussions happen amongst voters (*discussion-freq*: 1, 2 or 5), how easily voters are convinced to change their opinion (*voter-adapt-prob*: 0.5 or 1) and the shape (network-type: one of the four different topologies homophily-based, regular random, Erdös-Rényi, preferential attachment) and variability of the social network (model parameter *dynamic-network?* switched off or on). Each scenario is simulated 50 times with the same set of random number seeds.

To compare the different scenarios, we look at election results in the form of possible government formation and measure voter satisfaction as distance to the new government in all or the two most important issues, respectively. Government formation here solely takes the vote shares of parties into account. The largest party forms a coalition with the next largest party/parties until they reach a majority (> 50%). The ideological positions of such a government in the political space are then computed as the weighted averages of the coalition partners. While this may result in very unrealistic coalitions, for example combining the populist FPÖ with the Greens, it is still a suitable indication of the outcome of a simulation.

To see if voter interaction via the social network improves the realism of the results, each run is compared to the observed historical data. We find that for the *fixed networks*, none of the runs comes close and that the network topology does not make much of a difference (see Section 9.2.1 in the appendix for a selection of graphs for individual runs). The SPÖ prevails as the biggest party throughout, while the ÖVP comes out as the second biggest party in about 70% of runs, forming a coalition with the SPÖ. The populist FPÖ manages to join the government in up to a third of the cases, mostly in 3-party coalitions. The change of issue salience in the public opinion (rise of the immigration topic) never leads to a dramatic gain for the FPÖ but rather benefits the ÖVP temporarily (see Figure 5 for an example). This effect is slightly more pronounced with increased discussion frequency, coinciding with a decrease in the government participation of the populists. Figure 1 illustrates the subtle trends with regard to voter interaction.

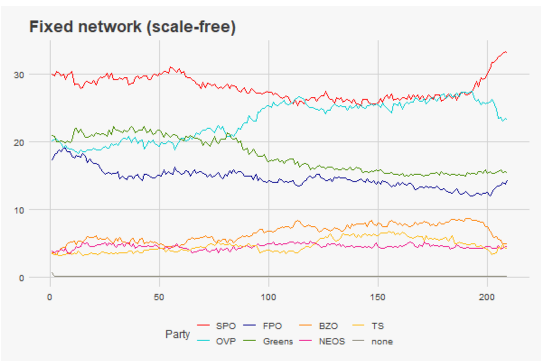

Figure 5: Typical run with a fixed network (scenario: scale-free network, discussion frequency 2, voter adaptation probability 1)

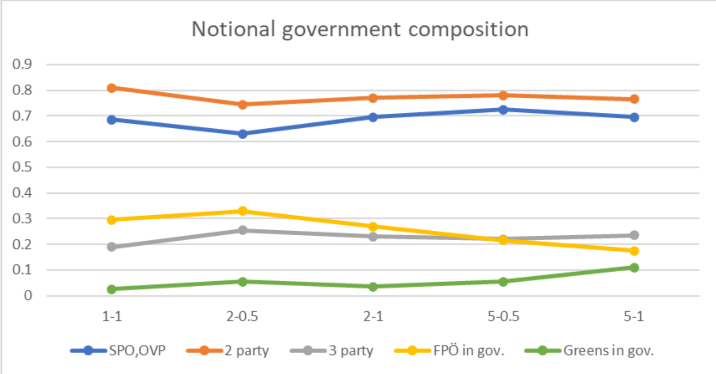

Figure 6: Composition of notional governments over different scenarios across fixed networks

The results differ for the *dynamic networks*, i.e., if voter agents are allowed to gain new discussion partners and stop talking to people they disagree with a lot during a simulation. Regardless of network type, there are no longer any 3-party coalitions, and the Greens are never in government. The larger parties win enough vote share to only need one other coalition partner and the Greens are not amongst those. The SPÖ is still either the biggest or the second biggest party, but the FPÖ now manages to win up to 27% of cases depending on the parameter settings defining the voter interaction (discussion frequency, voter-adapt-prob): starting from 3% (scenarios 1-1, 2-0.5) to 16% (scenario 2-1), to 27% (scenario 5-1). The gain for the ÖVP is even more dramatic, ranging from 3% (scenarios 1-1, 2-0.5) to 43.5% (scenario 5-1). The more people talk and convince each other, the higher the chance that the FPÖ or ÖVP become the largest party instead of the SPÖ (see Figure 7)

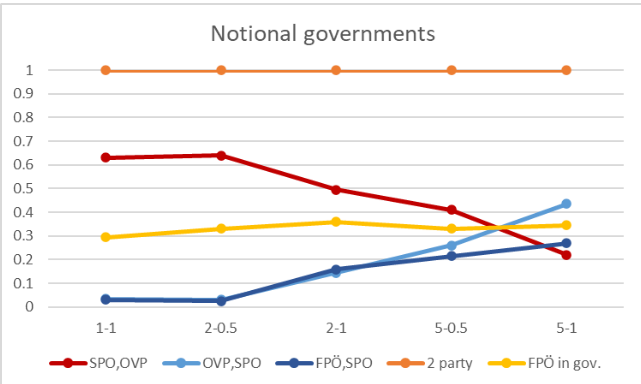

Figure 7: Composition of notional governments over different scenarios across dynamic networks

Change in issue salience in the public opinion now has a noticeable effect, though the advantage is still mostly taken by the ÖVP. A few runs do come qualitatively close to the historical data and here the network type does make a difference: while the Erdös-Rényi and Regular Random network both display examples of "successful" runs the other two network types (homophily-based and scale-free) do not. Figure 8 shows the best result, obtained with the Erdös-Renyi network in scenario 5-1 (discussion-frequency 5, voter adapt prob 1).

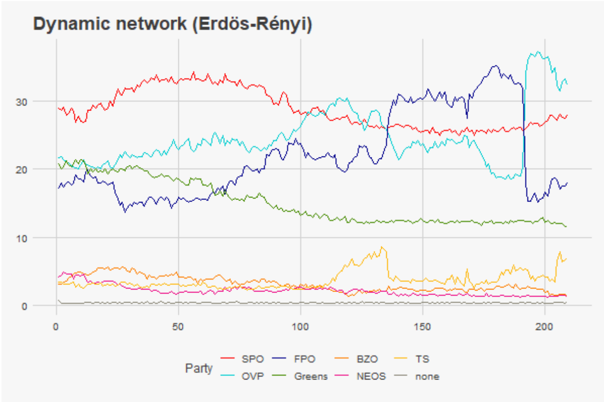

Figure 8: Best model results with dynamic networks

3.3 Effect of Positive Party Identification

Another avenue explored to improve the realism of the Austria model was to focus on voters who base their decision for a particular party on their positive identification with it. In political science terms this is called party identification or partisanship and denotes a long-term psychological attachment to a specific party (Dalton 2016). Social identity theory has been applied to study the nature of partisanship and its political consequences (Huddy & Bankert 2017), since it can be argued that party identification is similar to identifications with other social groups.

To implement the positive identity mechanism, we adapted the model based on the following assumptions:

1. A voter with 'positive identity' behaviour feels very close to the party they identify with. They will therefore always vote for this party, regardless of their agreement with the party's policy positions.
2. When discussing politics with others, voters identifying with a party will not change their opinions but may still influence others to do so.

We consider two different types of positive identity: 'green' (a partisan of the Greens) and 'nativist' (a partisan of the FPÖ). Their respective occurrence in the population can be set via two new model parameters (*green identity*, *nativist identity*). To stay as close as possible to the empirical data while also being able to vary the number of partisan voters we restricted the pool of possible 'identitarians' to voters who voted for the Greens / FPÖ in the last election and/or show the highest propensity to vote for them in the future (variables *voted-party* and *party-propensities*, both initialised from AUTNES). These are selected in order of distance, starting with those ideologically closest to the respective party in their 'trademark' policy issues (immigration and law and order for the FPÖ, environment and society for the Greens).[2] All other voters are initialised as having no identity ('none').

The allocation of voting strategies to voters remains the same. However, the strategies are slightly modified to ensure that 'identity' voters always choose the party they identify with (assumption 1). Interactions between voters differ only in their effect on 'identity' voters, who will not change their opinions but still adapt their issue salience (assumption 2).

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[2] As the maximum number of voters with highest propensity for the FPÖ is 215 (317 for the Greens), we decided to divide the group of possible nativist/green identitarians into 10 levels of 20 voters each. That means if the model-parameter *green-identity* is set to 7, 7 * 20 = 140 voters will be assigned the 'green' identity.

We simulated a range of scenarios to investigate the effect different fractions of 'positive identity' voters in the population might have on the election outcome. For this we varied the parameters green-identity and nativist-identity from 0 to 10 in steps of 2. This means that we look at what happens when none, 4%, 8%, 11%, 15% or 19% of voters adopt the 'green' or 'nativist' identity and any combinations of these. Each scenario consists of 50 simulation runs with the same set of 50 random number seeds. We repeated the whole set of scenarios once for the default opinion formation process (random mixing, as described in section 2.1) and once for the variation with static social networks using the homophily-based political discussion network (see section 3.2.1). Other parameters were kept fixed (discussion-frequency 1, voter-adapt-prob 1, max-salience-change 3, max-p-move 0.5).

Does this improve the realism of the model with regard to the evolution of vote shares over time or the election results? Comparing each run to the observed historical data shows that none of them comes qualitatively close to the real opinion polls when using the fixed network. With random mixing (equivalent to all agents being connected to all others), a very small number of runs arguably demonstrate the main features of a rise of the FPÖ during the migrant crisis followed by a sharp drop and rise of the ÖVP due to its change in leadership (see an example in Figure 9). But the presence of 'green identity' voters means that the vote share of the green party is always exaggerated compared to the observed polls.

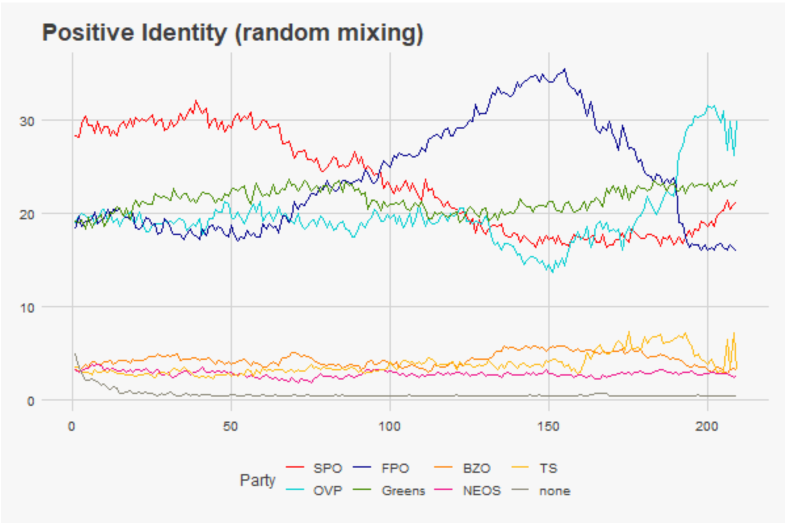

Figure 9: Example of a 'successful' run with low levels of positive identity voters

The tables below are visual representations of outcomes of the different scenarios. Each scenario is defined by the number of green identity voters (rows) and the number of nativist identity voters (columns) present in the agent population. The values in the cells are the proportion of simulation runs that result in the given outcome. So a value of 0.94 in the table "FPÖ largest party" for scenario 'green 0 / nativist 200' shows that the FPÖ became the largest party in 94% of all 50 simulation runs undertaken for that scenario (see Figure 10, bottom left). The shading of the cells emphasizes the numerical values to aid in quick comparison between and across scenarios. The darker the colour, the higher the number. The colours were chosen to indicate the party (blue FPÖ, green Greens).

FPÖ in government

Scenarios		number of nativist identity voters					
		0	40	80	120	160	200
number of green identity voters	0	0.22	0.7	0.98	1	1	1
	40	0.18	0.44	0.86	1	1	1
	80	0.08	0.5	0.86	0.98	1	1
	120	0.02	0.34	0.94	0.98	1	1
	160	0	0.08	0.94	0.84	1	1
	200	0	0	0.94	0.58	0.98	1

Greens in government

Scenarios		number of nativist identity voters					
		0	40	80	120	160	200
number of green identity voters	0	0.3	0.22	0.18	0	0	0
	40	0.66	0.76	0.64	0.24	0.06	0.02
	80	0.92	0.96	0.88	0.74	0.28	0.12
	120	1	1	0.88	0.82	0.58	0.52
	160	1	1	0.88	1	0.94	0.98
	200	1	1	0.88	1	1	1

FPÖ largest party

Scenarios		number of nativist identity voters					
		0	40	80	120	160	200
number of green identity voters	0	0	0	0	0.1	0.66	0.94
	40	0	0	0	0.14	0.78	1
	80	0	0	0	0.22	0.8	1
	120	0	0	0.02	0.32	0.86	1
	160	0	0	0	0.06	0.66	0.98
	200	0	0	0	0	0.08	0.74

Greens largest party

Scenarios		number of nativist identity voters					
		0	40	80	120	160	200
number of green identity voters	0	0	0	0	0	0	0
	40	0	0	0	0	0	0
	80	0	0	0	0	0	0
	120	0.06	0.04	0.08	0.14	0.04	0
	160	0.56	0.7	0.76	0.78	0.3	0.02
	200	0.98	0.98	1	1	0.92	0.26

Figure 10: Comparison of scenarios (fixed network)

FPÖ in government

Scenarios		number of nativist identity voters					
		0	40	80	120	160	200
number of green identity voters	0	0.22	0.38	0.42	0.8	0.96	1
	40	0.24	0.18	0.46	0.7	0.92	0.98
	80	0.24	0.3	0.34	0.62	0.8	1
	120	0.08	0.26	0.18	0.52	0.84	1
	160	0.12	0.28	0.28	0.44	0.82	1
	200	0.18	0.2	0.36	0.5	0.94	1

Greens in government

Scenarios		number of nativist identity voters					
		0	40	80	120	160	200
number of green identity voters	0	0.98	1	1	0.92	0.9	0.62
	40	1	1	1	1	0.92	0.88
	80	1	1	1	1	0.98	0.98
	120	1	1	1	1	1	1
	160	1	1	1	1	1	1
	200	1	1	1	1	1	1

FPÖ largest party

Scenarios		number of nativist identity voters					
		0	40	80	120	160	200
number of green identity voters	0	0.16	0.3	0.26	0.26	0.6	0.94
	40	0.2	0.18	0.32	0.18	0.52	0.96
	80	0.24	0.28	0.28	0.28	0.5	0.94
	120	0.08	0.26	0.16	0.42	0.78	1
	160	0.12	0.28	0.28	0.44	0.82	1
	200	0.18	0.2	0.36	0.5	0.94	1

Greens largest party

Scenarios		number of nativist identity voters					
		0	40	80	120	160	200
number of green identity voters	0	0.1	0.06	0.02	0	0	0
	40	0.28	0.14	0.3	0.26	0.2	0.02
	80	0.44	0.54	0.56	0.64	0.44	0.06
	120	0.88	0.68	0.84	0.58	0.22	0
	160	0.88	0.72	0.72	0.56	0.18	0
	200	0.82	0.8	0.64	0.5	0.06	0

Figure 11: Comparison of scenarios (random mixing)

Since the FPÖ and Greens are at the opposite end of the political spectrum the blue areas (where the FPÖ agent ends up in government) tend to be complementary to the green areas (where the Greens end up in government). However, in this model, the notional governing coalition elected is just a collection of the biggest parties until one has more than half the votes. This allows for cases with high levels of fixed identity for FPÖ and Greens, for a coalition with both parties in government, whereas the ideological differences between the two might mean this was unlikely in reality.

Even relatively low numbers of voters with positive party identification can influence the election outcomes considerably. While the nativist voters are (slightly) more successful in pushing the FPÖ to become the largest party (see Figures Figure 10 and Figure 11, bottom left), the Greens nearly always achieve to become part of the government (even if only the second or third largest party of a coalition) when voters are not restricted to the links in their social network to find discussion partners (see Figure 11, top right). when voters interact with randomly selected discussion partners.

Another interesting difference between the two forms of discussion partner selection is that the fixed network favours the SPÖ as remaining second or third force in a notional government, whereas random mixing favours the ÖVP (see results in section 9.3 of the appendix). With rising numbers of both green and nativist 'identitarians' in the electorate their vote share starts to decrease until it drops down to zero. A level of 100 (11%) of identity voters of either faction is the turning point.

Comparing these results to the what-if scenarios about the effect of social networks (section 3.2), we find that relatively small numbers of fixed nativist identity voters in the population of 1060 agents together with unrestricted political discussion across the whole population leads to the FPÖ in government of about 30% of runs (see Figure 11, top left, columns 0-80). This is similar to the success rate for the FPÖ in the scenarios where voters without fixed identity interact in dynamic social networks, i.e. where they are able to find new interaction partners and drop links to others they disagree with (see Figure 7). This is plausible, since a certain level of "intrinsic" party identification with the FPÖ is present in the empirical data (survey respondents feeling close to the FPÖ) and is thus endogenous to all model variants.

4 Germany Model

After successfully establishing a version of the Austria model that is able to produce results qualitatively close to the historical data, we sought to apply it to a new case. Germany was chosen due to the availability of similar data sources. Adapting the Austria model to fit the Germany model required choosing the relevant German data to feed into the model, namely:

1. Replacing the Austrian parties with the respective German ones, utilising again the Chapel Hill Expert Survey 2014 (Polk et al. 2017).
2. Initialising the population of voters with data obtained from the German Longitudinal Election Study (GLES) performed in 2013 (GLES 2019).
3. Identifying joint key issues from both CHES and GLES to be used as the dimensions of the political space, in which the interactions of voters and parties take place.
4. Updating issue salience in the public opinion (the proxy for media influence) with the relevant data for Germany from the Eurobarometer surveys.
5. Identifying relevant external events to be incorporated in the model.

In the German electoral system voters have two votes: one to elect a representative for their local constituency (first past the post) and a second one to vote for a party (proportional representation). Since the second vote determines the percentage of seats a party will win in the Bundestag, it is the only one considered in the model.

4.1 Parties

The 2014 CHES includes ten parties for Germany: CDU, SPD, FDP, Grüne, Linke, CSU, NPD, AfD, Piraten, and the Tierschutzpartei. Since neither NPD, Piraten nor Tierschutzpartei made it into parliament in 2017, they are not represented in the model. The CSU is only available in Bavaria, where it replaces the CDU. Country-wide, the parties mostly appear together as CDU/CSU; the GLES survey reflects this in many questions, e.g., the retrospective vote choice only considers CDU/CSU not CDU and CSU separately. We therefore decided to merge both parties into one in the model. This involved merging the respective CHES variables, giving the CDU a weight of 75% and the CSU 25%.

4.2 Voters

GLES 2013 has a total of 3911 participants, 2003 before the election, 1908 after the election. Of the latter, 1427 have voted for a party represented in the model with their second vote (variable n11ba = {CDU/CSU, SPD, FDP, Grüne, Linke, AfD}). As with the analysis of the AUTNES data for the Austria model (see Meyer et al. 2022), we used this subset of GLES to determine which strategies to assign to voters. The results are shown in Table 2.

Table 2: Allocation of strategies to voters

Strategy	**Voter type**	**Condition (stating GLES variables)**	**Number of voters**	**Percent of voters**	**Rescaled %**
Rational choice	Voters who voted for their 'rational choice' as determined by their ideological positions	voted party (n11ab) = party chosen by strategy "rational-choice" after model initialisation	269	18.9%	12.0%
Confirmatory	Voters who voted for the party they feel closest to	Voted party = closest party (vn119a)	985	69.0%	43.9%
Fast and frugal	Voters who voted for the party best able to handle their most important issue	Voted party = best party for mip 1 (vn25a)	842	59.0%	37.5%
Heuristic-based (follow friend recommendation)	Voters who trust other people and don't like to make up their own mind / seek information by talking to others	Generally trusting in people (vn124b >=4) AND (not making up own mind (vn124d <= 2) OR source of information is personal communications (vn97))	77	5.4%	3.4%
Go with gut	Voters with low political interest and knowledge	Low political interest (vn3 >= 4) AND low political knowledge (correct answers in vn7, vn15a, n250-n253 <=2)	71	5.0%	3.2%
None			220	15.4%	

4.3 Political Space

While the Austria model contains seven different policy issues, we were only able to identify five common issues across the voter and party data sets, coinciding with the first five Austrian ones (see Table 3Table 3). These are all mentioned as "most important issues" (mip) and can be mapped to positions in the space. The dominant issue for parties was "EU integration" but the only EU-related GLES variable (vn40e: "Regarding the European debt crisis, Germany should provide financial support for EU member states experiencing financial and economic difficulties") did not match this. As the topic was also of far less importance to the voters, it was decided to not include it in the model.

Table 3: Common issues spanning the political space in the Germany model

Policy Issue	GLES variable	GLES mip	CHES variable	CHES mip
Economy	vn40c ("The state should stay out of the economy")	Economy	econ_interven	state intervention
Welfare state	vn40d ("The government should take measures to reduce differences in income levels")	Welfare state	redistribution	redistribution
Spend vs tax	vn67 ("what position do you take on taxes and social services?")	Budget	spendvtax	public services vs taxes
Immigration	vn68 ("what position do you take on immigration for foreigners?")	Immigration	immigrate_policy	immigration
Environment	vn69 ("what position do you take on the fight against climate change and economic growth?")	Environmental protection	environment	environment

4.4 Issue Salience

For modelling the influence of the media on public opinion, we returned to the Eurobarometer surveys of the European Commission. These contain two to three data sets per year for the time period 2013-2017. Figure 12 shows the resulting time series after matching the relevant Eurobarometer categories to the five issues represented in the Germany model and rescaling the data. The spike in the salience of the 'immigration' topic coinciding with the refugee crisis of 2015/16 is obvious.

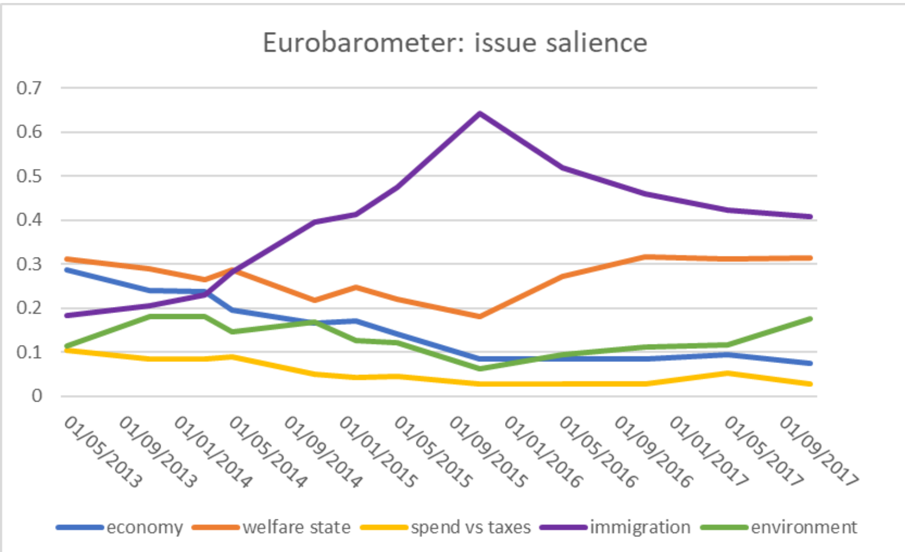

Figure 12: Salience of the modelled five issues in the German public opinion over time, adapted from Eurobarometer data.

4.5 External Events

The most important external event to be included in the Germany model is again the migrant crisis of 2015/16. The resultant change in public opinion is represented through the incorporation of the

Eurobarometer data, thus the impact on voters is accounted for. Chancellor Merkel’s decision to allow refugees into the country, which lead to a leadership crisis of the CDU/CSU and a rise of the populist AfD, can be interpreted as a clear deviation from party politics and should therefore be included in the model.

We represent this as a move of the CDU/CSU to a more liberal immigration policy at time step 101 (1 September 2015) by adding “immigration” to their most important topics and defining an ideal position that the party strives to attain. The ‘Aggregator’ strategy then pursues a path weighing its supporters’ positions against the party’s own ideological ideal positions as defined by (Laver and Sergenti 2012) instead of solely moving towards the average position of supporters.[3] At the end of the crisis (time step 162), the party returns to a stricter view on immigration policy by setting their ideal position to a value taken from the 2017 CHES data set.

5 Simulated Scenarios with the Germany Model

To explore the Germany model we simulated several scenarios with the mix of voter strategies obtained from the GLES analysis since the mix of voter strategies produced the most realistic results for the Austria case study. We varied how often political discussions happen amongst voters (*discussion-freq*: 1, 2 or 5) and how easily voters are convinced to change their opinion (*voter-adapt-prob*: 0.5 or 1). Parties were assigned similar strategies to the Austrian case: the major parties CDU/CSU and SPD use ‘Aggregator’, the FDP uses ‘Satisficer’, the right-wing populist party AfD uses ‘Hunter’ Other model parameters were kept fixed. For each scenario we undertook 50 simulation runs with the same set of random number seeds.

As with Austria, we then compared each run to the real opinion poll data between 2013 and 2017 (cf. Figure 14) to see if any of them come qualitatively close. We find that overall, the level of fit for Germany is lower than for Austria. The majority of runs demonstrate the main feature of a distinct rise of vote shares for the AfD during the migrant crisis 2015/16 but this is generally overestimated. In contrast, the vote share of the CDU/CSU is underestimated for the first half of the simulation and never fits the actual opinion poll data. On the other hand, the loss of voter support for the CDU/CSU is visible in most runs albeit less pronounced. In general, scenarios with less voter interaction and more ‘stubborn’ voters (i.e. voters who are less likely to change their opinions) produce slightly better results in the sense that there are more runs partly resembling the historical data. The higher the interaction and voter variability, the greater the volatility in party vote shares and the farther from reality the time series of simulated opinion polls (see section 9.4). Figure 13 shows an example of the best results with the Germany model obtained so far.

[3] This variation of the ‘Aggregator’ strategy is already implemented in the model. It was previously applied to represent the change in leadership and immigration policy of the ÖVP in the Austria case study.

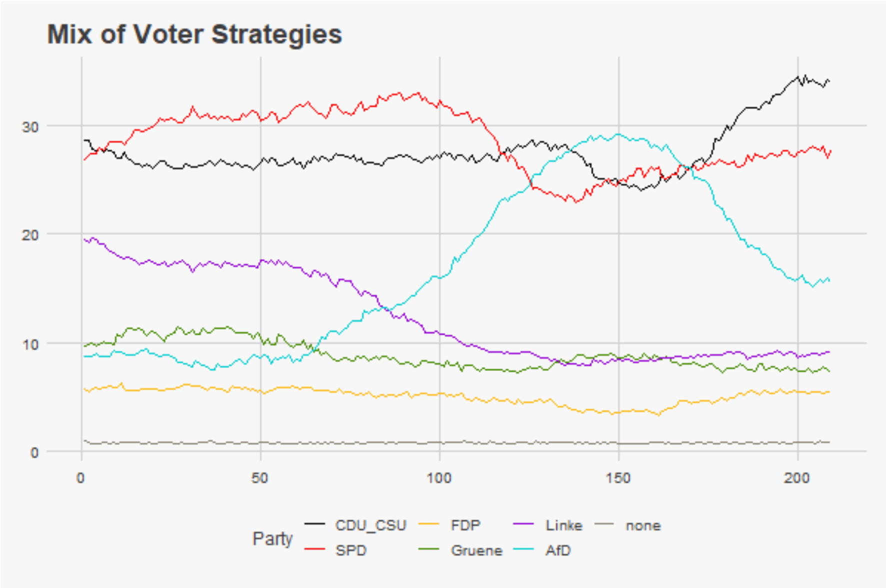

Figure 13: Best results with the Germany model (scenario discussion-freq 2, voter-adapt-prob 0.5)

The short rise and subsequent fall in voter support for the SPD in the first months of 2017, which is clearly visible in the opinion poll data (see Figure 14), is never reproduced by our model. This “bump” in the vote-share timeline coincides with the announcement of a new leader for the SPD and can be explained as a rise (and subsequent disappointment) of the hopes of some of the electorate. The model in its current state does not include processes to plausibly represent attractiveness of candidates or feelings of voters towards a particular party (leader). While this did not seem crucial for the Austria model it appears to be a shortcoming for a good representation of the Germany case study.

If we only regard the simulated election results for the national election of 2017 (end of each simulation run), the Germany model achieves a better fit. The CDU/CSU as the biggest party forms a coalition with the SPD in 92% of all runs, while the AfD generally comes in as the third largest party. Section 9.4 shows an example of the outcomes.

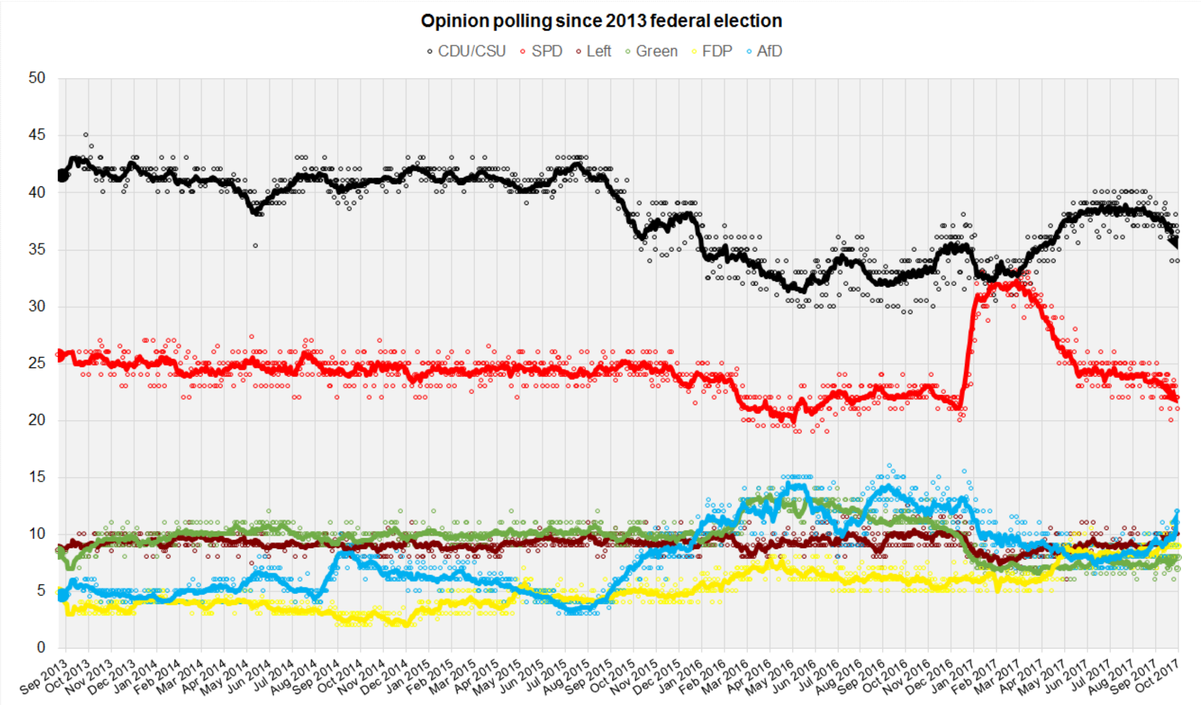

Figure 14: Trends in opinion polls for Germany between 2013 and 2017[4]

6 The commonality in both models

Many political models are either (a) specific to a country and historical period with a good qualitative fit or (b) generic across countries with a weaker average fit. In other words, the level of underlying generality is low. In this work we have developed a model structure and applied it to the data from two different countries.

As illustrated in Figure 1, the model incorporates theories about voter decision making, opinion formation and party strategies to define the behaviour of its voter and party agents. These agents interact in a multi-dimensional political space, where voters discuss politics with each other, change their opinions and the importance they give to policy issues, and decide which party they would vote for, while the parties try and gauge where to position themselves to best attract votes. All of these processes form the core model structure that remains the same in both the Austria and the Germany model. What differs are the input data (top left in Figure 1) necessary to define the characteristics of voters and parties and – by implication – the data handling routines used to read in data from files and convert it into model entities plus some elements of the graphical user interface related to country-specific outputs (names and colours of parties, policy issues).

7 Discussion and Conclusion

Going back to our research questions, we will discuss each one in turn.

7.1 To what extent can we capture the underlying dynamics displayed in the Austrian case?

First experiments with the Austria model investigated the impact of different voter decision strategies on the outcome of the simulated elections (see section 3.1 and Meyer et al. 2022). We found that the empirically based mix of voter decision strategies is a necessary but not sufficient

[4] Source: https://en.wikipedia.org/wiki/Opinion_polling_for_the_2017_German_federal_election. Image by KevinNinja (licence CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=46656620)

requirement to obtain results close to the observed historical data. While none of the experiments could replicate the actual election results of 2017, a small number of runs with the mix of strategies managed to qualitatively reproduce the trends in opinion polls between 2013 and 2017. Coming qualitatively close to real-world opinion polls is quite an achievement for a model that – even though based on comparatively rich empirical data – has to make assumptions where data and behavioural theories leave gaps.

The number of 'best fitting' runs is rather small, indicating a high variability in possible outcomes of this complex system. The observed history is only one of a plethora of pathways the system could have taken. Better knowledge about the behaviour of the involved actors would certainly help to improve the realism of the model. For this, we have to ask political science research to focus more on individual behaviour and motivations instead of the established macro-level approach.

7.2 Can the observed outcomes be explained by pure 'Rational Choice' or 'Fast and Frugal' voting strategies?

The short answer is no. Although it is hard to prove a negative, we did not manage to get even vaguely plausible outcomes when all voter agents are given 'Rational Choice' or given 'Fast and Frugal' voting strategies. The work here suggests that a mix of strategies among voter agents is necessary to get plausible outcomes.

7.3 Does the underlying influence network matter to what governments might be elected and, if so, how?

Yes this does matter a lot, but this is something explore in "D4.3 Populism and Opinion Dynamics". The above explorations and those in D4.3 show that some mechanism for voters clustering around parties is important for the plausiblility of outcomes, but this can be achieved by either imposing a proportion of fixed identity voters in a random mixing mode, or endogenously in a social network by a convergence of attitudes around them.

7.4 To what extent can 'positive party identification' be a contributory explanatory factor of the observed polling results?

In the model, the proportion voters that have a fixed 'identity-based' voting mechanism (for FPO and Greens) can have a big effect on whether that party gets enough votes to be a candidate for the government coalition. This core of voters has a disproportional effect, past the impact of their own votes, due to the influence they have on others.

7.5 To what extent can the same model structure be used to explain both Austrian and German polling data?

The idea to use the same model structure for both Austria and Germany arose from their perceived similarity in available data and country characteristics. On the surface, the data sources for both Austria and Germany are very similar. Both comprise the Chapel Hill Expert Survey (CHES) for the parties and the Eurobarometer surveys for which topics were seen as most important for their country by its citizens. While Austria has AUTNES, the Austrian National Election Study, Germany has GLES, the German Longitudinal Election Study, to provide empirical data about voters on a comparable level of detail. However, it is precisely the detail where these differ. For Germany, we could only match five policy issues between party data and voter data and the most important issues for the parties (EU integration) could not be represented in the model due to lack of matching data in GLES and the Eurobarometer. Thus, the internal "fit" of parties to voters is slightly more off in the Germany model.

Looking at the results obtained so far with the Germany model, there seems to be something missing that no amount of parameter fine-tuning can cover. As discussed in section 5, the model structure does not include processes to represent attractiveness of candidates or feelings of voters towards a particular party (leader). While this did not seem crucial for the Austria model it appears to be a shortcoming for a good representation of the Germany case study. We will need to research theories on the influence of affections on voter behaviour in order to extend the model accordingly.

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9 Appendix

9.1 Matching empirical data to model components

9.1.1 Initialising voters from AUTNES 2013

Austrian National Election Study (AUTNES) 2013			**Model voters**	
Variable	*Description*	*Value Range*	*Voter Attribute*	*Manipulation*
pagnr	Respondent ID	unique integer	id	Unchanged
zpage	Age of respondent in years	15 - 96	age	Unchanged
zpsex	Gender of respondent	1 (male), 2 (female)	gender	Unchanged
W1_q88	Highest level of education	1 (no school) to 14 (PhD), 15 (other)	education-level	Grouped into 4 categories (low, medium, high, other)
W1_q115	Assessment of income situation	1 (get along very well) to 4 (great difficulty)	Income-situation	unchanged
W1_q107	Description of residential area (urban/rural)	1 (village) 2 (small town) 3 (mid-size town) 4 centre of large city 5 suburbs of large city	residential-area	unchanged
W1_q4	Political interest	1 (very interested) to 4 (not at all interested)	political-interest	unchanged; missing values set to 2.5 (medium)
W1_q43	Party respondent feels closer to	1 SPO 2 OVP 3 FPO 4 FP Kärnten 5 BZO 6 The Greens 7 KPO 8 NEOS 9 Team Stronach 10 Pirates 11 other 12 no party	closest-party	Translated to party ids of the model (0 none 1 SPO 2 OVP 3 FPO 4 The Greens 5 BZO 6 NEOS 7 TS); set to 0 for all parties not represented
W1_q44	Degree of closeness to this party	1 very close 2 fairly close 3 not very close	degree-of-closeness	Unchanged

W1_q48x1-6	Propensity to vote SPO/OVP/FPO/BZO/Greens/TS	0 (very unlikely) to 10 (very likely)	pp	Combined into a list, values unchanged, index of list is party ID
W1_q49	Probability to vote	0 will definitely not vote to 10 will definitely vote	prob-vote	Unchanged, missing values set to -1
W1_q50/51	Anticipated vote choice	Party ids 1 - 12 (same as w1_q43)	mvf-party	Translated to party IDs of model
W2_q15	Vote choice (retrospective); only answered by respondents in wave 2 of survey after the election	Party ids 1-12	voted-party	Translated to party IDs of model; missing values set to 0
W1_q26x1, w1_q26x2, w1_q26x3, W1_q26x11+ w1_q26x12, w1_q26x9, w1_q26x6, w1_q26x7	Respondent's positions on issues: "economy", "welfare state", "public spending vs. tax (budget)", "immigration", "environment", "society", "security"	1 completely agree to 5 completely disagree	my-positions	Combined into a list; missing values set to 3; scales of immigration and security reversed to fit into left-right political landscape
W1_q5x1, W2_q5x1, W1_q6x1	Most important issue, second most important issue	10000 economy to 23000 government formation, 77777 multiple answers 99999 not classifiable	my-issues	Translated to issues represented in the model (0 - 6) and combined into a list of up to three entries
W1_q7, W2_q3, W1_q8	Party best able to handle (second) most important issue	Party ids 1-12	my-opinions	Translated to model party ids and stored in 2D array (issues x parties)
			aff-level	[0,1]; computed from political interest

9.1.2 Initialising parties from CHES 2014

Chapel Hill Expert Survey (CHES) 2014			**Model parties**	
Variable	*Description*	*Value Range*	*Party Attribute*	*Manipulation*
party_id	Party ID	1301 - 1310	id	Translated to model party ids (1 – 7)
party_name	Party Name	SPO, OVP, FPO, Grune, BZO, NEOS, TeamStronach	name	unchanged
econ_interven, redistribution, spendvtax, immigrate_policy, environment, scociallifestyle, civlib_laworder	Positions on: state interven-tion in the economy, redistribution of wealth from the rich to the poor, improving public services vs. reducing taxes, immigration policy, the environment, social lifestyle, civil liberties vs. law and order	0 fully in favour (of liberal policies) to 10 fully opposes (liberal policies, i.e. in favour of restrictive policies)	our-positions	Rescaled to values 1 – 5 and combined into a list
mip_one, mip_two, mip_three	Most important issues	"State intervention" to "social lifestyle"	our-issues	Translated to issues represented in the model (0 - 6) and combined into a list of up to three entries

9.2 Simulation Results

9.2.1 Selected Simulation Runs with Fixed Networks

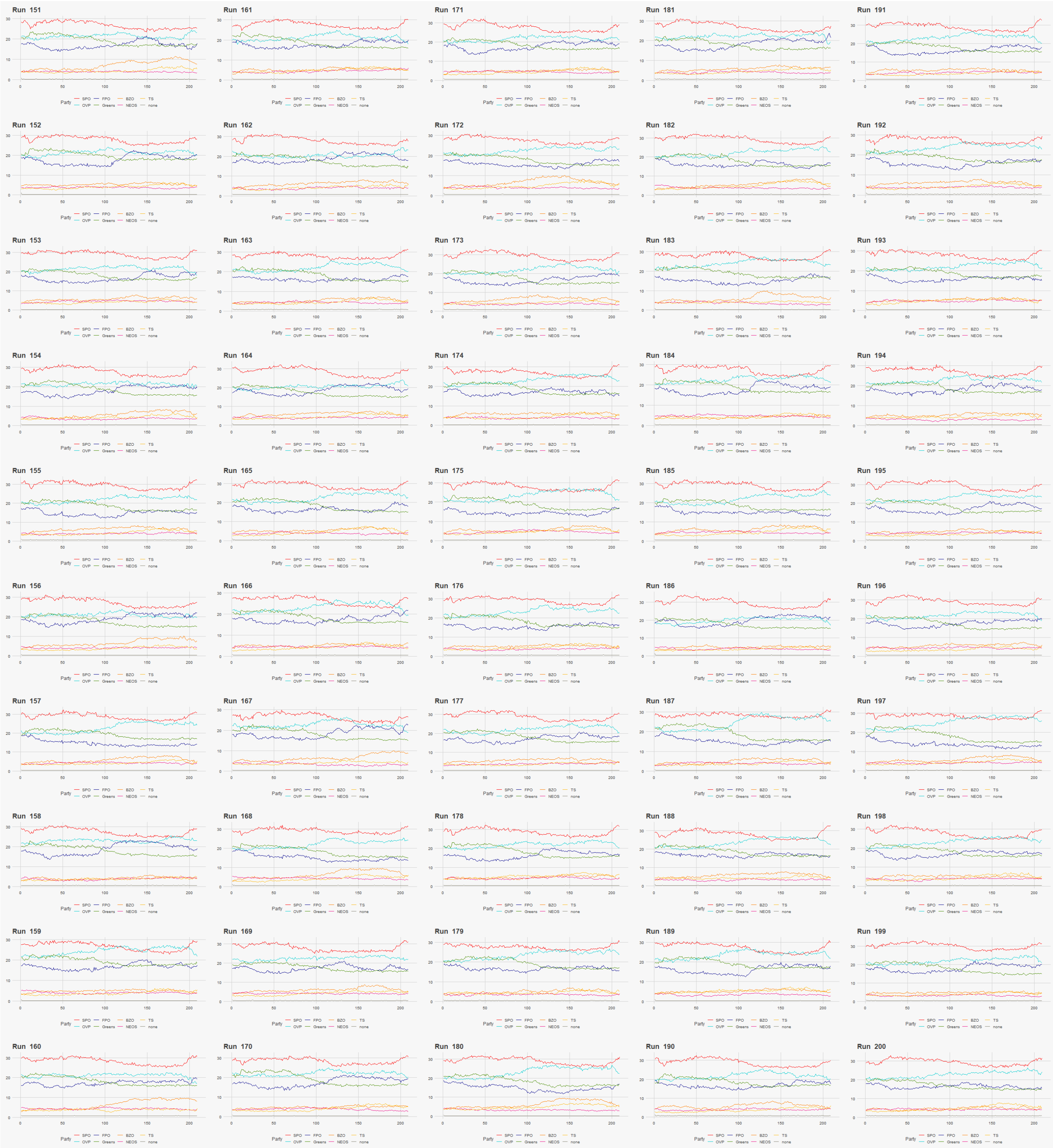

Figure 15: Scenario with Erdös-Rényi network, discussion-freq 1, voter-adapt-prob 1

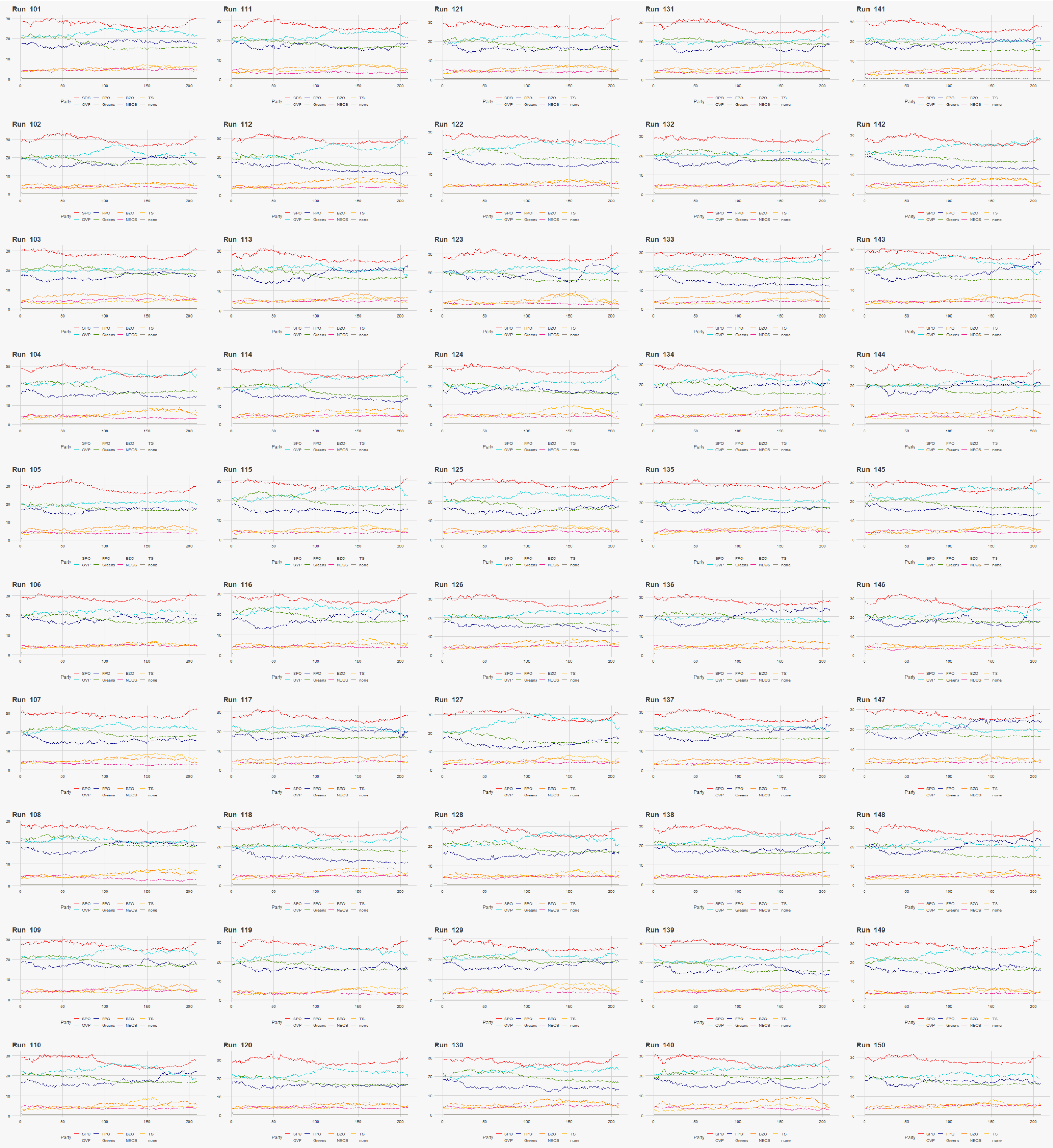

Figure 16: Scenario Scale-free Network, discussion-freq 2, voter-adapt-prob 1

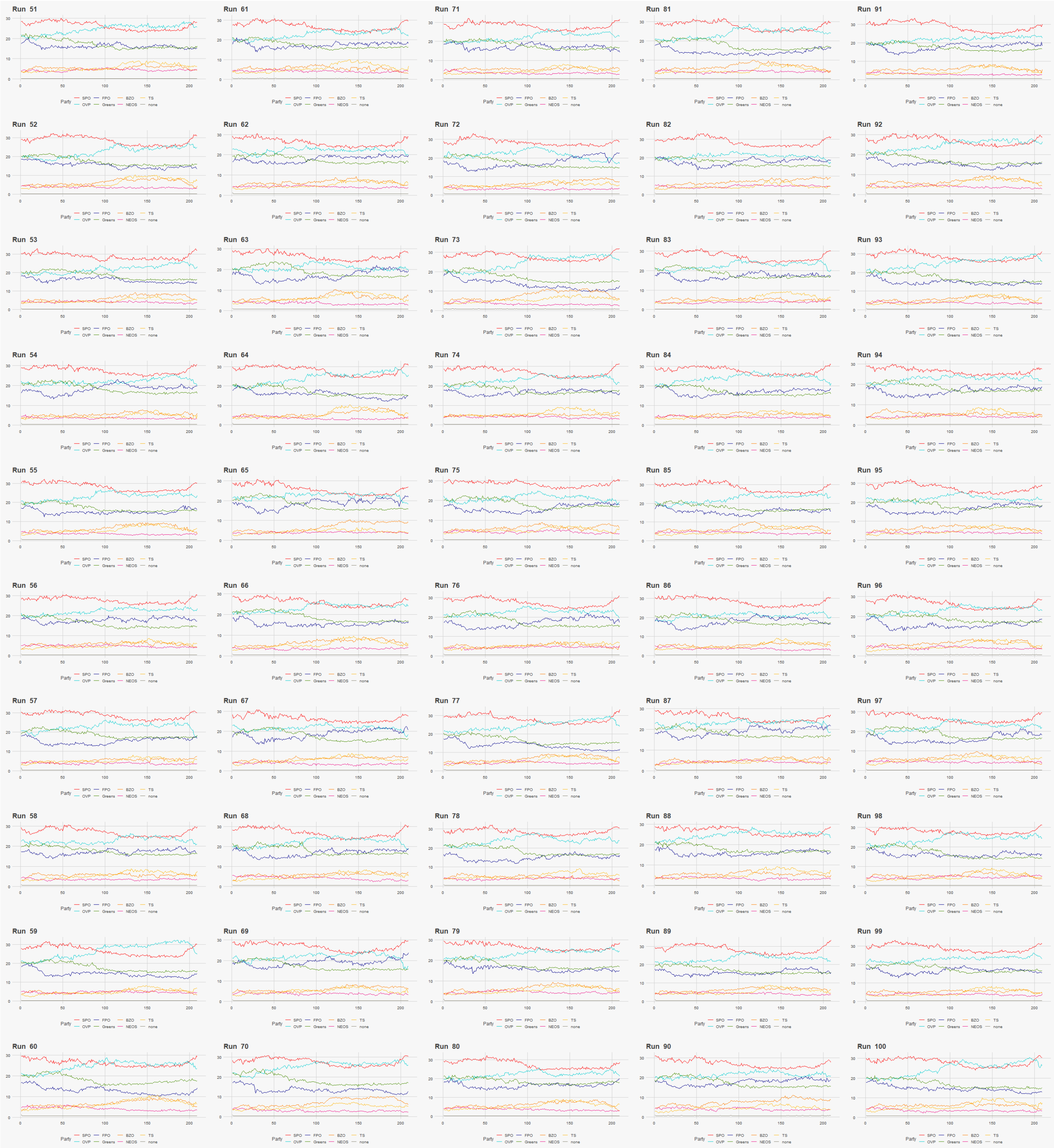

Figure 17: Scenario Regular random network, discussion-freq 5, voter-adapt-prob 0.5

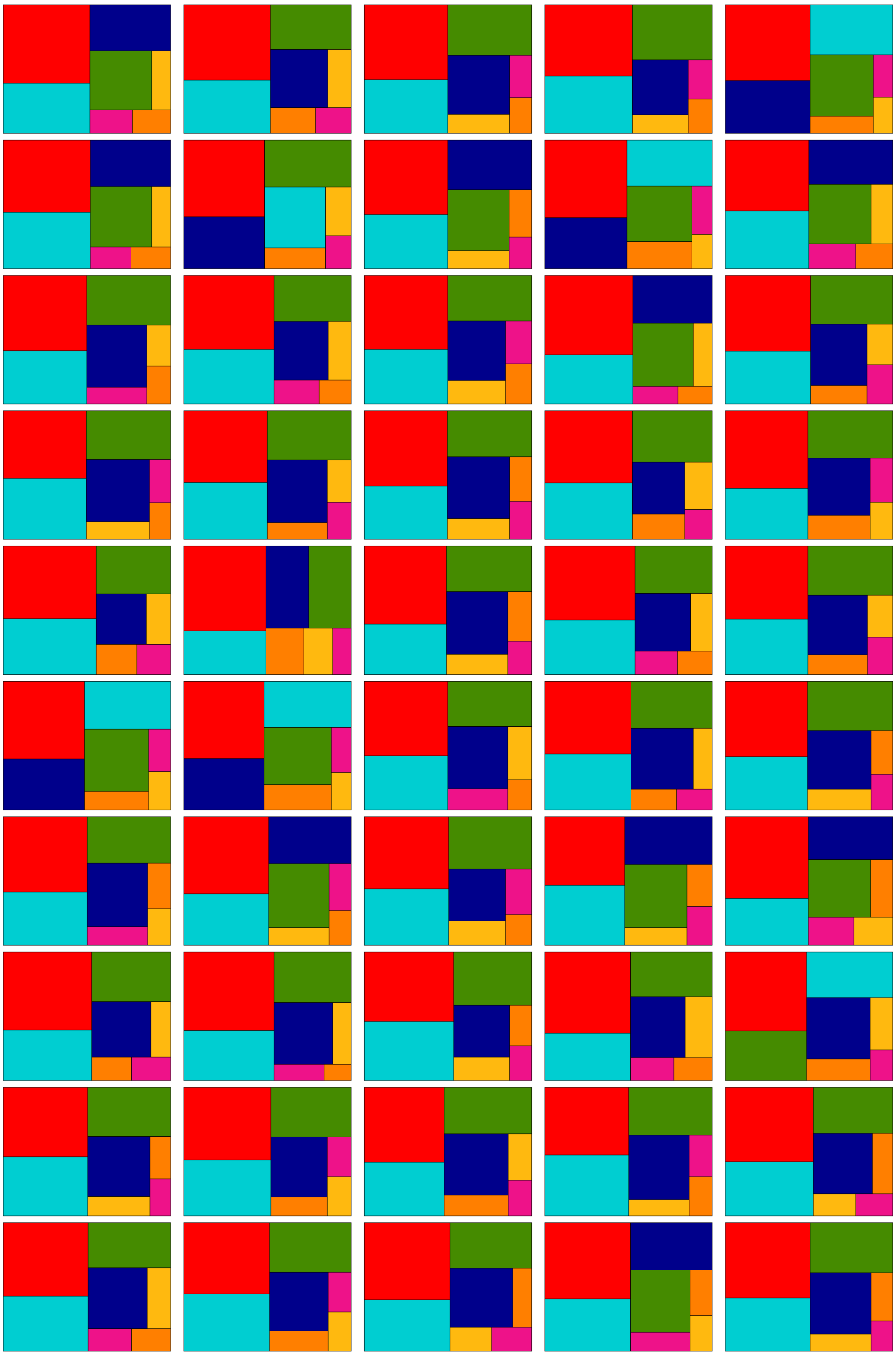

Figure 18: Simulated election outcomes for scenario homophily-based network, discussion frequency 5, voter adap probability 1. The different coloured rectangles represent the vote shares of the different parties (red: SPÖ, light blue: ÖVP, dark blue: FPÖ, green: Greens, orange: BZÖ, pink: NEOS, yellow: Team Stronach). Displayed are the outcomes for all 50

runs in 5 columns x 10 rows. The dominance of the SPÖ as largest party is easily visible, also that most governments are formed of SPÖ and ÖVP.

9.2.2 Selected simulation runs with dynamic networks

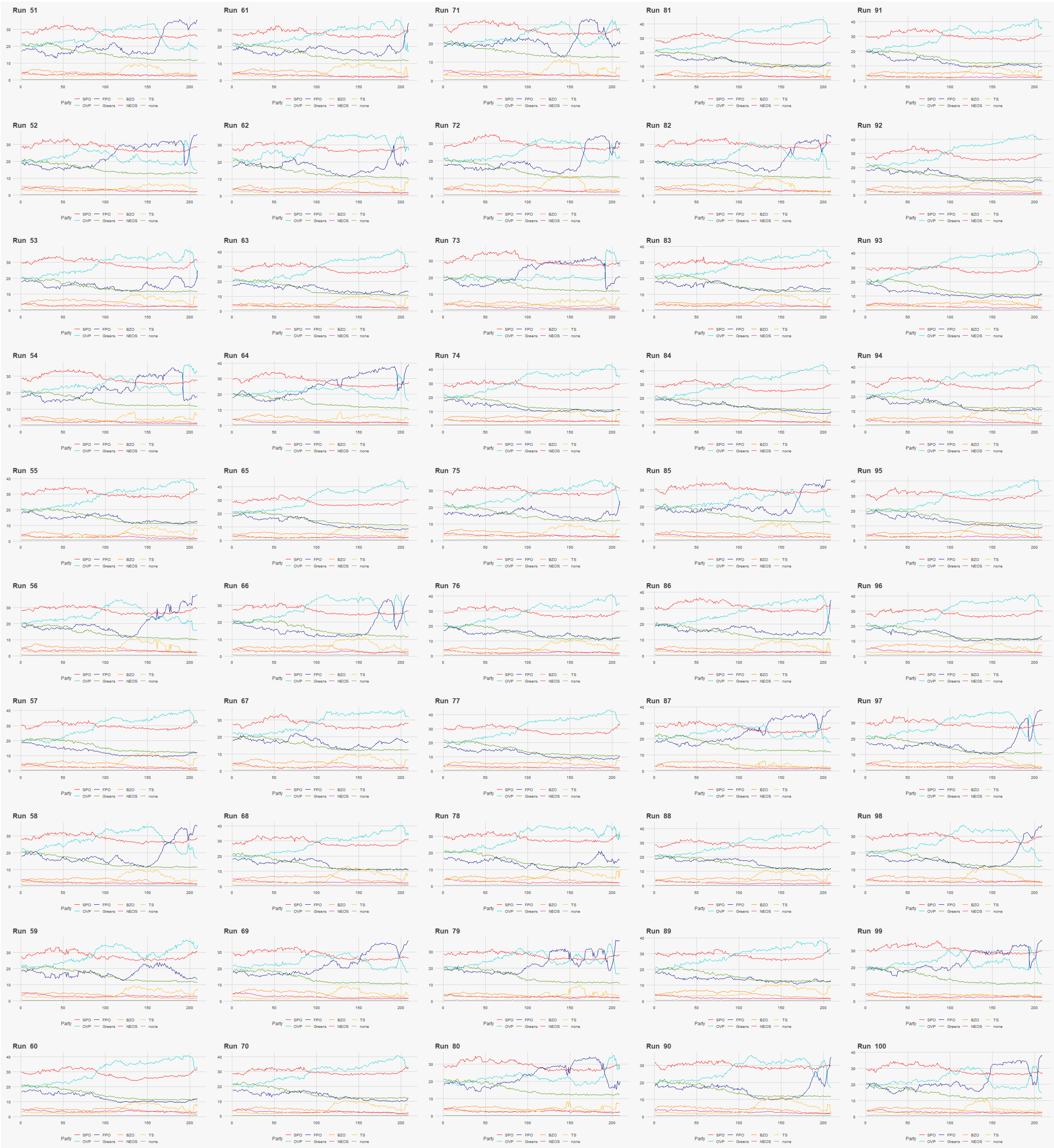

Figure 19: Scenario Erdös-Rényi network, discussion frequency 5, voter-adapt probability 0.5. Note that run 73 (middle of row 3) is another example of a more successful run.

9.3 Selected Simulation Runs with Positive Identity

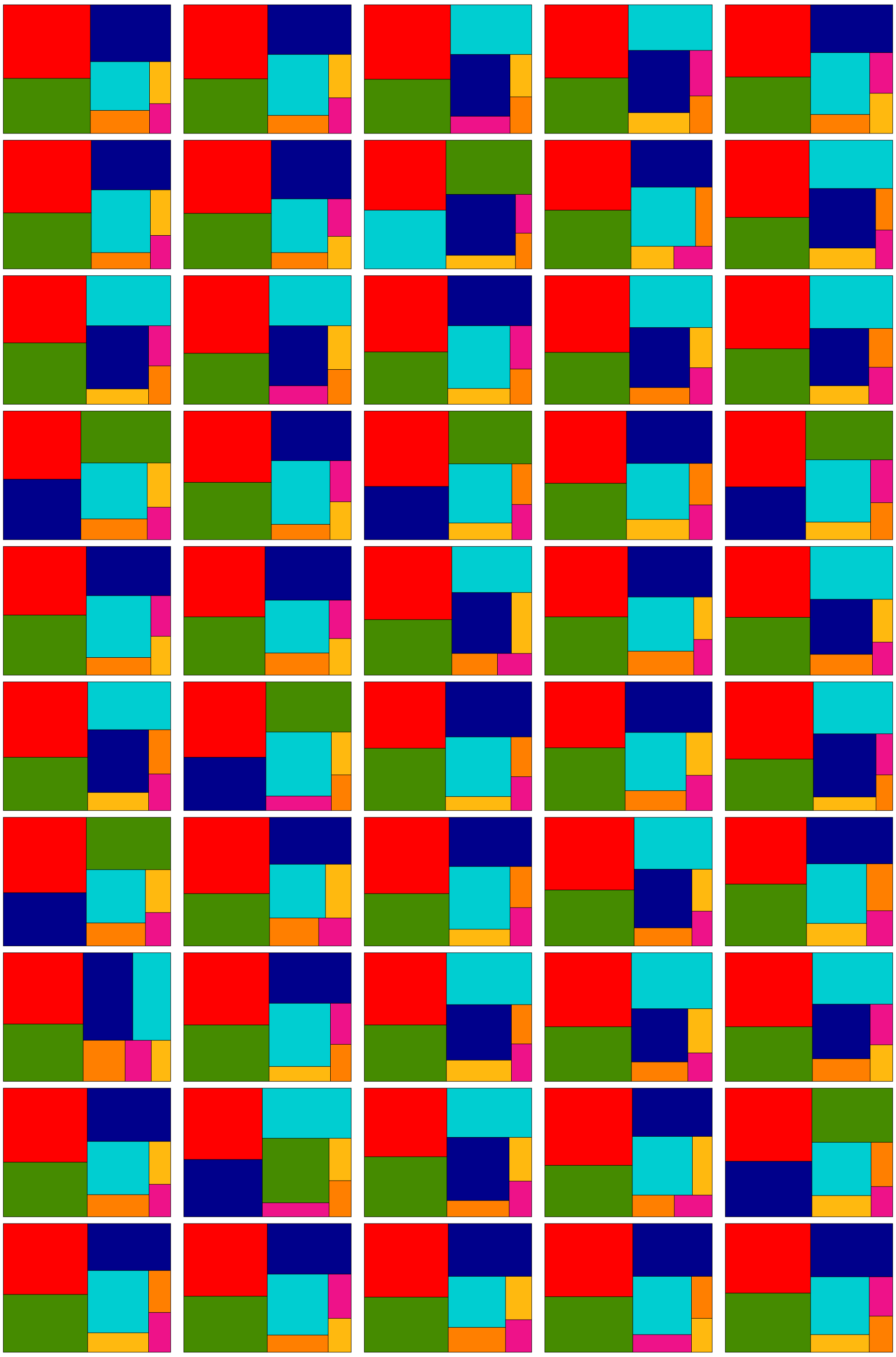

Figure 20: Election outcomes for the scenario g80-n40 (8% voters with green, 4% with nativist identity), fixed network. The SPÖ is always the largest party.

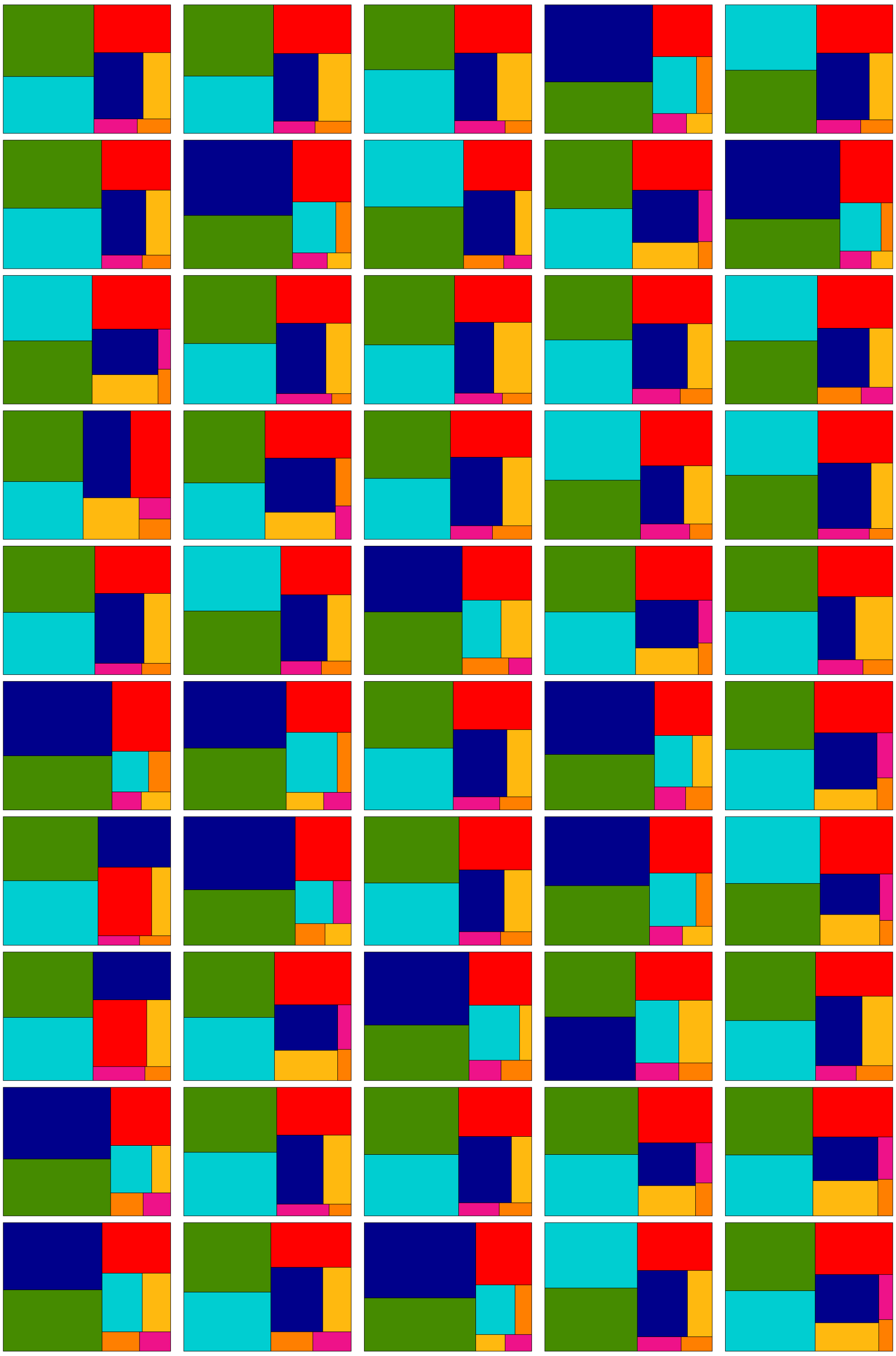

Figure 21: Election outcomes for scenario g80-n40 (8% voters with green, 4% with nativist identity), random mixing. The ÖVP participates in government coalitions in 72% of runs, mostly together with the Greens as largest or second largest party.

9.4 Selected Results for the Germany Model

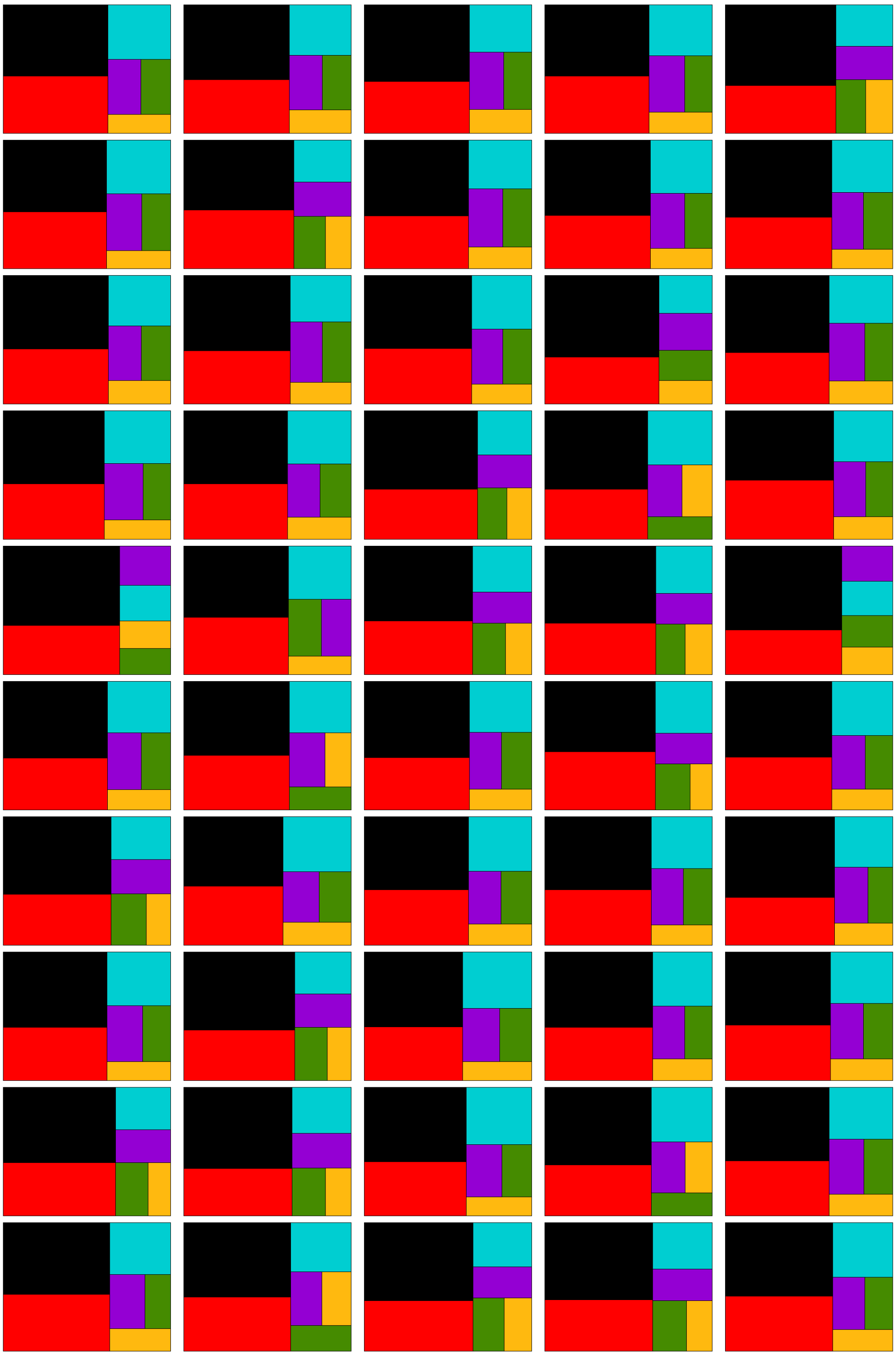

Figure 22: Election outcomes for all runs of scenario with medium levels of voter interaction and low adaptability (discussion-freq 2 / voter-adapt-prob 0.5).

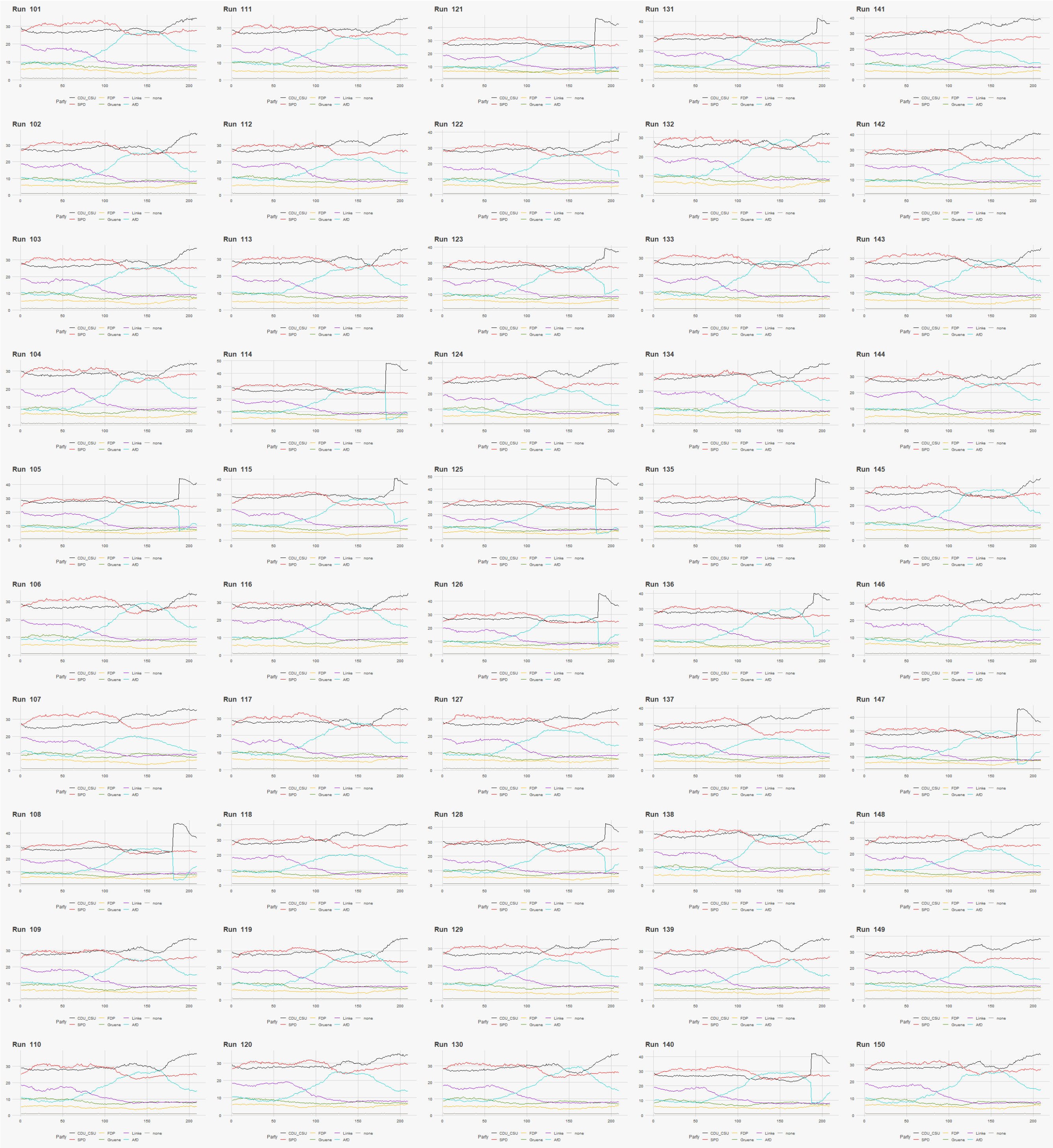

Figure 23: Simulation runs with medium levels of voter interaction and low adaptability (discussion-freq 2 / voter-adapt-prob 0.5).

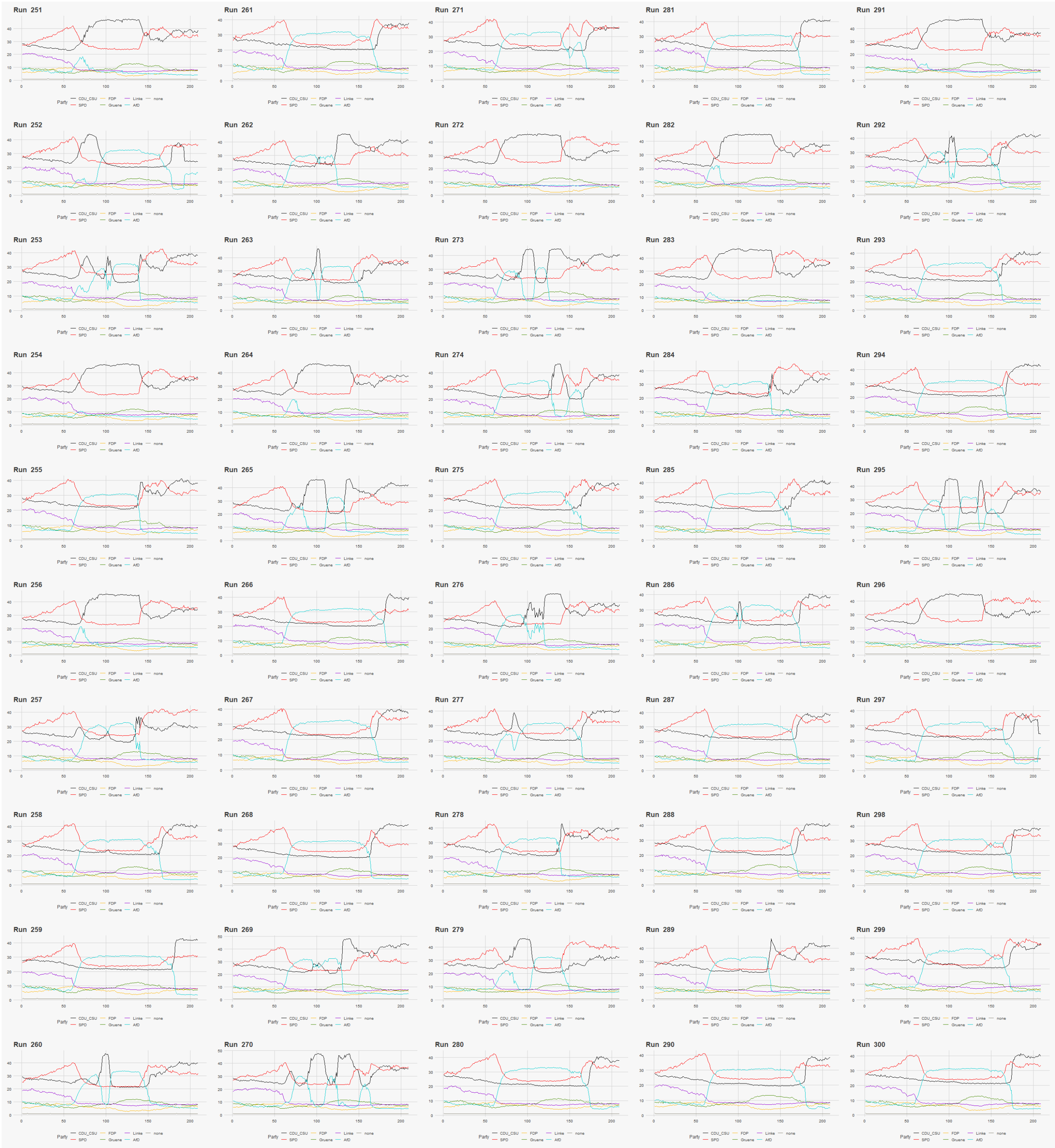

Figure 24: Simulation runs for high levels of voter interaction and adaptability (discussion frequency 5, voter-adapt-probability 1).