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Aaron Kamm

Political actors playing games: Theory and Experiments

Political actors exert enormous influence over our daily lives. Their influence on economic activities cannot be underestimated. Voters determine the distribution of political power, political candidates choose policy platforms that they intend to enact if elected, and legislators bargain to arrive at laws. Understanding political actors' behavior is therefore essential for explaining economic outcomes. This thesis follows the tradition of the political economy literature and considers the effect of institutional rules on the behavior of three types of political actors: voters, candidates, and negotiators. It does so by combining insights from game-theoretic models and controlled laboratory experiments.

Specifically, this thesis analyzes voter behavior in mandatory and voluntary voting regimes; investigates how candidate behavior differs between plurality voting and proportional representation as well as what role coalition governments play in this context; and explores bargaining behavior in asymmetric environments.

Aaron Kamm holds a BSc degree in economics from Mannheim University and a MPhil in economics from the Tinbergen Institute. After graduating from the Tinbergen Institute, he joined the Center for Research in Experimental Economics and Political Decision Making (CREED) at the University of Amsterdam to write his dissertation. His main fields of interest are Experimental Economics and Political Economy. In September 2015, he joined New York University Abu Dhabi as a Post-Doctoral Associate.

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Theory and Experiments

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Aaron

Amsterdam, June 2015

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Chapter 1

Introduction

Throughout the world, governments dominate the economic scene. Their spending determines whether full employment prevails; their taxes influence countless decisions, their policies control international trade; and their domestic regulations extend into almost every economic act.

Anthony Downs, *An Economic Theory of Democracy* (1957)

Our daily lives are strongly influenced by government activities. As expressed by the above quote this influence is especially strong with respect to economic activities. For instance, government regulations constrain our behavior and tax policies profoundly affect the incentives we face. Given the importance of government policies in explaining economic behavior, understanding how government policies come about and what shapes them is equally essential for explaining economic outcomes.

Since various political actors have an influence on government policies, it is necessary to consider the behavior of distinct political actors and how they interact. In this thesis I consider three political actors: Chapter 2 focuses on voters who through their behavior determine the distribution of power. In chapters 3 and 4, I consider the behavior of candidates, who will influence how voters behave in the election. Chapter 5 considers how legislators in parliament arrive at laws through bargaining.

Just like any economic actor's behavior, also the behavior of political actors strongly depends on the constraints under which they operate. The most relevant constraints political actors face originate from the institutional rules of the political system. Therefore, following the tradition of the political economy literature,¹ the main question this thesis addresses is: How do the rules of the political system affect the behavior of the political actors that influence government policies?

The aim of this thesis is to extend our understanding of various political institutions. Chapter 2 considers the effect of mandatory and voluntary voting on voter behavior. Chapters 3 and 4 analyze the difference in candidate behavior between plurality voting and

¹ See chapter 1 in Drazen (2000) for a discussion of how the definition of the field changed over time and what the term 'political economy' means today.

proportional representation, with chapter 3 paying special attention to the role of coalition governments. Chapter 5 investigates the effect of asymmetric bargaining environments on behavior.

This thesis analyzes the different actors' behavior by combining insights from game-theoretic models and controlled laboratory experiments. The theory contributes to understanding behavior in three main ways: First, the game-theoretic models capture the strategic interactions between the political actors and allow us to understand the equilibrium outcome of these interactions. For instance, in chapter 5 this analysis reveals that due to the interdependence of strategies, changes in parameters can have subtle and unintuitive effects on behavior. Second, using models makes it necessary to identify the essential mechanisms and parameters for the question at hand thereby clarifying causal relationships. And third, the structured analysis of theoretical models makes it possible to derive clear predictions for behavior.

The controlled laboratory experiments build on the theoretical analysis and complement it. Experiments have the advantage that they allow a measurement of causal processes that is not possible with observational field data. Contrary to empirical data, which are rife with confounding factors, in the laboratory the experimenter can implement *ceteris paribus* variations to isolate the effects one is interested in. These advantages of the experimental method have led to a sharp increase in the use of experiments in political science (Druckman et al., 2006) and the political economy literature (Palfrey, 2012). The experimental method is especially useful when investigating the role of institutions since in the field institutions are highly endogenous and have co-evolved with behavior. Another reason for using experiments is to 'speak to the theorist' (Roth, 1988), i.e. to test the degree to which a formal model is able to achieve its goal of explaining behavior. The advantage of laboratory experiments compared to field data is that in the laboratory all the underlying parameters are known and it is therefore possible to derive clear predictions that can subsequently be compared to the behavior observed.

The conversation between theory and experiments not only runs from theory to experiments, but also the other way. If we observe systematic deviations from the theory we can use these to adapt our theories. One example is found in chapter 5, which shows that subjects have problems comprehending the subtle effect of asymmetric bargaining institutions and deviate from the theory in systematic ways. If in future work this deviation proves to be robust a next step would be to develop a model of bargaining that takes into account the heuristics observed in the laboratory. An example of such a new theoretical concept motivated by experimental research is the quantal response equilibrium (QRE: McKelvey and Palfrey, 1995). This equilibrium concept takes into account that people make mistakes and therefore do not always play a best-response (as prescribed by the Nash equilibrium) but often play a 'better-response', i.e. better choices are made more often than worse choice. Given that QRE is better able to capture noisy decision-making in the laboratory, this concept is used in all the chapters that consider experimental data.

1.1 Overview

In this section I will briefly describe the research questions, methodology and main results of each chapter. Chapter 2 deals with voter behavior, chapters 3 and 4 consider candidate behavior and chapter 5 analyzes bargaining behavior.

In chapter 2 (which is joint work with Arthur Schram), *A Simultaneous Analysis of Turnout and Voting under Proportional Representation – Theory and Experiments*, we address the question whether a voter’s turnout decision and her selection of a party (or candidate) interact. Specifically, we consider whether an extreme vote is more likely to be observed when voting is voluntary than in systems of compulsory voting and how the voluntary or mandatory nature of turnout affect strategic voting.²

Even though voting has been studied for a long time up to now such questions have mostly been ignored and instead much of the literature has focused on either analyzing the determinants of a voter’s turnout decision or on trying to explain her party choice. We argue that this might miss important dynamics, especially in a system of proportional representation that gives rise to incentives for strategic voting. To address this potential interaction effect we present a theoretical model of voting in a system of proportional representation and complement this with data from a controlled laboratory experiment.

Our theoretical analysis predicts three effects. First, a *Polarization Effect*: Voters who cast a vote are more likely to vote for an extreme party when there is a possibility to abstain than when voting is mandatory. The mechanism underlying this effect is that voluntary voting reduces the extent of strategic voting by the more extreme voters. The intuition is related to the fact that extremist voters are more likely to cast a vote (the second effect). As a consequence, the election becomes more of a run-off between the extreme parties than in the mandatory voting case. In turn, this reduces the expected benefit from voting strategically for a more moderate party. We denote the second effect, that extremist voters are more likely to turn out, as the *Extremist Effect*. The intuition here is that there is more at stake for extreme voters because the worst-case scenario (the other extreme winning the election) is worse than for centrist voters. The third effect is the *Turnout Effect*: voters are more likely to vote when the polarization of party positions increases. Here, the reason is that increased differences across parties put more at stake in the elections for all voters.

We test these theoretical predictions using a laboratory experiments that in a between-subjects design varies the polarization of party positions and whether voting is mandatory or voluntary. Our experimental results provide support for the predictions, though only weak support is found for the *Polarization Effect* of voluntary voting when the parties are relatively close. The observed turnout rates exhibit the predicted feature that polarization boosts turnout and extreme voters are more likely to vote than centrist voters. This latter difference is not as pronounced as theoretically expected because centrist voters turn out substantially more often than predicted.

² Strategic voting is defined as abandoning the most preferred party to favorably influence the election outcome.

Obviously, the results from the laboratory experiment cannot give a definitive answer as to whether these effects are also present in the field. We therefore complement the experimental data with three empirical exercises that each address one of the three effects. To identify the *Polarization Effect* we make use of the fact that both the Netherlands and Belgium used to have mandatory voting and that both abolished it (Netherlands in 1970) or stopped enforcing the penalty for abstaining (Belgium in 2003). Given the similarity of these countries in terms of political system and political views, we compare the extent of extreme voting between the two countries in the two elections following the policy change in one. As predicted by our model, we find that polarization increases dramatically in the country that abolished compulsory voting while no substantial change is observed in the comparison country. Using data from the Comparative Study of Election Systems, the Eurobarometer and the Dutch Election Study we also find the predicted pattern that more extreme voters have higher turnout rates. Furthermore, a case study of the Netherlands shows a positive correlation between the polarization of the party system and turnout rates.

Given that theory, laboratory data and empirical evidence all provide supportive evidence for the interaction effects between party choice and turnout, we conclude that they are to be reckoned with when studying voter behavior.

In chapters 3 and 4, I turn my attention to candidate behavior. Since, similar to the case of voter behavior studied in chapter 2, an interaction effect might exist between a candidate's entry decision and her policy choice I use the citizen-candidate paradigm (Osborne and Slivinsky, 1996, Besley and Coate, 1997) to study candidate behavior. This paradigm makes it possible to study entry and policy choice simultaneously by assuming that citizens have fixed positions in the policy space (which are common knowledge) and each citizen can run for office. It is obvious that this model can be used to analyze entry behavior but by investigating where in the policy space the entrants are located I can also gain insights into the policy choice, for instance how polarized entrants' positions will be in equilibrium.

In chapter 3, *Plurality Voting versus Proportional Representation in the Citizen-Candidate Model: The Role of Coalitions*, I address the question how the number of candidates and their polarization varies between plurality voting and proportional representation. The main contribution of the chapter is to investigate how the difference between the electoral systems depends on the details of modelling proportional representation. Up to now the standard approach in the literature has been to model government policy in a system of proportional representation as the weighted average of all candidates' policy positions. I argue that this misses one of the defining characteristics of proportional representation, the presence of coalition governments. Therefore, I introduce a model of proportional representation with coalition formation where only the members of the government coalition have an influence on the policy and the members of the coalition proportionally share the office rents.

I then derive the Nash equilibria for the case of purely policy-motivated and purely office-motivated (i.e. 'Downsian') candidates. The theoretical analysis leads to three main results. First, taking the coalitions associated with proportional representation into account leads –

compared to ignoring coalitions—to candidate positions that are less polarized. This implies that the common criticism of proportional representation leading to high polarization has less bite once we take into account the incentives associated with coalition formation. Second, for the case without coalition formation, I do find that plurality voting leads to more centrist outcomes than proportional representation. This is in line with the hypothesis put forth by Cox (1990) that proportional representation leads to more polarized outcomes. Third, for the classical case of Downsian candidates, I find that proportional representation with coalitions is more conducive to multi-candidate equilibria than proportional representation without coalitions or plurality voting.

In chapter 4, *Plurality Voting versus Proportional Representation in the Citizen-Candidate Model: An Experiment*, I address the question of the difference in candidate behavior between plurality voting and proportional representation using a controlled laboratory experiment. In the laboratory I implement the citizen-candidate model with five potential candidates that are equally spaced along a one-dimensional policy space and vary the electoral system and the costs of running for office in a between-subject design employing a partner matching.

Theory predicts an (intuitive) cost effect, where higher costs of running for office reduce the number of entrants. Furthermore, when the costs of running for office are low proportional representation is predicted to lead to more entry while with high costs no such difference is expected. This makes it possible to investigate whether more entry under proportional representation is an equilibrium phenomenon or simply due to some heuristic. If it were based on a heuristic (such as entering to influence the policy, without regard for payoffs) then the difference should appear independently of costs.

The results from the experiment are broadly in line with the theory and I observe the predicted comparative statics effect for the electoral system and the costs of running for office. At the same time the data exhibit substantial over-entry compared to the Nash equilibrium predictions, which is a common finding in experiments on entry and contest games. The over-entry might be explained by a joy of winning effect, i.e. a non-monetary benefit from winning the election.

Combining the findings from chapters 3 and 4 gives rise to two main conclusions. First, the citizen-candidate paradigm is supported by experimental evidence, which strengthens confidence in the usefulness of this approach. Second, if we want to analyze the effects of proportional representation we have to accept the challenge of incorporating coalition formation and the associated incentives into our models. An obvious follow-up building on these two conclusions would be to add the model of proportional representation with coalitions presented in chapter 3 to the experimental framework of chapter 4.

In joint work with Harold Houba, chapter 5, *Bargaining in the Presence of Condorcet Cycles: The Role of Asymmetries*, investigates the role of asymmetries in strategic bargaining. We focus on the case where no Condorcet winner, i.e. an alternative that beats any other alternative in a pair-wise vote, exists, since otherwise the Condorcet winner is very likely to be implemented irrespective of the details of the bargaining institution. We

analyze the situation using the strategic bargaining model by Baron & Ferejohn (1989), where in each bargaining round one player is randomly chosen to make a proposal that the other players then vote on.

Building on work by Herings and Houba (2010), who theoretically analyze a very similar game, we set up a controlled laboratory experiment in which three players have to choose which of three options to implement. In a between-subjects design we vary whether the options are symmetric or whether one player gets a higher payoff from her best option than the other two players. The second parameter we vary is the probability that a given player will be able to make a proposal. We contrast the symmetric situation where all players are equally likely to be the proposer to the situation where one player has a lower probability of being the proposer.

From the experiment two main results arise: First, subjects are underexploiting their bargaining power and accept proposals too often, which might be caused by subjects' risk aversion. The second main result is that for asymmetric probabilities we observe systematic deviations from the model predictions. In comparison, subjects' change in behavior when going from symmetric to asymmetric alternatives is more in line with the theory when probabilities are symmetric. The systematic deviations for asymmetric probabilities not only arise relative to the risk-neutral Nash equilibrium but also when a quantal response equilibrium –with risk-aversion and noise parameters estimated using the experimental data– is used as the theoretical benchmark. We therefore conclude that subjects have a harder time understanding the strategic implications of asymmetric recognition probabilities than asymmetric payoffs and rely on heuristics when dealing with such asymmetric recognition. One such heuristic that is consistent with the data would be that subjects equate the probability of being the proposer with a player's bargaining power.

Chapter 2

A Simultaneous Analysis of Turnout and Voting under Proportional Representation: Theory and Experiments¹

2.1 Introduction

Do voters' turnout decision and their selection of a party (or candidate) interact? For example, is an extreme vote more likely to be observed when voting is voluntary than in systems of compulsory voting? Does the voluntary or mandatory nature of turnout affect strategic voting? How does the interaction between turnout and party choice depend on the polarization of party positions?

Surprisingly, such questions have rarely been addressed in voting studies (Kittel, Luhan and Morton, 2014), even though voting has been an important part of the research agenda for over five decades. Most of this literature has focused on either analyzing the determinants of a voter's turnout decision or on trying to explain her party choice but not on both questions simultaneously. This may miss important dynamics. In fact, in his seminal 1957 contribution Anthony Downs already expressed the view that the two decisions are intertwined (Downs 1957: 271). In this chapter, we therefore simultaneously study the decision whether or not to cast a vote and the decision of which party to vote for. We do so both theoretically and with data from a controlled laboratory experiment.

A possible reason for this gap in the literature is that a study of this interaction is quite challenging from a theoretical point of view. This does not make it less important, however. The mere fact that many models in the political realm take results from voting studies as primitives is a good reason to tackle the challenge. Since the conclusion of such models often crucially rests on the assumptions regarding the voting stage, it might well be that a very different picture than currently found would emerge if the interaction effects between turnout and party choice were taken into account. A recent paper by Krishna and Morgan (2014) serves to illustrate this concern. Traditionally, the literature has concluded that majority voting conflicts with utilitarian welfare. This is because the median voter's

¹ This chapter is based on Kamm and Schram (2013).

preferences dominate in majority rule, leaving other voters' preferences immaterial for the outcome (irrespective of the strength of these preferences). These authors show that when turnout is endogenous and costly, majority voting leads to a utilitarian outcome, since now the strength of preferences matters. Endogenizing turnout thus fundamentally changes the conclusions regarding a very basic and well-studied question.²

There is some evidence from the field that turnout and party choice interact. In particular, it appears that voluntary voting leads to more extreme party choice than mandatory voting. This also seems to be a conventional wisdom.³ In other words, the party choice is different when abstention is an option than when it is not. To illustrate, we consider election results in the Netherlands and Belgium. In both countries, voting was for many decades compulsory. However, the Netherlands abandoned this system in 1970 (i.e., introduced voluntary voting) and Belgium did so in 2003 (i.e., it stopped enforcing the penalty for abstaining). Given the similarity of these countries in terms of political system and political views, we compare the extent of extreme voting between the two countries in the two elections following the policy change in one. To make this comparison we constructed an extremism index that consists of the vote weighted average of the absolute value of the left-right score (from -10 to 10) taken from the Manifesto Project Database (Volkens et al. 2010). Hence, a higher number indicates more extreme voting. Figure 2.1 shows the value of this index for the two elections preceding and succeeding the changes in voting rule.⁴

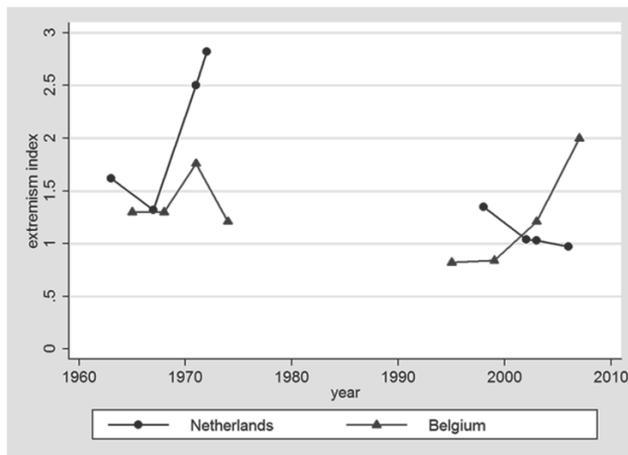


Figure 2.1: Extremism and Voluntary Voting

Notes. For each country, the lines show the value of the extremism index in the two elections before and after 1970 (when compulsory voting was abolished in the Netherlands) and 2003 (idem, Belgium).

² This example serves to illustrate the potential importance of interaction effects, but the mechanisms concerned are very different from the focus of our paper.

³ E.g., New York Times, November 6th, 2011.

⁴ Data for all elections since the Second World War are available from the authors. One noticeable observation is a monotonic decrease in the extremism index in the Netherlands from 1959 to 1986, with the exception of the two elections immediately after the rule change in 1970.

The index increases dramatically in the country that abolished compulsory voting while no substantial change in the index is observed in the comparison country. Furthermore, this effect persists and even increases in the second election after the rule change.

Further evidence of an interaction effect from the field comes from a recent study by Weschle (2014). Using observational field data from four different countries, he shows that abstention is an important element of economic voting (i.e., rewarding or punishing incumbent parties based on economic performance). In other words, economic conditions jointly affect the turnout and party choice decisions.

Hence, theoretical results, conventional wisdom, casual empiricism and empirical analysis all point to the importance of studying the interaction between voter turnout and party choice. With this in mind this chapter tackles this issue. To do so, we employ a theoretical model that explores whether an interaction effect is to be expected and, if so, what it looks like. In addition, we address the role of party positions by asking whether the extent of party polarization is related to the turnout decision. Our theoretical analysis allows us to predict three effects. First, there is a *Polarization Effect*. This predicts that voters who cast a vote are more likely to vote for an extreme party when there is a possibility to abstain than when voting is mandatory. The mechanism underlying this effect is that voluntary voting reduces the extent of strategic voting by the more extreme voters.⁵ The intuition for this effect is related to the fact that extremist voters are more likely to cast a vote (the second effect). As a consequence, the election becomes more of a run-off between the extreme parties than in the mandatory voting case. In turn, this reduces the expected benefit from voting strategically for a more moderate party. We denote the second effect as the *Extremist Effect*. The intuition is that there is more at stake for extreme voters because the worst-case scenario (the other extreme winning the election) is worse than for centrist voters. The third effect we derive is the *Turnout Effect*. This is that voters are more likely to vote when the polarization of party positions increases.⁶ Here, the reason is that increased differences across parties put more at stake in the elections for all voters.

We complement the theoretical analysis with a laboratory experiment. The experiment allows us to test the model's theoretical predictions (in particular, the three effects that we derive) in a controlled environment. We use a laboratory experiment and not an empirical test based on observational data from real elections for testing the theory since these data are rife with confounding factors. Laboratory control allows us to isolate those factors that are relevant for the theory. Moreover, it enables a measurement of causal processes that is not possible with observational field data. In the laboratory, the experimenter can implement *ceteris paribus* variations to isolate the effects one is interested in. Nevertheless, to obtain an indication of the generalizability of our results, we also provide evidence of

⁵ By strategic voting, we mean abandoning the most preferred party to favorably influence the election outcome.

⁶ Note that the term 'polarization' is used here to indicate party position, whereas it refers to voters' party choice in the Polarization Effect. Whether polarization refers to voters or parties should be clear from the context.

the three effects from real world elections. Both our experimental results and the additional empirical evidence provide support for the three interaction effects that we derived.

Finally, we note that our focus in this paper is on a system of proportional representation. This is because the existence of the interaction effect requires that voters engage in strategic voting. Given that under proportional representation the question of which party to choose is less straightforward than under majority voting, a system of proportional representation offers more scope for interaction effects. Furthermore, as argued in the following section, the question of party choice in systems of proportional representation has been under-studied, which is surprising since this system is used in many countries (including a large majority of the members of the European Union). We therefore also hope to contribute to the literature concerning strategic voting in a system of proportional representation. An important element of such systems is that many governments are formed as coalitions of various parties. This has consequences for the incentives that voters face when deciding whether or not to vote, and for whom. Our model takes these incentives into account.

The remainder of this chapter is structured as follows. In the next section we will discuss the related literature. In section 2.3 we will present the theoretical model and its equilibrium predictions before testing these predictions with a laboratory experiment whose design will be presented in section 2.4. The data from the experiment will be analyzed in section 2.5. Section 2.6 provides evidence of the generalizability of our results and section 2.7 concludes and discusses possible avenues for future research.

2.2 State of the Art

A necessary condition for the occurrence of an interaction effect is that voters are strategic in their voting decision and do not vote sincerely for the party closest to their preferences. Therefore the literature on strategic voting in systems of proportional representation is relevant for our research question.

We therefore start with discussing the literature on the determinants of party choice in a system of proportional representation. Until recently, surprisingly little attention had been paid to this question. The main reasons can be traced back to two pioneers in the study of party choice in proportional representation.

On one side is the view expressed by Duverger in his seminal 1955 contribution. He argues that in a system of proportional representation the votes more or less continuously translate into seats in the legislature. As a consequence, no incentive for strategic voting exists. Based on this view, for many years the standard way to model the implemented policy resulting from a system of proportional representation was to assume that it is the average of the policy positions of the parties in parliament weighted by their share of seats (see for

instance Cox and Shugart, 1996, Cox, 1997, Kedar, 2009).⁷ Under this assumption there is little reason to vote strategically.

Underlying Duverger's reasoning is the notion that voters care about who is represented in parliament. Yet, Downs (1957) already pointed out that it is more reasonable to think about voters trying to influence the final policy that the parliament enacts. If so, then influencing which parties are in parliament is only a proximate goal. A full analysis requires shifting attention to the manner in which parliamentary seat distributions translate to implemented policies (e.g., Indridason 2011). In this respect, it is doubtful whether it is reasonable to assume that the implemented policy is a weighted average of the policy positions of all parties in parliament. This assumes that all parties have an influence on the final policy, which is predominantly not the case. Based on such insights, Indridason (2011) investigates how robust conclusions drawn from models where every party has an influence on the final policy are to introducing the majoritarian decision rules that parliaments tend to employ. He shows that assuming that a party with an absolute majority can implement its own policy platform is already enough to lead to substantially different model predictions. If coalition governments are also added to the model, the predictions are even further away from those of the original models. Additionally (and especially relevant for our research question) he shows that strategic voting can be an equilibrium strategy in such models.

Indridason's results imply that Duverger's reasons to discount strategic voting in systems of proportional representation do not hold if people care about policy outcomes instead of election outcomes per se. Though this insight can be traced back to Downs' work, it is interesting to note that –while not sharing Duverger's point of view– Downs was also skeptical about whether strategic voting would be a relevant phenomenon in a system of proportional representation. Because of the complex reasoning involved in strategic voting, he concluded that in this setting a voter would use sincere voting as a heuristic (Downs, 1957: 163).

Recent evidence shows that this task might be easier than Downs thought, however. One example is given by Irwin and van Holsteyn (2012) who study behavior by Dutch voters. Based on the Dutch Parliamentary Election Study 2002-2003 (a survey) they investigate whether voters have the expectations needed to behave strategically. They show that voters can predict before elections the most likely coalitions to form and can also anticipate the compromises that parties will make when forming the coalition. Given that the positions of the different parties were well known, the authors argue that the voters can make an educated guess concerning the policy outcome that will result from a coalition.

Since voters both have the information needed to behave strategically as well as an incentive to do so if they care about final policy, we conclude that there are sound reasons to investigate strategic voting in a system of proportional representation. In turn, this may

⁷ Herrera, Morelli and Palfrey (2014) are somewhat of an exception since they do not assume a linear mapping from seat shares to policy weights.

well interact with the endogeneity of the turnout decision, leading to distinct levels of strategic voting in systems of mandatory versus voluntary turnout.

This research agenda where voters are assumed to care about policy outcomes can be subsumed under the heading of “coalitional voting”. On the theoretical side a seminal contribution is by Austen-Smith and Banks (1988). Using a game theoretic model, they analyze a three-party model with a minimum vote threshold in a one-dimensional policy space and mandatory voting. The coalition formation process is modeled as a bargaining game between the parties in parliament. In equilibrium, the largest and smallest parties form a coalition. Hence, a party’s influence on the final policy is non-monotonic in the number of votes it receives. In a second step, Austen-Smith and Banks solve for the optimal (possibly strategic) voter behavior given the equilibrium bargaining outcome that will ensue for a given distribution of votes. Finally, they close the model by allowing the parties to choose their positions in the policy space to optimize their chances of winning the election. An important result is that voters behave strategically in equilibrium. Though this study provides a comprehensive analysis of party and voter behavior in proportional representation, it remains unclear whether it generalizes to more parties⁸ or a different coalition formation process. Moreover, the model does not allow for abstention. More generally, much work remains to be done on the theory side.

There is by now abundant evidence that voters’ party choice is significantly affected by the probabilities of different coalitions forming after an election. Examples include the 2006 elections in Austria (Herrmann 2008, Meffert and Geschwend 2010), and the 2003 (Blais et al. 2006) and 2006 (Bargsted and Kedar 2009) Israeli parliamentary elections. More generally, there is no evidence of less strategic voting in countries with proportional representation than in majoritarian systems (Abramson et al. 2010, Bargsted and Kedar 2009; Hobolt and Karp 2010). The most comprehensive cross-country analysis of coalitional voting is given by Duch et al. (2010), who estimate a model of party choice using data from 23 countries. They apply a decision theoretic model, where voters on the one hand care about the policy position of a specific party and on the other hand about how a vote for this party will influence the final policy. They then estimate how important the two factors are in determining the party choice and find strong support for the hypothesis that reasoning about possible coalition governments plays an important role.

Though all these studies seem to indicate that coalitional voting is pervasive, their conclusions are based on survey data and may be blurred by confounding factors.⁹ Further evidence stems from experimental investigations, which allow for greater control, making it easier to isolate the effects one is interested in. An example closely related to survey-based research is Irwin and Holsteyn (2012). In a survey, they first ask for the respondent’s preferred party and then present different electoral scenarios (consisting of poll numbers

⁸ Herrmann (2014) investigates a decision theoretic model of coalitional voting with four or more parties. Given that his focus is on investigating the effect of polls, the model is quite specific, however, and would need to be adapted to more generally explain strategic voting with four or more parties.

⁹ Kawai and Watanabe (2013) and Spenkuch (2013) offer an empirical analysis of strategic voting under plurality rule using election results and find a substantial number of strategic voters. For the case of proportional representation we are not aware of any such analysis.

and a statement concerning the coalitions the parties would like or not like to form) framed in terms of the 2002 Dutch parliamentary elections. They report clear evidence that voters change their party choice depending on the electoral scenario and the likely coalitions associated with it. A more traditional experiment (in the sense of being a laboratory experiment with monetary incentives) is reported by McCuen and Morton (2010). They implement the Austen-Smith and Banks (1988) model in the laboratory and find that voters indeed behave strategically. They do so much less frequently than predicted by the theory, however, and often vote naively for the party closest to them. On the other hand, there are also voters who abandon their most preferred party even though the model predicts them to behave sincerely.¹⁰ The authors conclude that coalitions have an effect on party choice and conjecture that the observed deviations from the predictions can be attributed to their American subjects being unfamiliar with a system of proportional representation.

These experimental studies show that many subjects behave strategically in a system of proportional representation. This implies that there is scope for the interaction effect between party choice and turnout that we are interested in.

The interaction effect not only implies that turnout may affect the party choice, it also means the reverse: the decision to vote may depend on the party one prefers. A seminal contribution to understanding voter turnout is due to Palfrey and Rosenthal (1983) who model turnout as a participation game. In a participation game individual members of groups have to decide whether or not to participate in an activity. The members of the group with the highest participation all get a prize irrespective of whether or not they participated themselves. Laboratory studies of voter turnout typically apply the participation game (e.g., Schram and Sonnemans 1996a). The comparative statics predicted by the theory are observed in the laboratory as well as in the field (Levine and Palfrey 2007). Though most studies have focused on the majoritarian case, a few consider a system of proportional representation. These find that turnout is higher in the majoritarian case than in a proportional representation system (Schram and Sonnemans 1996b), unless the majority is much larger than the minority (Herrera, Morelli and Palfrey 2014, Kartal 2014). A shortcoming of these studies is that they only investigate cases with two parties and assume a linear mapping from votes to payoffs. As argued above, this neglects a main feature of systems of proportional representation, which is the occurrence of coalition governments.

This discussion on voter turnout shows that a joint investigation of turnout and party choice for systems of proportional representation is still missing for the most interesting case of more than two parties.¹¹ In fact, as far as theory is concerned, we are not aware of any formal model that combines the two in this setting. The only two attempts at such a joint investigation we are aware of are given by Kittel et al. (2014) and Blackwell and Calgano (2014). Kittel et al. in a ‘first-past-the-post’ setting, investigate how pre-voting communication affects the turnout decision and strategic voting. Given that their focus is

¹⁰ Of course, this may be a best response to the low levels of strategic voting by others.

¹¹ As discussed in the introduction, Weschle (2014) provides evidence that turnout interacts with economic voting. This is indicative that it interacts with party choice.

on communication and not on exploring the interaction between turnout and party choice, their study (while a very important first step) unfortunately gives no indication on what this interaction effect might look like. Blackwell and Calgano investigate the effect of different primary types on turnout and strategic voting using an experiment. They find that with high voting costs (which lead to lower turnout) less strategic voting is observed which is in line with the Polarization Effect.

2.3 The model

We model the situation at hand in the long tradition of spatial voting (Downs, 1957; Black, 1958) which assumes that parties and voters are located in a policy space and that the payoff to a voter is decreasing in the distance between her position (her ideal point) and the implemented policy. Specifically we assume that the policy space is one-dimensional and can be described by the line segment $[-10,10] \in \mathfrak{R}$, which may be interpreted as capturing a left-right spectrum of the political arena.

2.3.1 Voters

Five voters are randomly and independently located across the policy space. The distribution function from which their positions are drawn is discussed below. We follow the standard approach and assume that the utility a voter receives is decreasing in the squared difference between her ideal policy (given by her location in the policy space, x_i) and the implemented policy x^* . This leads to the following utility function:

$$U_i = -(x_i - x^*)^2 - c_i \tag{1}$$

Here c_i represents the net costs that a voter has to incur if she casts a ballot. The net costs of voting are given by the difference between the costs and benefits of casting a ballot, other than the benefits derived from influencing the policy outcome.¹² We do not specifically model the costs and benefits of voting but make only an assumption concerning the net costs. These are assumed to be i.i.d. uniformly distributed on a domain that - due to the potential utility gains from the act of voting per se - may include negative values.

In every election, each voter has to decide whether or not she wants to cast a vote and thereby incur the net costs of voting. Conditional on deciding to vote she subsequently has to decide for which party to vote. In case of mandatory voting, the first step is (obviously) not applicable. The reasoning underlying this sequential decision process is that it seems natural that voters will only invest time and effort into making a party choice if they plan

¹² The costs can be divided into two main categories: on the one hand it takes costly effort to get informed about the party positions and to decide for which party to vote. On the other hand there are the opportunity costs associated with attending the election. The benefits of voting measure utility that a voter gets from the act of voting per se. These are generally interpreted to be due to a sense of civic duty (Riker and Ordeshook 1968), which is based on the notion that a voter ‘feels good’ when doing her civic duty of voting (and thereby avoiding the costs that are associated with violating the social norm of voting).

to cast a ballot.¹³ All voters make these decisions simultaneously and given that both the voters' positions as well as their voting costs are private knowledge, the decision can only be conditioned on the distribution of costs and positions, which is common knowledge. Furthermore, voters are unaware of how many voters decided to vote when making their party choice.

2.3.2 Parties

At the other side of the election there are three parties described by a policy position in the one-dimensional policy space. Since our focus in this paper is on voter behavior these positions are exogenously given and cannot be changed by the parties. Furthermore, the rules of coalition formation are fixed and therefore the parties have no choice regarding the coalition to form.

2.3.3 Government formation

The rules of government formation are the following (these rules are inspired by Austen-Smith and Banks, 1988 and Indridasson, 2011):

1. If a party receives an absolute majority of votes cast this party unilaterally forms a government and the implemented policy x^* is equal to this party's policy position.
2. If no party receives an absolute majority of votes cast, the largest party is assigned the role of government formateur.¹⁴ This party then proposes a coalition to the parties it wants to cooperate with; if all these parties agree, the coalition is formed and the implemented policy is the average of the policy positions of the parties in the coalition weighted by the number of votes they received. When forming a coalition, the formateur tries to keep the implemented policy as close as possible to its own policy position while not including more parties in the coalition than needed for a majority.
3. If multiple parties have the most votes a fair random draw decides which of the largest parties is assigned the role of formateur.
4. If the coalition is rejected, bargaining breaks down and every party receives a payoff of $-\infty$.

Two things are important to note regarding these rules. Firstly, the rule that there are no more parties than necessary in the coalition does not mean that a minimal-winning coalition (i.e. the coalition with the smallest majority) is formed. Instead, it implies that

¹³ Schram (1992) and Thurner and Eymann (2000) report empirical evidence for this two-step decision process.

¹⁴ An alternative assumption is that the formateur is randomly chosen (as in Baron and Ferejohn, 1989) with recognition probabilities proportional to vote shares. Both assumptions find empirical support. F.i., Diermeier and Merlo (2004) find that the random formateur model fits the data better than recognition in order of seat share but the largest party has a disproportionately high probability of being recognized first. Furthermore, Ansolabehere et al. (2005) find that controlling for vote shares the largest party is twice as likely to be the formateur.

coalitions that keep a majority even if one party would leave are not permitted.¹⁵ The reason that we restrict attention to coalitions that are not excessively large is that one rarely observes such coalitions in reality.¹⁶ A reason could be that parties are also office-motivated (as we will discuss in chapters three and four) and do not like to share the spoils of office with unnecessarily many other parties. The second important thing to note is that rule 4 makes sure that any proposal in line with rule 2 will be accepted. We may therefore abstract from the bargaining process itself. Obviously, one could set up a more elaborate bargaining process like in Austen-Smith and Banks (1988), but given that parties are not active players in our model this very simple process seems adequate. Finally, one can think of the rule that the policy implemented by a coalition is the vote weighted average of the policy positions of the parties in the coalition as reflecting the outcome of a bargaining process that is not modeled explicitly.

2.3.4 Equilibrium analysis

We solve the model using the quantal response equilibrium (QRE) concept (McKelvey and Palfrey 1995). In particular, we apply ‘logit equilibrium’. In this equilibrium, conditional on casting a ballot the probability that a voter votes for party j ($j = 1; 2; 3$) given a position x and costs c is given by the following expression:

$$P_j(x) = \frac{\exp(\lambda * EU(\text{vote for party } j))}{\sum_k \exp(\lambda * EU(\text{vote for party } k))} \quad (2)$$

In case that voting is voluntary the probability of casting a ballot is given by:

$$p^{\text{turnout}}(x, c) = \frac{\sum_j \exp(\lambda * P_j(x) * EU(\text{vote for party } j))}{\exp(\lambda * EU(\text{abstain})) + \sum_j \exp(\lambda * P_j(x) * EU(\text{vote for party } j))} \quad (3)$$

Here, λ is a so-called ‘noise parameter’ that captures the extent of noise in individual voters’ decisions. As the noise decreases, λ increases and the QRE converges to a Nash equilibrium.¹⁷ In QRE the probability of choosing an action is increasing in the expected (relative) payoff of an action and the speed of this change is measured by λ . If it is very small, the expected performance of an action does not matter very much and behavior is close to random while when λ is very large we are close to Nash behavior where the best action is chosen with certainty. Furthermore, EU denotes the expected utility (as defined in eq. 1) of an action, which is a function of the probabilities with which the other voters vote for the different parties, as well as the voter’s policy position and her costs of voting. We assume that the equilibrium is symmetric in the sense that voters with the same policy position and costs of voting have the same probability of choosing the different parties. A

¹⁵ The difference can be seen in the following example: Suppose that there are 4 parties; parties 1 and 2 receive 5 votes each, 3 receives 10 votes and 4 receives 15 votes. The minimum-winning coalition would be a coalition with 20 votes (parties 1 and 4, 2 and 4 or 1, 2 and 3). We also allow a coalition of parties 3 and 4 and only rule out coalitions like 1, 2 and 4.

¹⁶ Ström et al. (2008) report that in 80% of the cases a minimum winning coalition is formed. In the remaining cases one rarely observes super-majorities.

¹⁷ More specifically, this holds for the so-called ‘principal branch’ of the Multinomial Logit Correspondence (see McKelvey and Palfrey 1995).

logit equilibrium is then found by solving the set of equations in (2) for the vector of probabilities P_j . Appendix 2.A provides an overview of the equilibria for our game.

Choosing QRE over Nash as a solution concept has two advantages in our application. Firstly, it has a better track record than Nash in explaining experimental data in voting experiments (e.g., Goeree and Holt 2005; Großer and Schram 2010). Secondly, QRE provides an equilibrium selection in case of multiple Nash equilibria. This is important because of the multiplicity of equilibria that are present when using Nash equilibrium in this type of voting games (see Appendix 2.B for the Nash predictions for our game).

To derive predictions, we use an out-of-sample estimate of the noise parameter (λ). Using data from a pilot experiment with a similar set-up but with fixed voter positions (see Kamm, 2012), we obtain an estimate $\lambda=3.7$.

In our analysis we will assume (as in the experimental design) that parties are located at 7.5 (a right-wing party), 0 (a central party) and α (a left-wing party), where α is between -7.5 and 0. The reason for only varying the left-wing party's position is that parties' relative positions matter more than their absolute positions. By varying α we can investigate both a situation with polarized parties (α is close to -7.5) and a more centrist situation (α is close to 0) to study whether this matters for the interaction effect between turnout and party choice. Figure 2.2 summarizes how parties are distributed in the policy space.

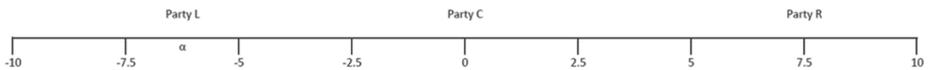


Figure 2.2: Parties in the Policy Space

Notes. The line indicates the policy space. Party positions are given above the line.

Furthermore, we assume that the voters are distributed on the one-dimensional policy space according to a truncated t-distribution with 0.05 degrees of freedom. This specific parameterization was chosen to fit the distribution of voter preference taken from the German Longitudinal Election Study 2009 and the Dutch Parliamentary Election Study 2006.

With these assumptions, we can determine the QRE. This describes for each possible voter position in the left-right policy space, the probabilities that she will vote for the left-wing, central or right-wing party. As an example, Figure 2.3 shows the equilibrium party choices (conditional on voting) for one of the parameter values used in the experiment. In this case, voting is voluntary and the left-wing party's policy position is located close to the central party's position (i.e., $\alpha = -1.5$).

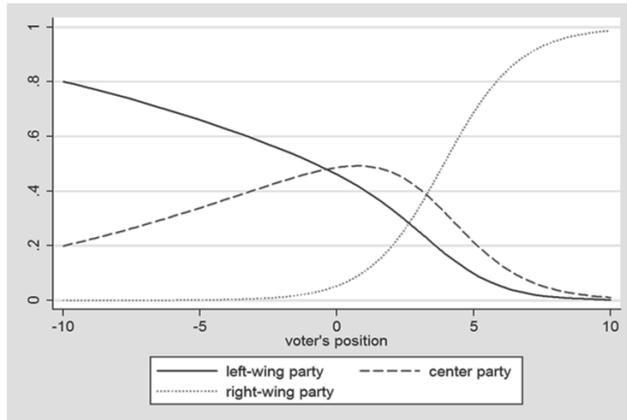


Figure 2.3: Equilibrium Probabilities of Voting for Parties

Notes. The figure shows the predicted probability of voting for each of the three parties in the treatment voluntary-centrist as the voter's position varies along the horizontal-axis.

This graph shows that extreme left (right-) wing parties have a high probability of voting for the party on 'their wing' of the spectrum. This sincere voting is not symmetric, however: any voter with an ideal point between 8 and 10 votes for the right-wing party with a probability of at least 80%, whereas the probability of voting for the left-wing counterpart is less than 80% for any voter positioned between -8 and -10 (the probability of voting strategically for the center party is more than 20%). As the voter moves towards the right (left) of the policy space the probability of voting for the left-wing (right-wing) party decreases. Note that the QRE allows for a very small probability that an extreme voter will vote for the party at the other end of the spectrum. Finally, note that the mode for the central party's support is to the right of its own position (which is 0). It is more likely to get votes from extreme left wing voters than from extreme right wing voters, however.

Similarly, one can determine the equilibrium turnout probabilities for each voter position and for different positions of the left-wing party (cf. Appendix 2.A). This allows for the derivation of comparative statics predictions. A first thing that such an analysis shows is that (conditional on voting) voters have higher probabilities of voting for an extreme party when there is a possibility to abstain. This is illustrated in Figure 2.4.

The figure shows that, compared to mandatory voting regimes, voluntary voting is predicted to increase the probability that a voter who turns out will vote for an extreme party. The intuition for this prediction is that when voting, a voter faces a tradeoff between two objectives. On the one hand she wants to give her favorite party (the one located closest to her) a strong position in the coalition formation process by voting sincerely. At the same time, a voter tries to minimize the risk that the party that is farthest away becomes part of the government. When voting is mandatory, it is often worthwhile for a voter with a sincere preference for an extreme party to vote strategically for the central party in order to weaken the position of the party at the other extreme. When voting is voluntary this

incentive is weaker (in equilibrium) due to abstention by other voters (see below) and we therefore see less strategic voting by extreme voters and hence more extreme voting.

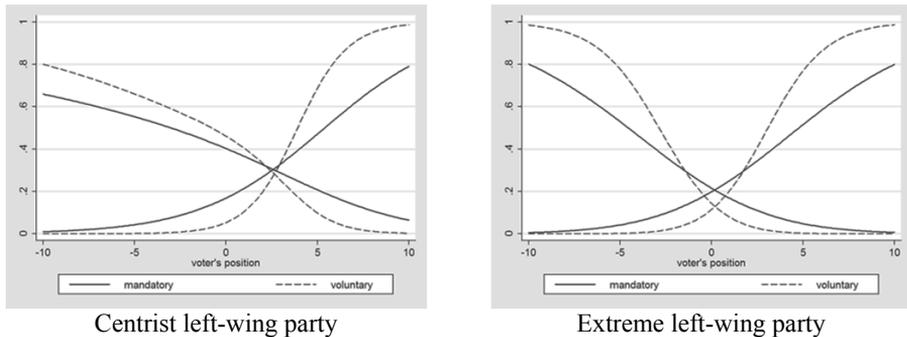


Figure 2.4: Predicted party choice (voluntary versus mandatory voting)

Notes. The figures compare the predicted probability of voting for each of the extreme parties between compulsory and voluntary voting as the voter's position varies along the horizontal axis. The predictions are based on the QRE model with $\lambda=3.7$. The left panel depicts the case for $\alpha = -1.5$ (a 'centrist' left-wing party) and the panel on the right depicts the case for $\alpha = -1.5$ (an 'extreme' left-wing party).

The success rate for extreme parties is further increased by a second comparative static, which is that voters close to the extremes of the policy space have higher equilibrium turnout rates than voters close to the median voter's position (see Figure 2.5). The reason is that extreme voters have more to lose. Their worst-case scenario is a situation where the party on the other side of the policy spectrum is in power. They therefore have a large incentive to participate in the election to reduce the probability of this happening. Centrist voters, on the other hand, have less to lose. For them, it does not matter as much if an extreme party obtains power and therefore they have less of an incentive to incur the costs of voting. As a consequence, turnout is a u-shaped function of the voter's position.

However, the minimum of this function is not necessarily at the median position. In particular, turnout rates for the case where the left-wing party is relatively 'centrist' are not symmetric around a position of zero. The voter with the lowest probability of turning out is not the median voter but the voter that is halfway between the two extreme parties. This is because such a voter has the lowest incentive to turnout since she is indifferent as to which of the two extreme parties is in power. In contrast, when the left-wing party is extreme the situation is almost symmetric and therefore the point of minimum turnout is close to the median voter.

Finally, for almost all voter positions equilibrium turnout rates are higher when parties are more polarized (compare the two curves in Figure 2.5). The intuition is rather obvious. The higher the polarization, the larger are the differences in utility between the different possible outcomes. These larger incentives make it worthwhile to incur larger voting costs leading to higher turnout rates.

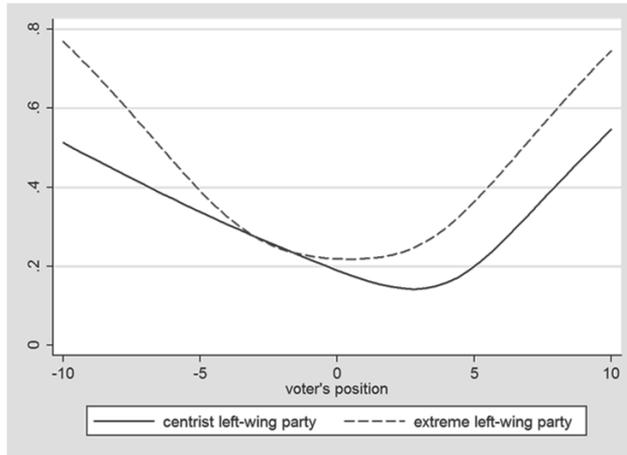


Figure 2.5: Predicted turnout rates

Notes. The figure shows the predicted turnout rates as the voter's position varies along the horizontal axis. The predictions are based on the QRE model with $\lambda=3.7$.

The equilibrium analysis thus yields three stylized results:

Polarization Effect: Party choice (conditional on voting) is less strategic and therefore more extreme when voting is voluntary.

Extremist Effect: Extreme voters have higher turnout rates than centrist voters.

Turnout Effect: Turnout rates are higher when parties are more polarized.

It is important to note that these stylized results are robust to variations in the specific levels of polarization (i.e. the position of the left-wing party) and the particular distribution of costs imposed. Moreover, the results are also obtained when using a uniform distribution of voters' positions as opposed to the t-distribution.¹⁸

We will test the three stylized results with laboratory data. The following section presents our experimental design.

2.4 Experimental design

2.4.1 Experimental Protocol

The experiment was conducted at the CREED laboratory at the University of Amsterdam in February 2013 and implemented using php/mysql. Participants were recruited using CREED's subject database. In each of eight sessions, 25 or 30 subjects participated. Most

¹⁸ The Extremist Effect and Turnout Effect are also independent of the equilibrium concept used; they are predicted by the Nash equilibrium outcomes (see Appendix 2.B). As for the Polarization Effect, more sincere voting when turnout is voluntary is also predicted by the Nash equilibrium but this only implies more votes for extreme parties when the parties are far apart; not when the left-wing party is centrist.

of the 230 subjects in the experiment were undergraduate students of various disciplines.¹⁹ Earnings in the experiment are in ‘points’, which are converted to euros at the end of the experiment at an exchange rate of 100 points = 1€. The experiment lasted on average 100 minutes and the average earnings were €23.90 (including a 7€ show-up fee).

After all subjects have arrived at the laboratory, they are randomly assigned to one of the computers. Once everyone is seated they are shown the instructions on their screen. After everyone has read these and the experimenter has privately answered questions, a summary of the instructions is distributed. This summary included a table that specifies which coalition would be formed for each possible configuration of votes (for an example see Appendix 2.D). Then, all subjects have to answer quiz questions that test their understanding of the instructions. After everyone has successfully finished this quiz, the experiment starts. At the end of the session, all subjects answer a short questionnaire and are subsequently paid their earnings in private.

Each session consists of thirty rounds and in each round subjects are in electorates of five where each group is confronted with the task of electing a new government.²⁰ Electorates are rematched in every round. This serves the purpose of avoiding repeated game effects and reduces the influence of noise players. For this re-matching, we use matching groups of ten or fifteen subjects²¹ (depending on whether a session consisted of 30 or 25 subjects). As a consequence, each session generates two or three independent matching group-level observations.

The specific task in each round is presented as follows: in all treatments subjects are informed in every round about their draw of the net voting costs as well as their position in the policy space. To aid comparison, we use the same realizations of positions in all sessions. In the treatments with mandatory voting subjects are asked to decide for which of the three parties (labeled party 1, party 2 and party 3) they would like to vote. In the treatments with voluntary voting they had a fourth option, abstention.²² In all treatments we give the subjects the option to see the complete history in which they took part by clicking on a button.²³ Hence, they can see what they did in the past for different voting costs, what the distribution of votes was and what the resulting government was. Furthermore, we provide them with a payoff calculator such that they can compute the payoffs they would get from different coalitions, given their parameters in the current round. For an example of what the interface looks like, see Appendix 2.D.

¹⁹ 127 out of 228 (two did not give information on their field of study) majored in economics or business.

²⁰ We decided to frame the task in terms of an election since otherwise the setting would be quite complicated to explain. We think that this framing will not substantially affect behavior, though this could be tested, of course (Levine and Palfrey, 2007; n. 9, report finding no framing effects in their turnout experiment). Note that we do not use terms like “left-wing” in the instructions but refer to voters and parties by numbers.

²¹ Subjects are told that they are randomly re-matched every period, without specifying the matching groups.

²² This option was presented above the three parties such as to visually separate the two types of behavior (voting or abstaining).

²³ Subjects did not use this option very much. In the first 15 rounds subjects looked at the history 4.7% of the time. For the last 15 rounds this was 2.9%. These probabilities did not vary much across treatments.

After everyone has voted, the computer counts the votes and shows each subject the distribution of votes (and number of abstentions, if applicable), the government that is formed and what policy it implements, and the payoff from the current round as well as the accumulated payoffs from past rounds.

The per round payoffs (which are in terms of points) are determined by:

$$160 - 2 * (x_i - x^*)^2 - c_i$$

where x^* is the implemented policy, x_i is the subject's position in the policy space and c_i is the realization of voting costs in the round concerned.

We implement the costs (which may be negative) of voting as real costs that are deducted from the payoff and not as opportunity costs (represented by a bonus if one decides to abstain) since this seems the more appropriate framing of the decision problem. The constant 160 is used to ensure that the subjects rarely have a negative aggregate payoff from past rounds, since otherwise (unmeasured) loss aversion could lead to uncontrolled effects.

2.4.2 Treatments and predictions

To test for the stylized facts outlined in the previous session the experiment employs a full 2x2 design where in the first treatment dimension we vary the position of the left-wing party and in the second dimension whether voting is voluntary or mandatory. Table 2.1 gives a summary of the treatments.

We implement two distinct positions for the left-wing party: In one case –denoted by ‘Centrist’–, the party is relatively close to the center ($\alpha = -1.5$) and in the other case – ‘Extreme’–, it is much more left-wing ($\alpha = -7.0$). The reasoning underlying the choice of these two specific values of α is to create sufficient difference in polarization between the two situations to yield a difference in predicted turnout rates that is large enough to be measured even when subjects' behavior is noisy.

Table 2.1: Treatment Summary

	Mandatory voting	Voluntary voting
Centrist left-wing party ($\alpha = -1.5$)	CentMand N=6	CentVolu N=5
Extreme left-wing party ($\alpha = -7.0$)	ExtrMand N=5	ExtrVolu N=6

Notes. Cell entries give the treatment acronym used throughout this paper and the number of independent observations (N=# matching groups as discussed in the main text) for each treatment.

Having specified the distribution of voters' ideal points and parties' policy positions, the model will be completely specified after choosing a distribution for the net voting costs. Like in the theory section, we assume a uniform distribution. Aside from greatly simplifying the equilibrium analysis, this has as the advantage that it is a distribution that is quite easily explained to subjects. As bounds for the uniform distribution, we choose -15 and 200 . While these numbers are meaningless per se, one should note that they indeed allow for subjects to have a net benefit from voting.²⁴

Applying the equilibrium analysis to our design yields predictions that are parallel to the stylized results of the previous section:

Prediction 1 (Polarization Effect):

- a) *The probability of voting for the central party (conditional on voting at all) is lower in CentVolu than in CentMand;*
- b) *The probability of voting for the central party (conditional on voting at all) is lower in ExtrVolu than in ExtrMand*
- c) *The extent of strategic voting is lower in CentVolu than in CentMand;*
- d) *The extent of strategic voting is lower in ExtrVolu than in ExtrMand.*

Prediction 2 (Extremist Effect):

- a) *In CentVolu, voters with positions near 0 vote at lower rates than voters with more extreme positions;*
- b) *In ExtrVolu, voters with positions near 3 vote at lower rates than voters with more extreme positions.*

Prediction 3 (Turnout Effect):

Turnout is higher in ExtrVolu than in CentVolu.

2.5 Results

We will focus on the aggregate behavior in each treatment. We will begin by offering a description of the party choice per treatments. Then, we will look for differences across treatments and compare these to our predictions 1a-d. Subsequently, we will analyze the turnout decision, again going from a description of the data to a comparison across treatments and a test of the predictions (2a and 2b, 3).

2.5.1 Observed Party Choice

Figure 2.4 shows the aggregate party choice per treatment. Dots indicate for each position the observed fractions of votes for the different parties (smoothed by using the average fractions for positions ± 0.2 of the value on the horizontal axis). In addition, the figures show the estimated (multinomial) logit curves that fit the data (see Appendix 2.E for the underlying estimates). All four figures show aggregate behavior close to cut-point

²⁴ This will be the case for (on average) seven percent of the subjects. It does not seem completely unreasonable to think that such a proportion of the population might have such a high value of 'civic duty' that it overcompensates for the costs of voting.

strategies since the slopes are either close to zero or very steep. At the same time even at the extremes of the policy space we find that subjects do not always vote sincerely. To accommodate these extreme points, the estimated logit functions have a less steep slope than the observed data.

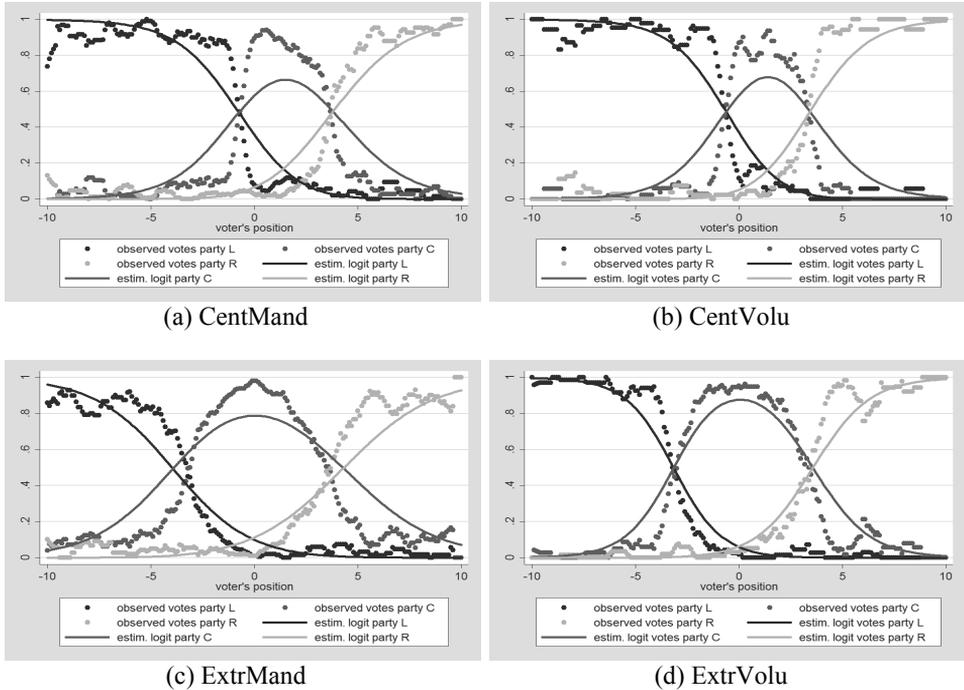


Figure 2.4: Party choice

Notes. Dots (lines) show the observed (estimated) probability of voting for each of the three parties as the voter's position varies along the horizontal axis. Data are averaged over ± 0.2 of the value on the x-axis. The data for CentVolu and ExtrVolu are conditional on turning out.

Comparing observed behavior to the QRE (see Appendix 2.A for a graphical representation) allows for two conclusions. First, the equilibrium shows for CentValu and CentMand a pronounced asymmetry between the extreme left and extreme right positions (where even for the most extreme left-wing voters behavior is not always sincere). This effect is not observed in the data. Second, in all treatments the observed slope near the cut-point is much steeper than predicted by QRE. Both findings may be attributed to the fact that quantal response does not take into account that sincere voting is a powerful heuristic. Therefore, when voting sincerely coincides with optimal behavior, voters behave optimally much more often than predicted. At the same time, estimating the λ parameter from our data yields a value of 3.3, which is close to the value taken from the pilot (3.7) and

therefore not the reason for differences between the prediction and the QRE on the data (see appendix 2.A).²⁵

2.5.2 Comparative Statics

We start with the Polarization effect, by considering the extent to which voters opt for extreme parties. Figure 2.5 compares the estimated probability functions of voting for the left-wing and right-wing parties in CentValu and CentMand. These show more extreme party choices when voting is voluntary, as predicted (Prediction 1a). This effect is most pronounced for moderately right-wing voters, but overall the effect is quite small. To formally test prediction 1a), we estimate a multinomial logit of party choice with the central party as the benchmark (with robust standard errors clustered at the level of matching groups). The results are presented in Table 2.2.

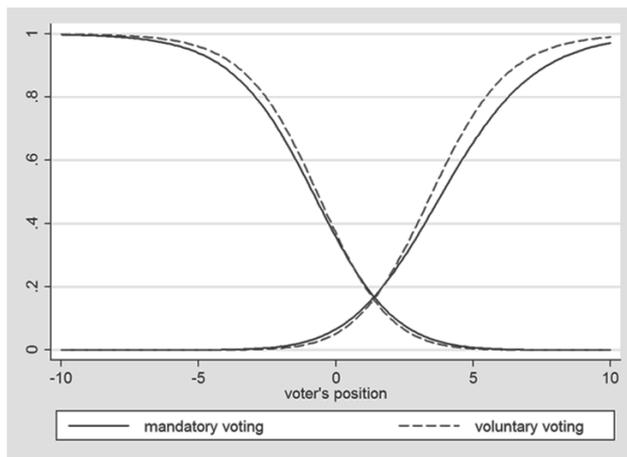


Figure 2.5 Extremist Voting, Centrist Left-wing

Notes. The figure compares the estimated probability of voting for the left- and right-wing party between CentMand and CentVolu as the voter's position varies along the horizontal axis.

These regressions include a dummy variable to distinguish between the voluntary and mandatory treatments. The results show that both coefficients for this variable are positive as predicted, but neither is statistically significant when considered in isolation. Considered jointly, a two-sided Wald test can only marginally reject the hypothesis that the treatment has no effect on voting for the extreme parties at all ($p=0.10$). Finally, note that the effect of a voter's position and her party choice is as predicted, as voters are more likely to vote for the left- (right-)wing party, the more left (right) their position is. As was to be expected, this effect is statistically very strong.

²⁵ We also estimated parameters for a QRE model that allows for different values of λ in the turnout and party choice decisions. This yields much more noise in the turnout decision than in party choice. The estimate for turnout is close to estimates from turnout experiments reported in Goeree and Holt (2005) and Großer and Schram (2010). See Appendix 2.A for more details.

Table 2.2: Multinomial Logit Results, Centrist Left-Wing

Constant and Independent Variables	Coefficients		
	Vote for left-wing party	Vote for center party	Vote for right-wing party
Constant	-0.50*** (0.108)		-2.27*** (0.449)
Voter's position	-0.66*** (0.147)	Benchmark	0.60*** (0.114)
Voluntary	0.12 (0.119)		.18 (0.154)

Notes. The table provides multinomial logit estimates of the determinants of party choice when the left-wing party is centrist. “Voluntary” is a dummy variable that is 1 if voting is voluntary. Standard errors given in brackets are clustered at the matching group level. For the voluntary voting treatments, only subjects who chose to vote for a party are included. *(**, ***) indicates significance at the 10% (5%; 1%) level.

A different way of testing prediction 1a) is to focus directly on the proportion of votes for the center party. Since one has to take into account the different turnout rates it is not possible to simply compare across treatments the observed votes for the center party. Due to the ‘Extremist Effect’ this would bias the analysis in favor of concluding that voluntary voting leads to less voting for the center party. To circumvent this problem we divide the policy space into twenty intervals of length one and compute for each matching group and interval the proportion of votes for the center party. A Wilcoxon signed-rank test then gives strong support for prediction 1a) (p-value: <0.01).²⁶

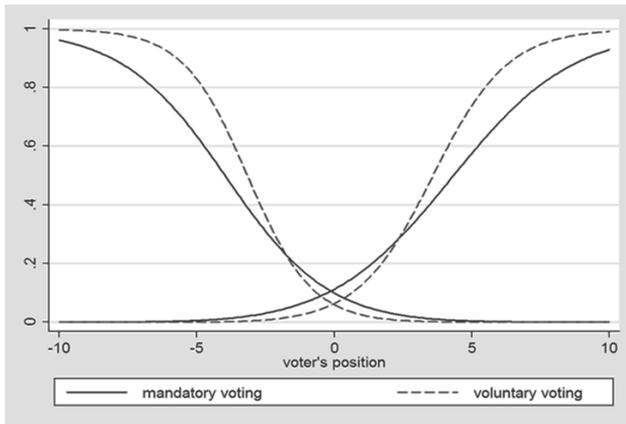


Figure 2.6: Extremist Voting, Extreme Left-Wing

Notes. The figure compares the estimated probability of voting for the left- and right-wing party between ExtrMand and ExtrVolu as the voter's position varies along the horizontal-axis.

²⁶ The matched pairs used in this test are constructed by averaging over the matching groups with the same realization of voter positions and voting costs.

Next, consider prediction 1c), that there is more strategic voting with mandatory turnout. To test this, we compute the proportion of strategic votes (defined as voting for the second favorite party). In CentMand 8.6% of the votes are strategic while in CentVolu the fraction is 7.9%.²⁷ While the fact that the proportion is higher for CentMand is in line with our prediction, a Wilcoxon ranksum test cannot reject that there is no difference between the two proportions (p-value: 0.52) and therefore prediction 1c) is not supported.

Turning now to the case with an extreme left-wing party (ExtrValu versus ExtrMand), Figure 2.6 shows a substantially higher probability of voting for an extreme party when voting is voluntary.

This result is supported by the regression analysis reported in Table 2.3. Here, both coefficients for the voluntary voting treatment dummy are positive, and the effect on voting for the left-wing party is highly significant when considered independently (p-value: <0.01). The effect for the right-wing party is not significant at the 10%-level (p-value: 0.16) in isolation. A two-sided Wald test for the joint significance of the two coefficients finds them to be significant at the 5%-level (p-value: 0.03). This provides support for prediction 1b. Once again, voters' positions affect their party choice in the intuitive way. A Wilcoxon signed-rank test, using the procedure outlined above gives further support for prediction 1b) (p-value: <0.01).

Table 2.3: Multinomial Logit Results, Extreme Left-Wing

Constant and Independent Variables	Coefficients		
	Vote for left-wing party	Vote for center party	Vote for right-wing party
Constant	-2.33*** (0.459)		-2.18*** (0.529)
Voter's position	-0.61*** (0.141)	Base outcome	0.53*** (0.151)
Voluntary	0.34*** (0.129)		.20 (0.143)

Notes. The table provides multinomial logit estimates of the determinants of party choice when the left-wing party is extreme. "Voluntary" is a dummy variable that is 1 if voting is voluntary. Standard errors given in brackets are clustered at the matching group level. For the voluntary voting treatments, only subjects who chose to vote for a party are included. *(**, ***) indicates significance at the 10% (5%; 1%) level.

Prediction 1d) (more strategic voting with mandatory turnout) is also supported. The proportion of strategic votes is significantly higher in ExtrMand (15.7%) than in ExtrVolu (11.3%).²⁸ A Wilcoxon ranksum test shows that this is a significant difference (p-value< 0.01).

²⁷ These frequencies are much lower than predicted by QRE (36.7% for CentMand and 32.6 for CentVolu, respectively).

²⁸ Again, these frequencies are much lower than predicted by QRE (33.0% for ExtrMand and 23.4 for ExtrVolu).

In summary, our results provide support for the Polarization Effect when the left-wing party is relatively extreme (1b+d), but weaker support when it is more centrist (1a+c).

2.5.3 Turnout

Figure 2.7 shows the (smoothed) turnout rates observed in our experiment. As predicted by the Turnout Effect (Prediction 3) we observe that turnout rates are consistently higher in the extreme treatment and that this difference is for most positions quite substantial (in the order of magnitude of at least ten percentage points). A Wilcoxon rank-sum test comparing average turnout per matching group in the two treatments shows that turnout rates are significantly higher in ExtrVolu than in CentVolu (p-value <0.01).

In line with the Extremist Effect (predictions 2a and 2b), Figure 2.7 also shows that extreme voters vote at higher rates than centrist voters. Table 2.4 provides statistical support for this observation. It shows (separately for CentValu and ExtrValu) logit regression results for the decision to vote, with the (absolute) distance between a voter's position and the position with (theoretically) minimal turnout as an independent variable.

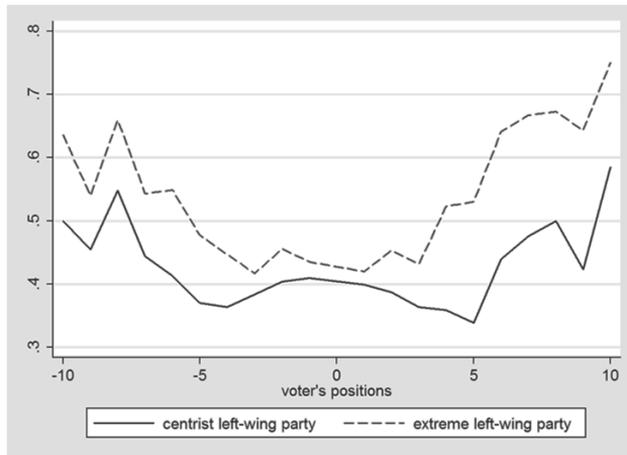


Figure 2.7: Turnout

Notes. The figure compares the observed turnout rates in CentVolu and ExtrVolu as the voter's position varies along the x-axis. Data are averaged over +/-0.2 of the value on the horizontal-axis.

The results indicate that the farther away a voter is from the point of minimal turnout, the higher is her probability of voting (p-value <0.01 for both treatments). This is direct support for predictions 2a and 2b. Though strongly significant, the effect is smaller than the QRE predicts. A comparison of the observed levels of turnout with the predicted levels shows that turnout changes at a much slower rate than predicted when moving along the policy space (Figure 2.8). The main reason is that centrist voters turn out at much higher rates than predicted. Finally, Table 2.4 also exhibits (as expected) that the turnout probability is negatively and statistically significantly related to a voter's voting costs.

Table 2.4: Logit results

Constant and Independent Variables	Coefficients	
	Centrist left-wing party	Extreme left-wing party
Constant	-1.58*** (0.309)	2.42*** (0.221)
Voting costs	-0.03*** (0.003)	-0.03*** (0.002)
Distance	0.06*** (0.022)	0.24*** (0.035)

Notes. Cells give the estimated coefficients of a logit regression of the decision to vote (the dependent variable is 1, if the subject voted in a given period). ‘Distance’ is the absolute value of the distance between voter’s position and the position with (theoretically) minimal turnout (0.25 for ExtrValu and 3 for CentValu). Standard errors given in brackets are clustered at the matching group level. *(**; ***) indicates significance at the 10% (5%; 1%) level.

All in all, our laboratory results provide support for both the Extremist Effect and the Turnout Effect. We therefore find evidence in support of all of our stylized (theoretical) results. In the following section, we offer a discussion of the generalizability of these effects.

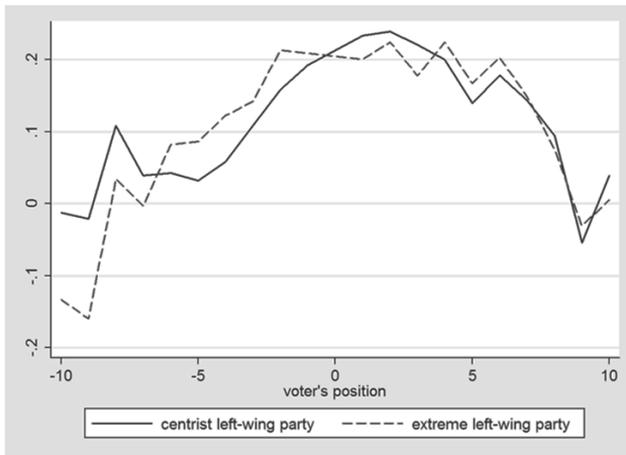


Figure 2.8: Comparison observed vs. predicted turnout rates

Notes. The figure shows the difference between the predicted and observed turnout rates for CentVolu and ExtrVolu as the voter’s position varies along the horizontal-axis.

2.6 Generalizability

Though we find support for the predicted interaction effects between turnout and party choice in our small laboratory elections, one may wonder how general our conclusions are. In other words, is there evidence of the Polarization Effect, Extremist Effect, and Turnout Effect in large-scale elections outside of the laboratory?

The empirical exercise for the Netherlands and Belgium presented in the introduction provides some evidence of the kind of interaction between turnout and party choice that these effects describe.²⁹ The increased extremism following the switch from mandatory to voluntary voting may be a consequence of the Polarization Effect (conditional on voting voters are more likely to vote for the extreme parties), the Extremist Effect (supporters of extreme parties are more likely to vote), or a combination of the two. Though this provides some external validity to our results, it also shows the difficulties related to using observational field data for an analysis of distinct mechanisms. In fact, the wish to disentangle such effects is one of the main reasons why we chose to run experiments in the first place.

Table 2.5: Empirics on Extremist Effect

Data from the CSES			
	Extreme left-wing voters	Centrist voters	Extreme right-wing voters
Wave I (1996-2001) 37 surveys in 32 countries	.894	.860	.907
Wave II (2001-2006) 39 surveys in 36 countries	.842	.835	.852
Wave III (2006-2011) 45 surveys in 35 countries	.876	.849	.864
Eurobarometer Study (1979-1995); Biannual survey in the EU member states			
	.886	.871	.919
Dutch Election Study ³⁰			
1977	.926	.901	.928
1981	.898	.886	.907
1982	.909	.905	.907
1986	.943	.911	.966
1989	.934	.897	.961
1994	.930	.888	.898
1998	.894	.880	.905
2002	.926	.921	.925

Notes. Average self-reported turnout rates compared between extreme left-wing, centrist and extreme right-wing voters. Entries in bold are significantly different from the centrist turnout rates at the 1% level using a Wilcoxon signed rank test with matching of turnout rates by survey.

One can also consider survey data to investigate the validity of the interaction effects. Here, we do so for the Extremist Effect. To test this, we use survey data from the Comparative Study of Electoral Systems (CSES), the Eurobarometer and the Dutch Election Study. These are surveys that ask voters about their self-placement on the left-right scale and about their vote intentions and past voting behavior. Based on their self-

²⁹ Obviously, more such case studies would strengthen the external validity of our results. Countries rarely switch from compulsory to voluntary voting or *vice versa*, however.

³⁰ Pooling the data across years, the difference is strongly significant. A Wilcoxon ranksum test shows that the difference in turnout rates of extreme left-wing and extreme right-wing voters on the one side and centrist voters on the other is statistically significant at the 1%-level.

placement we divide respondents into extreme and centrist voters³¹ and compare the average abstention rates across these groups. Table 2.5 shows the results for each of the three studies.

Given that the turnout decisions are self-reported, we expect them to be overstated (see for instance: Karp and Brockington, 2005) but as long as there is no difference across groups in the propensity of overstating turnout, this will not affect our comparison. The empirical data give strong support for the model prediction that extreme voters vote more often. In each observed year in each study, extreme voters have higher turnout rates than centrist voters. Many of these differences are statistically significant.

As a third empirical test of the generalizability of our interaction effects, we consider the Turnout Effect (polarization of the parties increases turnout rates). This is a question that has been studied in American politics for quite some time without a clear consensus developing (see Rogowski 2012 for an overview of the current state of affairs). The question has been much less studied in systems of proportional representation. We therefore conducted an analysis based on Dutch data. Following Dalton (2008) we define polarization as the vote weighted standard deviation of party positions. We conducted the analysis once using the party positions from the Comparative Manifesto Project (Volkens et al. 2010) (which we used to compute the extremism index in the introduction) and once for the Dutch Election Study. For each, we relate the measured polarization to observed turnout in various elections. Figure 2.9 shows the results.

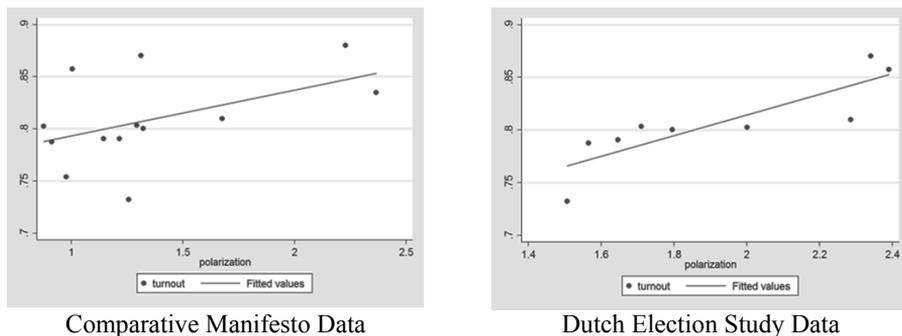


Figure 2.9: Correlation between polarization and turnout

Notes. The figure shows the relationship between the estimated polarization index and turnout rates in Dutch elections between 1971 and 2010 (Comparative Manifesto Data) and 1981 and 2006 (Dutch Election Study), respectively.

In both cases we observe a positive correlation between the polarization of party positions and turnout rates. This correlation is statistically significant and positive in both cases (a correlation of .48 with a two-sided p-value: 0.09 for the Comparative Manifesto Data;

³¹ A respondent was coded to be ‘extreme’ if she chose one of the three left- or rightmost positions. For the Eurobarometer and the Dutch election study the policy space are the number from 1 to 10 and for the CSES the policy space are the numbers 0 to 10.

and .85 with a two-sided p-value < 0.01 for the Dutch Election Study Data). This provides empirical evidence of the Turnout Effect.

In summary, the results of this section provide empirical evidence from the field that is in line with each of the three effects that was derived from our theoretical analysis. This strengthens the external validity of our experimental and theoretical results.

2.7 Conclusions

In this chapter we have analyzed the interaction between the turnout decision and party choice in a system of proportional representation. Based on a five-voter/three-party case we derived three basic predictions from the QRE. First, voluntary voting makes voters more likely to vote for extreme parties as opposed to strategically voting for the central party (a ‘Polarization Effect’). Second, voters with extreme preferences are most likely to vote (an ‘Extremist Effect’). Third, turnout increases with the polarization of the parties (a ‘Turnout Effect’).

Our experimental results provide support for these predictions, though only weak support is found for the polarization effect of voluntary voting when the parties are relatively close. The observed turnout rates exhibit the predicted feature that polarization boosts turnout and extreme voters are more likely to vote than centrist voters. This latter difference is not as pronounced as theoretically expected because centrist voters turn out substantially more often than predicted. The generalizability of our experimental and theoretical results is supported by additional empirical evidence from the field. Firstly, a case study of the Netherlands and Belgium shows that when one country abolished compulsory voting the election outcome in the next elections was more extreme while in the comparison country no such effect was observed. Secondly, data from the Comparative Study of Election Systems, the Eurobarometer and the Dutch Election Study exhibits the predicted pattern that more extreme voters have higher turnout rates. And thirdly, a case study of the Netherlands showed a positive correlation between the polarization of the party system and turnout rates.

Given our theoretical and experimental results we see this chapter as making the first step on the way to understanding the interaction effect between turnout and party choice. Both on the theoretical and empirical level a lot of work remains to be done. As we argued in the introduction, this further effort is important since the results we get from the analysis of voting may have implications for a large class of models in the political economy literature. Moreover, if party positions, party choice and turnout are intertwined in the manner we observe, a proper study of party choice or turnout cannot be conducted in isolation. This points to an avenue for future theoretical and experimental work. This would be to endogenize the party positions and to analyze what the equilibrium positions in this game are. Because of the Extremist Effect, parties may want to position themselves away from the center. It is an open question whether a median voter theorem could hold where all parties converge to the center of the policy space, or whether endogenous turnout yields an equilibrium with polarized parties.

A natural next step in terms of theoretical work would also be to investigate the robustness of our result. One possible avenue to pursue is to investigate alternative coalition formation processes and see whether this influences the existence or strength of the interaction effects. Another possible extension would be to investigate how the distribution of voter preferences influences the interaction effects. The case of preferences being uniformly distributed in the policy space leads to the same conclusions as described here but perhaps electorates with a bimodal preference distribution (which could indicate a polarized electorate) would lead to different conclusions. Nevertheless, this chapter has clearly established that the Polarization, Extremist and Turnout Effects are to be reckoned with when studying voter behavior. Compared to countries with mandatory voting, nations where people can choose whether or not to go to the polls are characterized by more extremist voting and voter turnout is positively correlated with the extent of party polarization.

Appendix 2.A: Additional analysis QRE

2.A.1 Computation of equilibrium for mandatory voting

As a point of departure we use that in the logit equilibrium the probability of voting for party j given a position x and costs of voting c is described by the following expression (eq 2 in the main text):³²

$$\Pr(\text{vote for party } j|x) = \frac{\exp(\lambda * EU(\text{vote for party } j|x))}{\sum_i \exp(\lambda * EU(\text{vote for party } i|x))} \quad (\text{A.1})$$

This implies that the ex-ante probability of voting for a given party is given by:

$$\Pr(\text{vote for party } j) = \int_x \Pr(\text{vote for party } j|x) f(x) dx \quad (\text{A.2})$$

where f is the distribution of ideal points (a truncated t-distribution with 0.05 degrees of freedom).

The expected utility of a vote is obtained by computing the payoff of this vote for all possible configurations of votes by the other four voters, weighted by the ex-ante probabilities. One can capture this in the following expression:

$$\sum_{a=0}^4 \sum_{b=0}^{4-a} \frac{4!}{a!b!(4-a-b)!} P_L^a P_C^b P_R^{4-a-b} (-2 * [x^*(a, b, j) - x]^2), j=L, C, R \quad (\text{A.3})$$

where x is the voter's position, P_j is the ex-ante probability of voting for party j , $a(b)$ is the number of other voters voting for party $L(C)$ (leaving $4-a-b$ to vote for R) and $x^*(a, b, j)$ is the implemented policy given the other voters behavior and the voter voting for party j .

Plugging equations A.2 and A.3 into A.1 yields three expressions (a voting probability for each party), which set-up a fixed point problem for the vector of probabilities. The set of equations was solved numerically and to account for the possibility of equilibrium multiplicity a wide range of initial conditions was checked. Because these all converge to the same equilibrium, we tentatively conclude that the results likely are unique.

2.A.2 Computation of equilibrium for voluntary voting

The case of voluntary voting is slightly more involved. While eq. (A.1) remains the same (A.2) becomes more complex. The reason is that the distribution of positions and voting costs for the voters may be different from the ex-ante distribution of these quantities. For instance, extreme voters are more likely to vote and therefore the distribution of ideal points for those who vote has fatter tails than the ex-ante distribution of ideal points. We therefore have to use the expression for the probability of turnout specified in equation (3) of the main text:

³² For notational convenience we drop the costs of voting c since they do not influence the party choice.

$$\Pr(\text{turnout}|x, c) = \frac{\sum_j \exp(\lambda * \Pr(\text{vote for party } j|x) * EU(\text{vote for party } j|x))}{\exp(\lambda * EU(\text{abstain}|x)) + \sum_j \Pr(\text{vote for party } j|x) * \exp(\lambda * EU(\text{vote for party } j|x))}$$

To capture the sequential voting decision (a voter first makes a decision whether to cast a ballot and only then decides for which party to vote) this expressions compares the expected payoff from turning out (which is the average of the expected payoff of voting for party j ($j=L, C, R$) weighted by the probability of voting for party j) to the expected payoff of abstaining.

The ex-ante probability of voting for party j (conditional on voting) is then given by the following expression:

$$\Pr(\text{vote for party } j) = \int_c \int_x \Pr(\text{vote for party } j|x) * \Pr(\text{turnout}|x, c) f(x)g(c) dx dc$$

where f is the distribution of ideal points (a truncated t-distribution with 0.05 degrees of freedom) and g the distribution of voting costs (uniform on [-15:200]).

The expression for the expected utility of voting for a specific party (eq. A.3) also becomes more involved since we now have to take abstentions into account and therefore do not know how many other votes will be cast. The expression used is as follows:

$$\left\{ \sum_{n=0}^4 \binom{4}{n} P_V^n (1 - P_V)^{4-n} \sum_{a=0}^n \sum_{b=0}^{n-a} \frac{n!}{a! b! (n - a - b)!} P_L^a P_C^b P_R^{n-a-b} (-2 * [x^*(a, b, j) - x]^2) \right\} - j * c$$

where the variables are defined as before, n is the number of votes cast by other voters and P_V is the ex-ante probability of turning out. The negative term $j*c$ appears since now voting costs matter because voting for party zero (i.e. abstention) avoids them.

Combining all the expressions yields a fixed point problem that was solved numerically. Again a large range of different initial conditions was checked that all converged to the same equilibrium.

2.A.3 Detailed predictions for the four treatments

Using the method described, we obtained the logit equilibria for the various treatments of our experiment. Figure 2A.1 shows these.

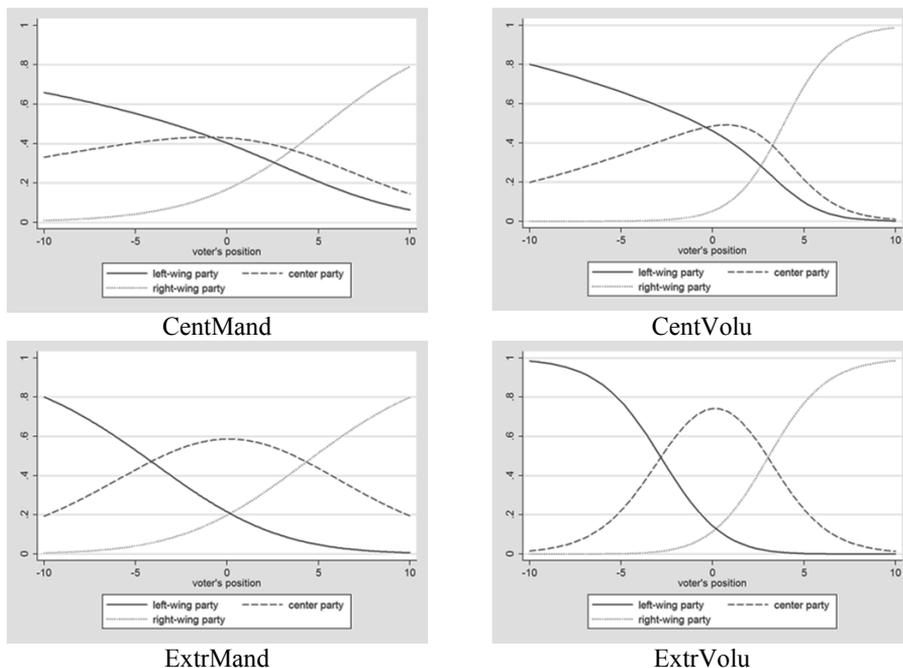


Figure 2A.1: Predicted party choice

Notes. The figures show the predicted probability of voting for each of the three parties as the voter's position varies along the horizontal-axis. The predictions are based on the QRE model with $\lambda=3.7$.

2.A.4 QRE predictions compared to observed behavior

Figure 2A.2 compares the QRE predictions to observed party choice. Though it shows that voting follows the general equilibrium pattern, there are also substantial deviations from the QRE prediction. In particular, extreme voters deviate much less from the party that yields the highest expected utility (i.e., the extreme party on their side of the spectrum) than is predicted by the 'noisy' logit equilibrium. Moreover, the slopes of the observed party choice functions are much steeper than predicted. As indicated in the main text, one possible explanation for these deviations is that behavior is less noisy than in the pilot in Kamm (2012) that was used to obtain an out-of-sample estimate of λ . To investigate this possibility, we explore the parameters that we can estimate from the data from our experiment.

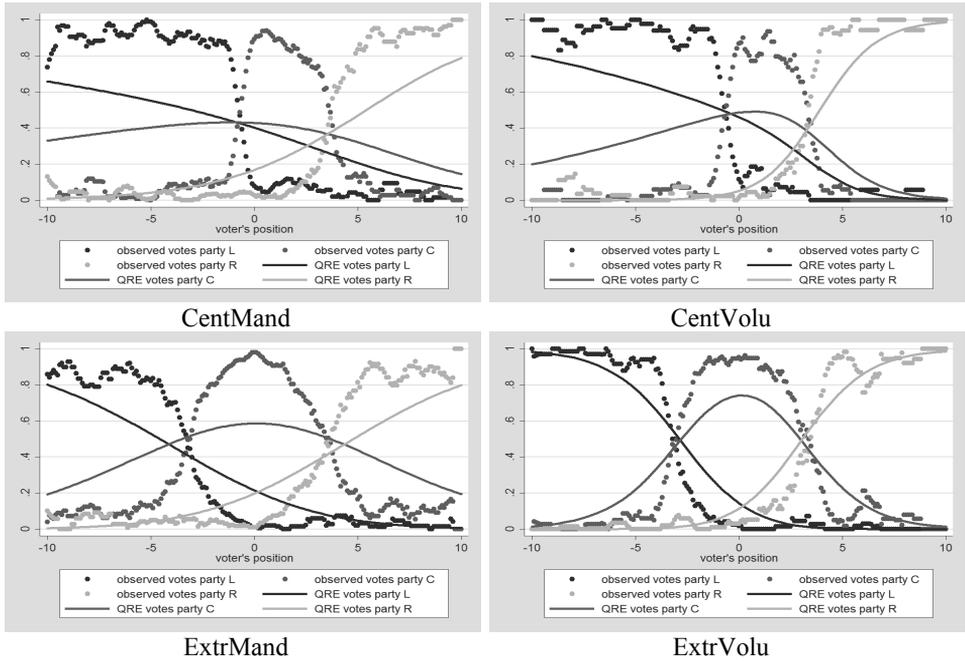


Figure 2A.2: Predicted compared to observed party choice

Notes. Dots (Lines) show the observed (predicted) probability of voting for each of the three parties as the voter's position varies along the horizontal-axis. The predictions are based on the QRE model with $\lambda=3.7$. To improve readability the observed data are averaged over ± 0.2 the value on the horizontal-axis.

2.A.5 QRE estimated on observed behavior

Combining the data from the party choice and turnout decisions, we estimate the noise level that yields the quantal response equilibrium that best fits the observed data. We allow for different levels of noise in the party choice and turnout decisions. The reason for doing so is that given the relatively high rates of observed turnout, a model with a single noise parameter would not be able to explain party choice very well since the noise parameter needs to be very low (implying a lot of noise) to explain the turnout rates. This would conflict with our observation that party choice is not very noisy. Indeed, if we estimate a model with a single noise parameter we find an ML estimate of $\lambda=3.3$. This is very close to the noise level taken from Kamm (2012) with $\lambda=3.7$ that we used thus far. Splitting the noise levels, yields an estimate of the noise parameter in the turnout decision of $\lambda_T=1.8$. This is similar to the noise levels observed in other experiments on turnout where estimated noise levels vary between 1.25 and 2.5 depending on the subjects' experience (Goeree and Holt 2005; Grosser and Schram 2010). The ML parameter for party choice is estimated to be $\lambda_P=8.2$ in our data. Hence, we observe much more noise in the turnout decision than in the party choice. A likelihood ratio test reveals that the model with two distinct noise parameters significantly improves the fit ($p\text{-value}<0.01$).

Figure 2A.3 compares the new QRE predictions with the estimated party choice. The estimated party choice is obtained from a multinomial logit regression of party choice on voter position (cf. Appendix 2.E). We find that with an extreme left-wing party the new predictions fit the observed party choice reasonably well. When the left-wing party is centrist we again find that quantal response underestimates the probability of voting sincerely for the left-wing party. As conjectured in the main text, this may be attributed to the powerful heuristic of voting sincerely.

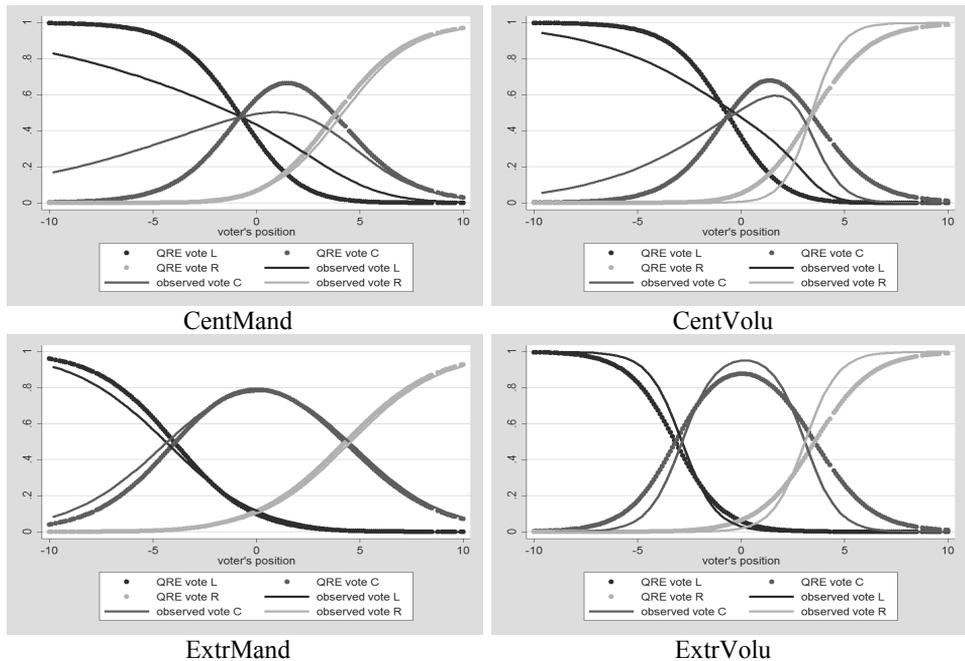


Figure 2A.3: New predicted compared to observed party choice

Notes. The thick (thin) lines show the estimated (predicted) probability of voting for each of the three parties as the voter’s position varies along the horizontal axis. The predictions are based on the two-parameter QRE model estimated on observed behavior.

Finally, figure 2A.4 shows the revised QRE predictions for the turnout decision. While these new estimates naturally improve over the predictions using out-of-sample parameter estimates, it still is not able to capture the relatively moderate degree to which centrist voters vote less than extreme voters.

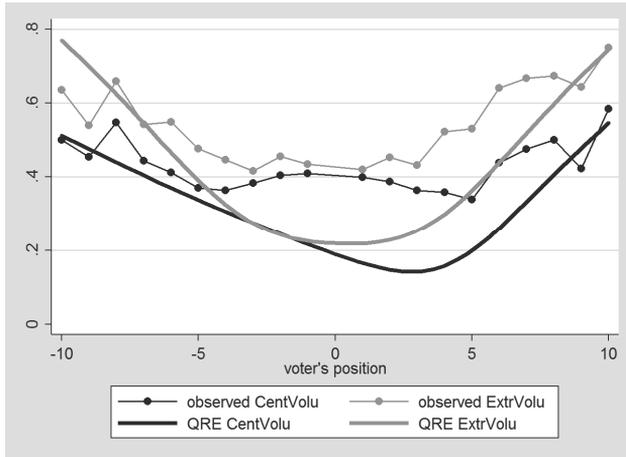


Figure 2A.4: Estimated turnout rates

Notes. The figure compares the observed and predicted turnout rates in CentVolu and ExtrVolu as the voter's position varies along the x-axis. For the observed behavior data are averaged over ± 0.2 of the value on the horizontal-axis and the predictions are based on the two-parameter QRE model estimated on observed behavior.

Appendix 2.B: Nash Equilibria

2.B.1 Mandatory voting

We solve for symmetric cut-point equilibria, which implies that voters with a position to the left of x_L vote for the left-wing party, voters between x_L and x_R vote for the central party and voters to the right of x_R vote for the right-wing party.

When voting is mandatory the equilibrium is therefore the solution to the following set of equations

- (i) $EU(\text{vote left}|\text{position is } x_L) = EU(\text{vote center}|\text{position is } x_L)$
- (ii) $EU(\text{vote right}|\text{position is } x_R) = EU(\text{vote center}|\text{position is } x_R)$
- (iii) $P(\text{vote left}) = P(\text{voters position to the left of } x_L)$
- (iv) $P(\text{vote right}) = P(\text{voters position to the right of } x_R)$
- (v) $EU(\text{vote left}|\text{position is } x) = f_L(P(\text{vote left}), P(\text{vote right}))$
- (vi) $EU(\text{vote center}|\text{position is } x) = f_C(P(\text{vote left}), P(\text{vote right}))$
- (vii) $EU(\text{vote right}|\text{position is } x) = f_R(P(\text{vote left}), P(\text{vote right}))$

Here EU is the expected payoff from an action and P denotes the probability of a certain event. The functions f_L , f_C and f_R compute the expected payoffs by going through all possible election outcomes, computing the resulting payoffs for the voter and weighting them by their respective probabilities given the probability that a vote will be for a certain party.

Numerical solution yields the Nash equilibria depicted in Table 2B.1.

Table 2B.1: Nash Equilibria Mandatory Voting

	CentMand	ExtrMand
Equilibrium 1 (selected by QRE)	$X_L=-0.65; X_R=3.65$	$X_L=-5.04; X_R=4.52$
Equilibrium 2	$X_L=-0.77; X_R=7.94$	$X_L=-4.07; X_R=6.01$
Equilibrium 3	$X_L=-3.56; X_R=3.63$	

Notes. Cells give the Nash equilibrium cut points for party choice when voting is mandatory. Voters with an ideal point to the left of X_L vote for the left-wing party, voters to the right of X_R vote for the right-wing party and voters in between vote for the central party.

The table shows multiple equilibria. One way to refine these is to solve for the quantal response equilibrium letting λ go to infinity along the principle branch of the Multinomial Logit Correspondence (McKelvey and Palfrey 1995). This selects the Nash equilibria shown in the top row.

2.B.2 Voluntary Voting

We again solve for symmetric cut-point equilibria with cut points x_L and x_R . Note that these cut-points are independent of the costs of voting since such costs only influence

whether a voter abstains or not but not for which party she will vote given that she turns out. The turnout decision is also described by a cut-point where a voter with position x votes if her voting costs are below a threshold $\bar{c}(x)$.

With voluntary voting the equilibrium is therefore the solution to the following set of equations

$$\begin{aligned}
 & (i) \ EU(\text{vote left}|\text{position is } x_L) = EU(\text{vote center}|\text{position is } x_L) \\
 & (ii) \ EU(\text{vote right}|\text{position is } x_R) = EU(\text{vote center}|\text{position is } x_R) \\
 & (iii) \ P(\text{vote left}) = \\
 & \quad P(\text{voters position to the right of } x_L) * \frac{P(\text{a voter to the right of } x_L \text{ votes})}{P(\text{a random voter votes})} \\
 & (iv) \ P(\text{vote right}) = \\
 & \quad P(\text{voters position to the right of } x_R) * \frac{P(\text{a voter to the right of } x_R \text{ votes})}{P(\text{a random voter votes})} \\
 & (v) \ EU(\text{vote left}|\text{position is } x) = f_L(P(\text{vote left}), P(\text{vote right})) \\
 & (vi) \ EU(\text{vote center}|\text{position is } x) = f_C(P(\text{vote left}), P(\text{vote right})) \\
 & (vii) \ EU(\text{vote right}|\text{position is } x) = f_R(P(\text{vote left}), P(\text{vote right})) \\
 & (viii) \ P(\text{a voter with position } x \text{ votes}) = \\
 & \quad P(\text{costs are below } \max_j [EU(\text{vote for party } j) - EU(\text{abstain})])
 \end{aligned}$$

Compared to the situation with mandatory voting we now have to take into account that voters have different turnout rates depending on their position. Therefore the probability of, for instance, a left-wing vote is not simply the probability that a voter is to the left of x_L , it also has to be weighted by the relative turnout rate of a left-wing voter compared to the average turnout rate in the population.

Solving this set of equations leads to unique equilibria for both specifications of left-wing party positions (table 2B.2).

Table 2B.2: Nash Equilibria Voluntary Voting

CentVolu	ExtrVolu
$X_L=-0.74; X_R=3.69$	$X_L=-3.41; X_R=3.65$

Notes. Cells give the Nash equilibrium cut points for party choice when voting is voluntary. If they vote, voters with an ideal point to the left of X_L vote for the left-wing party, voters to the right of X_R vote for the right-wing party and voters in between vote for the central party.

The equilibrium for the turnout decision is characterized by a function that assigns to each voter position a critical cost for which a voter is indifferent between abstaining and voting. Figure 2B.1 plots these for our two treatments.

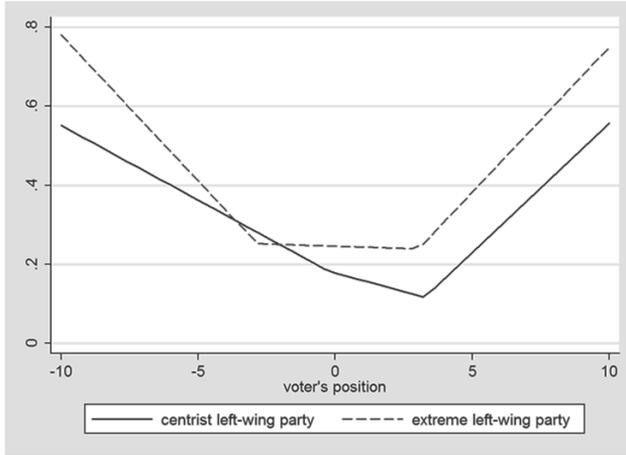


Figure 2B.1: Predicted turnout rates (Nash)

Notes. The figure shows the predicted Nash turnout rates for CentVolu and ExtrVolu as the voter's position varies along the horizontal axis.

Figure 2B.1 illustrates both the Extremist Effect and the Turnout Effect. The former follows from the observation that the threshold (and therefore expected turnout) is higher at the extremes than in the middle of the policy space. The minimum of expected turnout is observed at position 0.25 for the polarized case of an extreme left-wing party and at position 3 for the case with a centrist left-wing party.

Appendix 2.C: Analysis for uniform distribution of voters

As a robustness check we analyze the model assuming that the voters' positions are distributed uniformly along the policy space.

Figure 2C.1 shows the QRE predictions for party choice in this model. Note the close resemblance to the QRE predictions with a t-distribution of voter preferences (cf. figure 2.10 in the main text). A consequence of this resemblance is that both specifications predict the same interaction effects. For example, Figure 2C.2 investigates the interaction between the turnout regime and party choice in the uniform distribution case by comparing the predictions of the treatment with mandatory voting to the predictions with voluntary voting. It shows that the probability of voting for an extreme party is higher when voting is voluntary than when it is mandatory. Therefore, the 'Polarization Effect' is also observed when we assume that voters' ideal points are uniformly distributed.

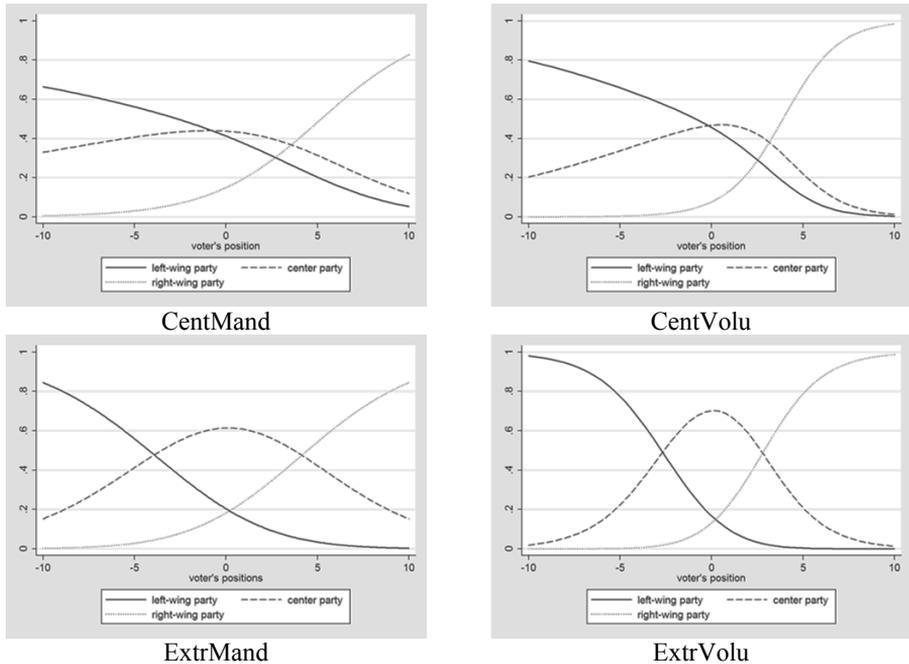
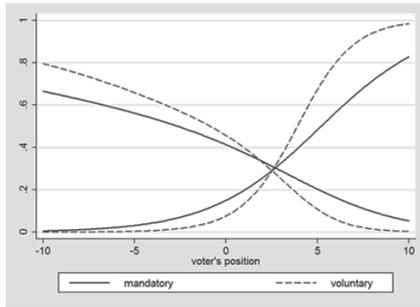
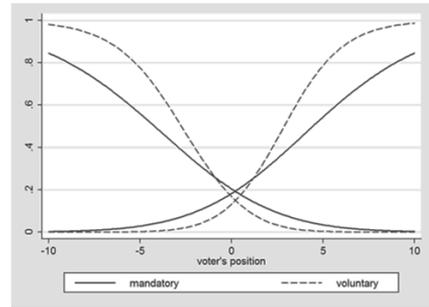


Figure 2C.1: Predicted party choice for uniform distribution

Notes. The figure shows the predicted probability of voting for each of the three parties as the voters position varies along the horizontal axis. The predictions are based on the QRE model with $\lambda=3.7$ and a uniform distribution of voter's positions.



Centrist left-wing party



Extreme left-wing party

Figure 2C.2: Predicted party choice for uniform distribution
(voluntary versus mandatory voting)

Notes. The figure compares the predicted probability of voting for each of the extreme parties (conditional on voting) between compulsory and voluntary voting as the voter's position varies along the horizontal axis. The predictions are based on the QRE model with $\lambda=3.7$ and a uniform distribution of voter's positions.

To replicate the other effects, figure 2C.3 compares the equilibrium turnout for the two levels of polarization used in the experiment. The horizontal axis shows the voter's positions and the vertical axis depicts the predicted turnout rates.

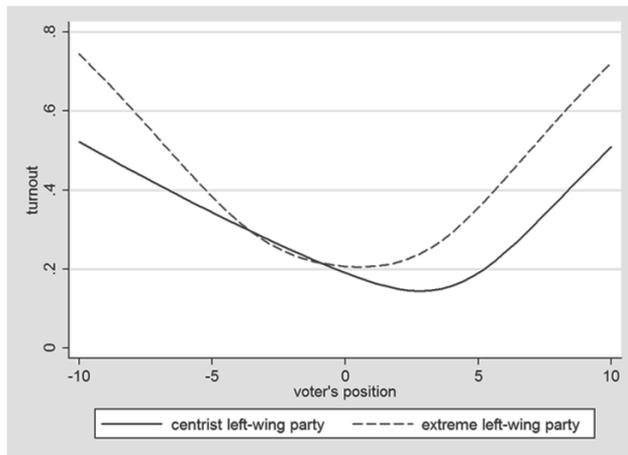


Figure 2C.3: Predicted turnout rates for uniform distribution

Notes. The figure shows the predicted turnout rates for CentVolu and ExtrVolu as the voter's position varies along the horizontal axis. The predictions are based on the QRE model with $\lambda=3.7$ and a uniform distribution of voter's positions.

This figure shows that the 'Turnout Effect' and the 'Extremist Effect' are also present when assuming a uniform distribution of policy positions.

Appendix 2.D: Instructions and screenshots of the experiment

In this appendix, we provide the instructions that the subjects read on their monitors. We also give the summary of the instructions that was handed out to subjects after they had read these on-screen instructions. Finally, we provide screenshots of the user interface of the experiment.

2.D.1 Instructions³³

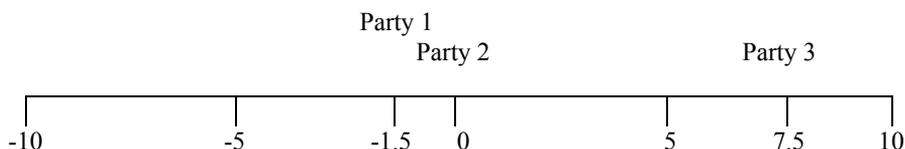
Welcome to this experiment on decision-making. Please carefully read the following instructions. If you have any questions, please raise your hand, and we will come to your table to answer your question in private.

In this experiment you will earn points. At the end of the experiment, your earnings in points will be exchanged for money at the rate 1 eurocent for each point. This means that for each 100 points you earn, you will receive 1 euro. Additionally, you will receive a show-up fee of 7 euros. Your earnings will be privately paid to you in cash at the end of the experiment.

This experiment will consist of 30 elections. In each election you will be one of five voters in the electorate that is electing a new government. Your earnings will be based on the outcome of these elections. The rest of these instructions will explain exactly how the experiment works.

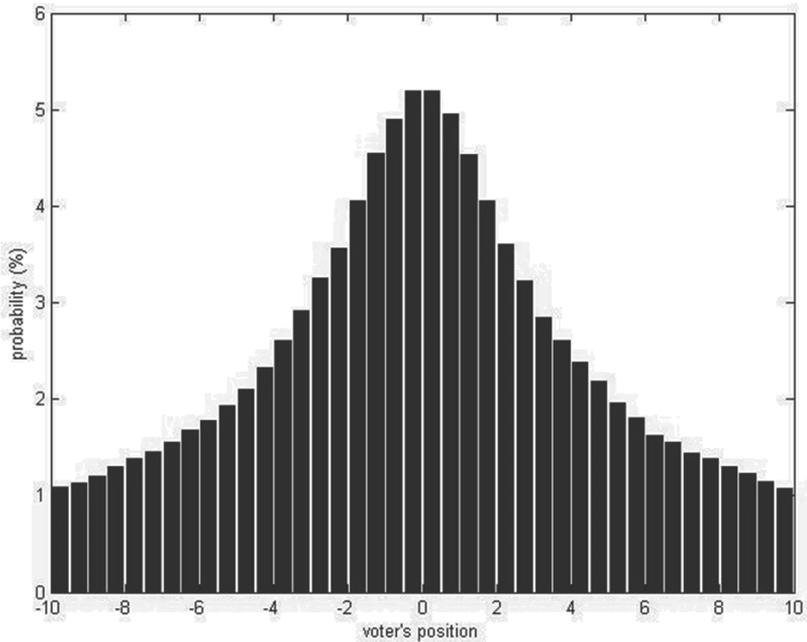
Parties and Voters

Three parties participate in the elections. Each party is described by a number between -10 and 10, which signifies their policy position. They will keep the same policy position throughout the experiment. You can see where they are located on the graph below (you will also find this graph on the handout) and on your monitor during the experiment.



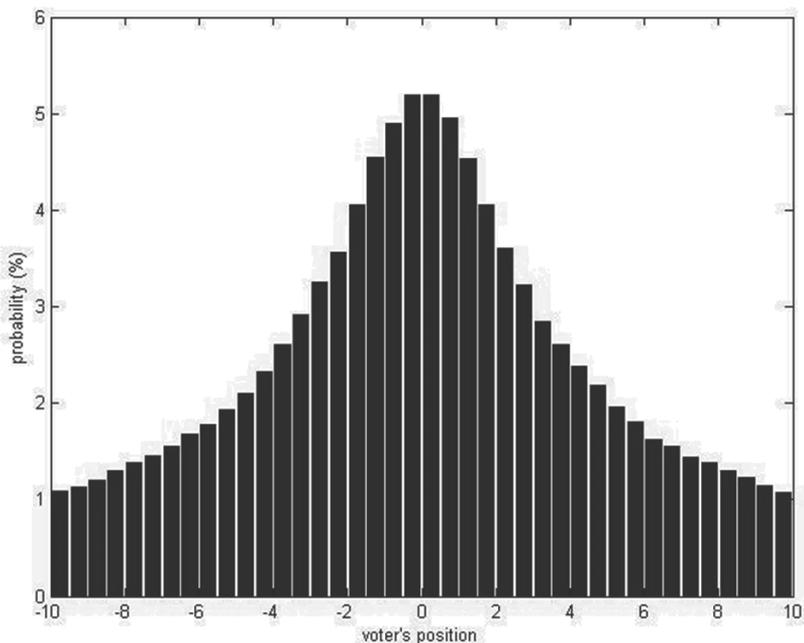
Every voter is also described by a position on the line from -10 to 10. This position corresponds to the policy that the voter would prefer to see implemented (this is her or his favorite policy). The five voters are randomly distributed over the policy space according to the distribution shown in the graph below. The height of a bar signifies how likely it is that a value occurs. In the experiment we will round the voter positions to one decimal point.

³³ We provide here the instructions used for the treatment centrist-voluntary. The instructions for other treatments are analogous and available upon request.



As you can see a position of 0 is most likely. The probability that the position is very close to zero (between -0.5 and 0.5) is 10%. This means that in (about) 10 of 100 cases the position will be in this interval.

Furthermore you can note that the distribution is symmetric around zero and therefore it is equally likely to be to the left and to the right of zero.



What follows are some further illustrating examples of the shape of the distribution

In about 45% of the cases (45 out of 100) a voter's position will be between -2.5 and 2.5.

In about 71% of the cases (71 out of 100) a voter's position will be between -5 and 5.

In about 96% of the cases (96 out of 100) a voter's position will be between -9 and 9.

In about 22% of the cases (22 out of 100) a voter's position will be between 2.5 and 7.5 and with the same probability s/he will be between -7.5 and -2.5.

In about 15% of the cases (15 out of 100) a voter's position will be between 5 and 10 and with the same probability s/he will be between -10 and -5.

If you want to know how likely it is that a voter's position is in a given interval you can use the tool below (you will also be able to use this tool during the experiment).

position is between and

For each voter, a new position will be drawn after every period and your position in the next period is completely independent of your position in the current period. You will always know your own position before making a decision but not the position of the other voters in your electorate.

Government formation

In each electorate (i.e. group of voters that form an election) there will be five voters. You will be one of them and the other four voters are some of the other subjects in the lab. The identity of the four other subjects will be randomly determined in each of the 30 periods. Hence, you are in a new electorate in each of the thirty rounds.

In each period you will have to decide whether you want to vote, and if so, for which of the three parties you want to cast your vote. If you decide to vote you have to incur costs of voting which in every period are an integer randomly drawn from the interval -15 and 200 . Every integer in this interval is equally likely to be drawn. You know your own costs of voting before making your decision, but only the distribution of the costs of voting for the other voters in your electorate. Note that there is a small chance that your costs are negative in a round. If this occurs, you will receive extra points if you vote.

The votes by the members of your electorate determine which government will be formed. When forming a government the following rules will be applied:

1. If a party receives an absolute majority (more than half) of the votes this party will form a single party government.
2. If no party receives an absolute majority, the party with the most votes forms a coalition with one of the other two parties. Which coalition will be formed for the different possible configurations of votes can be seen in the table below (you can also find this table on the handout). Coalitions are determined by assuming that the party that is forming the coalition tries to end up with a policy that is as close as possible to its own policy position.
3. If in 2. there are multiple parties with the most votes it is randomly determine which party forms the coalition.

Coalition Formation

Votes for party 1	Votes for party 2	Votes for party 3	Formed coalition	Implemented policy
2	2	1	parties 1 and 2	-0.8
2	1	2	parties 1 and 2 OR (determined by coin toss) parties 2 and 3	-1.0 5.0
1	2	2	parties 1 and 2 OR (determined by coin toss) parties 1 and 3	-0.5 4.5
2	1	1	parties 1 and 2	-1.0
1	2	1	parties 1 and 2	-0.5
1	1	2	parties 2 and 3	5.0
2	2	0	parties 1 and 2	-0.8
2	0	2	parties 1 and 3	3.0
0	2	2	parties 2 and 3	3.8
1	1	1	parties 1 and 2 OR (determined by throwing a dice; if it shows a 5 or 6 parties 2 and 3 form the coalition) parties 2 and 3	-0.8 3.8
1	1	0	parties 1 and 2	-0.8
1	0	1	parties 1 and 3	3.0
0	1	1	parties 2 and 3	3.8
0	0	0	party 1 OR (all with equal probability) party 2 OR (all with equal probability) party 3	-1.5 0 7.5

Based on the government that is formed, a policy will be implemented. If there is a single party government the implemented policy is equal to this party's policy position. If there is a coalition the implemented policy is the weighted (by votes) average of the positions of the parties in the coalition. If for instance party 3 receives two votes and forms a coalition with party 2 which received one vote than the policy position of party 3 (7.5) receives weight 2/3 and the policy position of party 2 (0) receives weight 1/3. The implemented policy is then 5.0 ($=1/3*0+2/3*7.5$). See also the table on the handout for the policy implemented by any possible coalition.

Your earnings in points in a period are computed using the following formula:

$$160 - 2 * (\text{implemented policy} - \text{favorite policy})^2 - \text{costs of voting}$$

As mentioned before, the costs of voting are an integer between -15 and 200. Every integer in this interval is equally likely to be drawn and you will have a new draw in every period. You only pay (or receive) the costs of voting if you decide to vote in a period. The second term in the formula shows that your earnings are decreasing in the squared difference between your favorite policy (i.e. position) and the implemented policy. As a consequence, your earnings are higher the smaller is the distance between the implemented policy and your favorite policy. Below you can test what your earnings are for different configurations of your own position, your costs of voting and the government elected.

Assume that the following government
Forms

<input type="text"/>	
Position <input type="text"/>	costs of voting <input type="text"/>

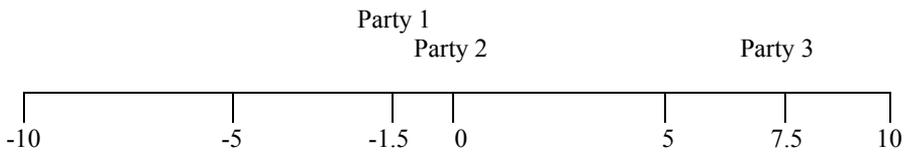
At the end of the experiment the earnings from all periods will be added up and per 100 points, you will receive 1 euro. These earnings will be paid to you privately and confidentially.

On the next screen you will be requested to answer some control questions to make sure that you have understood these instructions. Please answer these questions now.

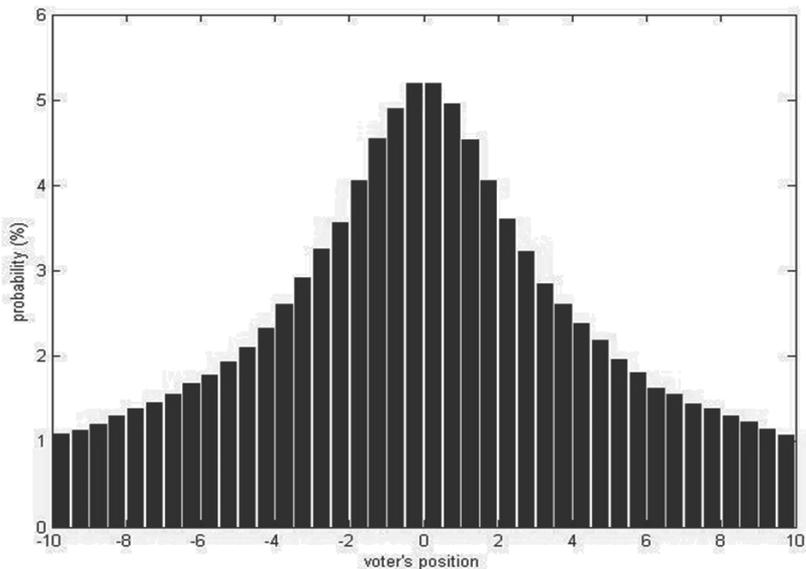
2.D.2 Printed summary of instructions

Summary Instructions

- Each electorate consists of five voters
- In each period you will be randomly rematched
- In each of the 30 periods you have to decide whether you want to vote and, if yes, for which party
- The three parties are described by policy positions as shown below



- every voter is described by a position on the line from -10 to 10. The voters are randomly distributed over the policy space according to the distribution shown in the graph below.



- In about 10% of the cases (10 out of 100) a voter's position will be between -0.5 and 0.5

- In about 45% of the cases (45 out of 100) a voter's position will be between -2.5 and 2.5
- In about 71% of the cases (71 out of 100) a voter's position will be between -5 and 5
- In about 96% of the cases (96 out of 100) a voter's position will be between -9 and 9

- Based on the votes a government will be formed
 - If a party receives an absolute majority of the votes this party will form a single party government.
 - Otherwise a coalition will be formed according to the table below
 - The implemented policy is the position of the party in government; if there is a coalition it is the vote weighted average of the positions of the members of this coalition

Votes for party 1	Votes for party 2	Votes for party 3	Formed coalition	Implemented policy
2	2	1	parties 1 and 2	-0.8
2	1	2	parties 1 and 2 OR (determined by coin toss) parties 2 and 3	-1.0 5.0
1	2	2	parties 1 and 2 OR (determined by coin toss) parties 1 and 3	-0.5 4.5
2	1	1	parties 1 and 2	-1.0
1	2	1	parties 1 and 2	-0.5
1	1	2	parties 2 and 3	5.0
2	2	0	parties 1 and 2	-0.8
2	0	2	parties 1 and 3	3.0
0	2	2	parties 2 and 3	3.8
1	1	1	parties 1 and 2 OR (determined by throwing a dice; if it shows a 5 or 6 parties 2 and 3 form the coalition) parties 2 and 3	-0.8 3.8
1	1	0	parties 1 and 2	-0.8
1	0	1	parties 1 and 3	3.0
0	1	1	parties 2 and 3	3.8
0	0	0	party 1 OR (all with equal probability) party 2 OR (all with equal probability) party 3	-1.5 0 7.5

- Your payoff per round is
 - $160 - 2 * (\text{implemented policy} - \text{favorite policy})^2 - \text{costs of voting}$**
 - The cost of voting are an integer number in the interval between -15 and 200. Every integer in this interval is equally likely to be drawn.
 - You only have to pay the costs of voting in periods where you decide to vote

Your final payoff is 1 Euro for every 100 points plus a show-up fee of 7 Euros.

Election outcome in period 1

In this period you decided to vote for party 2

The distribution of votes in this period is:



This voting pattern led to a coalition of parties 2 and 3 which implemented a policy located at 5.0

Given that your position is 3.5 and your cost of voting are 160, your payoff for this period is $160 - 2 * (5.0 - 3.5)^2 = -5$ and your accumulated payoff is -5

[Click here](#) to go to the next round.

Notes. The screen subjects saw after an election was over.

Appendix 2.E: Multinomial logit estimates

Below we report the estimation results underlying the logit choice functions for the party choice as depicted in Figure 2.4 of the main text. The variable "Voter's Position" measures a voter's position in the policy space. Standard errors are clustered at the matching group level.

Multinomial Logit Results, CentMand

Constant and Independent Variables	Coefficients		
	Vote for left-wing party	Vote for center party	Vote for right-wing party
Constant	-0.48*** (0.131)		-2.17*** (0.541)
Voter's position	-0.64*** (0.183)	Base outcome	0.57*** (0.139)

Notes. Multinomial logit estimates for the party choice decision in treatment CentMand. Standard errors are clustered at the matching group level. *(**, ***) indicates significance at the 10% (5%; 1%) level.

Multinomial Logit Results, ExtrMand

Constant and Independent Variables	Coefficients		
	Vote for left-wing party	Vote for center party	Vote for right-wing party
Constant	-2.07*** (0.519)		-1.95*** (0.610)
Voter's position	-0.53*** (0.158)	Base outcome	0.45*** (0.181)

Notes. Multinomial logit estimates for the party choice decision in treatment ExtrMand. Standard errors are clustered at the matching group level. *(**, ***) indicates significance at the 10% (5%; 1%) level.

Multinomial Logit Results, CentVolu

Constant and Independent Variables	Coefficients		
	Vote for left-wing party	Vote for center party	Vote for right-wing party
Constant	-0.45* (0.249)		-2.40*** (0.743)
Voter's position	-0.72*** (0.243)	Base outcome	0.70*** (0.195)

Notes. Multinomial logit estimates for the party choice decision in treatment CentVolu. Standard errors are clustered at the matching group level. *(**, ***) indicates significance at the 10% (5%; 1%) level.

Multinomial Logit Results, ExtrVolu

Constant and Independent Variables	Coefficients		
	Vote for left-wing party	Vote for center party	Vote for right-wing party
Constant	-2.69*** (0.610)		-2.63*** (0.689)
Voter's position	-0.85*** (0.223)	Base outcome	0.73*** (0.183)

Notes. Multinomial logit estimates for the party choice decision in treatment ExtrVolu. Standard errors are clustered at the matching group level. *(**; ***) indicates significance at the 10% (5%; 1%) level.

Chapter 3

Plurality Voting versus Proportional Representation in the Citizen-Candidate Model: The Role of Coalitions¹

3.1 Introduction

How does the electoral system influence the entry decision of candidates and parties? Specifically, how does the number of entrants and their polarization differ between plurality voting (i.e., first-past-the-post) and proportional representation? To address such questions this chapter offers a theoretical analysis comparing plurality voting and proportional representation while paying special attention to the coalition formation process typically associated with systems of proportional representation.

The research question underlying this chapter is at the core of one of the biggest questions in political science and political economy: How does the electoral system influence election outcomes both in terms of who wins and what policy results? This is a fundamental question since many political and economic outcomes are a function of election outcomes and the distribution of power they induce. In the end the electoral outcomes depend on the interaction of candidates, parties and voters. To comprehend the effects of the electoral system one needs first to understand the behavioral effects on each of these different groups. Subsequent research can aim at combining these effects and solving for an electoral equilibrium that includes all players.

While chapter 2 focuses on voter behavior, this chapter provides another such first step by focusing on candidates. The electoral system can influence their behavior in two important ways. First, it can influence which positions candidates adopt when campaigning. Second, the electoral rule can influence how many and what types of candidates (centrist vs. extreme) contest an election. A careful reading of the literature on the comparison of plurality voting (or first-past-the-post) and proportional representation reveals that it can be organized along these two dimensions. Starting with Duverger (1955) the number of candidates under the two electoral systems has received much attention and his hypothesis that proportional representation leads to more candidates running for office has been and

¹ This chapter is based on Kamm (2014).

continues to be studied extensively. Another hypothesis that has received a lot of attention is that proportional representation leads to more polarized parties than plurality voting (see for instance, Cox 1990). Up to now empirical work has not led to a consensus whether this is indeed the case, see for instance Ezrow (2008) for a null result and Dow (2011) for supportive evidence.²

Similar to the studies of voter behavior discussed in chapter 2, the possible interaction between a candidate's entry decision and the policy she adopts is mostly not taken account when studying the questions mentioned in the previous paragraph. The citizen-candidate paradigm (Osborne and Slivinsky, 1996, Besley and Coate, 1997) is an exception since it offers a tractable model that is able to address both decisions at the same time. For this reason, in this chapter I will employ this paradigm to analyze the effects of the electoral rule.

When comparing plurality voting and proportional representation a special focus will be on how to model the intricacies of proportional representation. One of the most important complicating factors when modeling proportional representation is the occurrence of coalitions, which is typically observed in this electoral system. Theoretical work in recent years shows an increased interest in integrating coalitions into models of voter behavior (see the discussion on coalitional voting in chapter 2) and candidate behavior in systems of proportional representation. With respect to party behavior most work has been concerned with modeling the coalition formation process (see Diermeier 2006 for a survey of this literature), i.e. the final decision parties have to make after an election. The effects of coalition formation on candidates' entry decision and policy choice when campaigning, on the other hand, has been studied much less (see Matakos et al 2013 for an example of theoretical work on this topic and Curini and Hino 2012 for an empirical paper that shows that coalitions are an important explanatory factor of party system polarization).

In this chapter I will contribute to this strand of the theoretical literature and compare candidates' entry decision and policy choice under plurality voting and proportional representation (PR), where PR is modeled first in the standard way that abstracts from coalition governments and subsequently in a novel way that explicitly takes coalitions into account. The main theoretical results are as follows. First, taking the coalitions associated with proportional representation into account allows for more centrist equilibria compared to proportional representation ignoring coalitions. Second, for policy-motivated candidates proportional representation with and without coalitions supports more polarized equilibria than plurality voting. And third, with Downsian –i.e. office-motivated– candidates, equilibria with many entrants are more likely under proportional representation with coalitions than with plurality voting or proportional representation without coalitions.

The remainder of this chapter is structured as follows. First, I present the general set-up of the citizen-candidate model for plurality voting and the two types of proportional representation. Next, I discuss the equilibria for the case of PR with coalitions and compare

² Another question that has received a lot of attention is how proportional representation and first-past-the-post differ in terms of public good provision. See Person and Tabellini (2004) for a survey of this literature.

the equilibria for the three different electoral rules. Section 3.4 concludes and discusses some avenues for possible future work.

3.2 The citizen-candidate model

The citizen-candidate model introduced by Besley and Coate (1997) and Osborne and Slivinsky (1996) is a model in the Downsian tradition of spatial voting (Downs, 1957). An electorate of citizens is distributed over a policy space where each citizen is described by her ideal point (i.e. position) in the policy space. The defining feature of the model –from which it derives its name– is that each citizen can run for office by paying a cost c . After simultaneous decisions on whether to run for office, all the candidates and their positions in the policy space are announced³ and an election takes place. This election determines a policy x^* that will be implemented as well as an allocation of office rents, denoted by b .⁴

The utility for a citizen with ideal point x_i is assumed to take the following form

$$U = -f(|x^* - x_i|) + b * W - c * R,$$

where $f \geq 0$; $f' > 0$; W is a dummy variable that is equal to 1 if the candidate obtains the office rents and R is a dummy variable that is equal to 1 if the candidate runs for election.

Contrasting the specific modeling assumptions made by Besley and Coate (1997, henceforth ‘B+C’), and Osborne and Slivinsky (1996, ‘O+S’), can help to clarify some of the important modeling decisions that have to be made. While O+S assume a continuous distribution of citizens along a one-dimensional policy space, B+C allow for a multi-dimensional policy space and focus on the finite case of N citizens. Regarding voter behavior, O+S impose sincere voting while B+C allow for strategic voting. Finally, O+S consider the case where candidates might care about office in itself (i.e. $b \geq 0$) while B+C assume that candidates are purely policy-motivated ($b = 0$).

My model is closer to O+S in the sense that I focus on a one-dimensional policy space where citizens are uniformly distributed on the interval $[0, 1]$ and I assume sincere behavior by the voters. Regarding the candidates’ motivation I analyze both the case of pure policy-motivation ($b = 0$) and pure-office motivation ($b = \infty$).⁵ Finally, I assume that a citizen’s utility function is linear in the distance between her ideal point x_i and implemented policy x^* . This gives rise to the following utility function:

$$U = -|x^* - x_i| + b * W - c * R$$

³ Großer and Palfrey (2014) demonstrate how important the assumption of perfect observability is by analyzing the opposite extreme where positions are not observable (or only whether they are to the left/right of the median) and show that this fundamentally changes the equilibria.

⁴ One can, for instance, think about these office rents as compensation for government work or perks from office but also as an improvement in job market opportunities upon leaving office.

⁵ More precisely, candidates have lexicographic preferences with office rents being the first priority. This follows from the observation that when multiple options lead to the same office rents, a candidate will choose the option that leads to the policy outcome she likes most.

The environment studied by B+C and O+S is one of plurality (or first-past-the-post) voting. In this case it is straightforward and intuitive to assume that the implemented policy x^* is the ideal point of the candidate receiving the most votes (with ties broken randomly) and that all the office rents are awarded to this candidate. I will adopt the same way of modelling plurality voting. An open question is what to assume for the case that no citizen enters the race. I follow O+S in assuming that each citizen then receives a payoff of $-\infty$ which can be interpreted as a large loss in utility due to a breakdown of democracy.^{6,7}

In the case of proportional representation it is less obvious how to model the mapping from votes to an implemented policy and the distribution of office rents. Hamlin and Hjortlund (2000) –who were the first to model candidate entry under proportional representation in the citizen-candidate paradigm– assume that the implemented policy is the vote-weighted average of all candidates’ positions and that the candidate with most votes is awarded the office rents (I will call this model ‘PR without coalitions’).⁸ While this way of modeling the implemented policy correctly takes into account that plurality is not needed in proportional representation to have an influence on the policy, as discussed in chapter 2, it cannot capture some other important features of proportional representation. For instance, the important discontinuity that arises when one candidate receives an absolute majority is not accounted for.⁹ But most importantly, it does not take account of one of the defining features of systems of proportional representation – coalition governments. Therefore I propose a different way of modeling proportional representation that takes coalitions explicitly into account.¹⁰

In my model, the implemented policy is assumed to be the vote-weighted average of the policy positions of the candidates that are part of the governing coalition. Furthermore, the office rents are allocated proportionally within the coalition. The proportional division within the coalition is motivated by Gamson’s Law (Gamson, 1961) which states that government portfolios are distributed proportionally within the coalition. Ansolabehere et al. (2005) offer supporting empirical evidence by investigating portfolio allocations in Western Europe from 1946 to 2001.

Coalitions are formed according to the following procedure:¹¹

1. If a candidate receives an absolute majority of votes cast, she unilaterally forms a government and the implemented policy x^* is equal to this candidate’s policy position.

⁶ B+C assume for this case that an exogenously given default policy will be implemented.

⁷ The results are robust to assuming that instead of breakdown of democracy one citizen will be randomly chosen to form a care-taker government by herself.

⁸ This can be interpreted as the office rent being the payoff associated with being the prime minister, a post often awarded to the largest party in parliament.

⁹ See Indridason (2011), who shows in a different context that it is sufficient to assume that a candidate with an absolute majority can implement her favorite policy to fundamentally change the equilibrium.

¹⁰ Bandyopadhyay and Oak (2004) also study the citizen-candidate model with coalitions. They use a similar set-up as mine but focus on the coalition formation stage and do not analyze the number and polarization of entrants.

¹¹ This is the same procedure for modelling coalition formation as in chapter 2.

2. If no candidate receives an absolute majority of votes cast, the candidate with the most votes is assigned the role of ‘government formateur’. This candidate then proposes a coalition to the candidate or candidates with whom she wants to cooperate; if everyone agrees, the coalition is formed.
3. If multiple candidates have the most votes, a fair random draw decides which of them is assigned the role of government formateur.
4. If the coalition is rejected, bargaining breaks down and every candidate receives a payoff of $-\infty$.

One can think about this as a simplified version of the bargaining approach used in Austen-Smith and Banks (1988), with bargaining breaking down after the first round. An alternative approach would be to have a random formateur (as used in Baron and Ferejohn, 1989) where recognition probabilities are proportional to vote shares. Which of the two assumptions about formateur choice has more external validity is an empirical question. Diermeier and Merlo (2004) analyze government formation in 14 Western European countries and find that the random formateur model fits the data better than recognition in order of seat shares but that the largest party has a disproportionately high probability of getting the first shot at forming a government. Additionally, Ansolabehere et al. (2005) find that controlling for vote shares the largest party is twice as likely to deliver the formateur. This provides some support for the simplifying assumption that the largest candidate forms the coalition.¹² Furthermore, while assuming bargaining to be take-it-or-leave-it is certainly restrictive, it greatly simplifies the analysis by avoiding the need to solve for a sub-game perfect equilibrium at the bargaining stage.¹³

Note that I do not impose that coalitions are minimal winning (Riker, 1962) or connected but let the formateur endogenously form the coalition that maximizes her utility (see Bandyopadhyay and Oak, 2008, for a model in a similar spirit).¹⁴

3.3 Equilibrium analysis and comparative statics

I offer an analysis for the two polar cases of purely policy-motivated ($b = 0$) candidates and the Downsian case of purely office-motivated ($b = \infty$) candidates.¹⁵ I focus on these two extreme cases since they are the ones used most frequently in the literature. Furthermore, while the case of candidates that care substantially for both office rents and policy is certainly very interesting and relevant, it complicates the equilibrium analysis tremendously. The interaction effect between the two motives is therefore left for future work. Furthermore, I restrict the equilibrium analysis to one-, two- and three-candidate equilibria since these three cases capture the important cases of uncontested elections, two-

¹² Moreover, in the case of purely policy-motivated candidates the equilibria do not change if I assume a random formateur rule instead.

¹³ Obviously, it would be interesting and important to investigate how robust the results are to the specifics of the bargaining protocol. I leave this for future work.

¹⁴ There is also an active empirical literature that tries to establish determinants for the type of coalition observed. Martin and Stephenson (2001), for instance, analyze 220 coalition formation processes in 14 established democracies. They find that both ideological alignment and office rents matter and that minimal winning coalitions are most frequently observed.

candidate elections and multi-candidate elections and they are therefore sufficient to make an argument regarding the number of entrants as well as their polarization across electoral rules. All proofs for the propositions presented here are relegated to appendix 3.A.

3.3.1 The case of policy-motivated candidates

Proposition 1 considers the case of plurality voting as analyzed by Osborne and Slivinsky (1996) and is applies their propositions 1, 2 and 4 under the assumptions made in this chapter.

Proposition 1 (Plurality voting and policy-motivated candidates)

- (a) A single entrant at position X is an equilibrium iff
 - a. $0 \leq X < 0.5$ and $1 - 2X \leq c$ **OR**
 - b. $X = 0.5$ **OR**
 - c. $0.5 < X \leq 1$ and $2X - 1 \leq c$
- (b) Two candidates entering at position L and R is an equilibrium iff:
 - a. $R = 1 - L$ and $\frac{1}{6} \leq L < \frac{1}{2}$ and $c < 0.5 - L$
- (c) No equilibrium with three candidates exists

The intuition for structure of these equilibria is the following: In a one-candidate equilibrium the costs of running for office have to be high enough so that it is not worthwhile for another, more centrist, candidate to enter. For the two-candidate equilibrium the symmetry is necessary since otherwise one of the candidates would not have any influence on the implemented policy and would therefore prefer not to enter the election. The reason why no three-candidate equilibrium exists is that for all possible candidate positions at least one of the candidates would prefer to stay out of the election thereby ensuring that the remaining candidate that is located closer to her position wins the election.

Proposition 2 describes the equilibria for the case of proportional representation without coalitions and is an application of propositions 1-3 in Hamlin and Hjortlund (2001).

Proposition 2 (PR without coalitions and policy-motivated candidates)

- (a) A single entrant at position X is an equilibrium iff
 - a. $0 \leq X < 0.5$ and $\frac{1}{2}(1 - X)^2 \leq c$ **OR**
 - b. $X = 0.5$ **OR**
 - c. $0.5 < X \leq 1$ and $\frac{1}{2}X^2 \leq c$

¹⁵ As mentioned above, the latter candidates do care about policy but only if multiple decisions give them the same office rents.

- (b) Two candidates entering at position L and R is an equilibrium iff:
- $0 \leq L < \sqrt{2} - 1$ and $\frac{L^2+1}{2} < R \leq 1 - L$ and $\frac{(1-R)^2}{2} < c < \frac{R^2-L^2}{2}$ **OR**
 - $0 \leq L \leq \sqrt{2} - 1$ and $1 - L \leq R \leq 1$ and $\frac{1}{2} L^2 < c < \frac{(2-R-L)*(R-L)}{2}$ **OR**
 - $\sqrt{2} - 1 < L < \frac{1}{2}$ and $1 - \sqrt{1-2L} < R \leq 1$ and $\frac{1}{2} L^2 < c < \frac{(2-R-L)*(R-L)}{2}$
- (c) No equilibrium with three candidates exists

The intuition for the one-candidate equilibrium is again that costs have to be high enough to deter entry by another entrant. In contrast to the case of plurality voting discussed above it is not entry by centrist but by extreme candidates that has to be deterred. This follows from the observation that they have the biggest influence on the policy and therefore the highest incentive to enter. For the two-candidate equilibrium two forces have to be traded off; on the one hand costs have to be high enough so that no additional candidates want to enter at the extremes of the policy space and on the other hand costs have to be low enough that both candidates want to enter. Finally, no three-candidate equilibrium exists because given the assumed uniform distribution of sincere voters the implemented policy would be the same whether the centrist candidate enters or not and therefore the centrist candidate will never enter.

Proposition 3 (PR with coalitions and policy-motivated candidates)

- (a) A single entrant at position X is an equilibrium iff
- $0 \leq X < 0.5$ and $1 - 2X \leq c$ **OR**
 - $X = 0.5$ **OR**
 - $0.5 < X \leq 1$ and $2X - 1 \leq c$
- (b) Two candidates entering at position L and R is an equilibrium iff:
- $R = 1 - L$ and $\frac{\sqrt{29}-1}{28} \leq L < \frac{1}{2}$ and $c < 0.5 - L$ **OR**
 - $R = 1 - L$ and $L < \frac{\sqrt{29}-1}{28}$ and $\frac{0.5-2L-14L^2}{1+2L} < c < 0.5 - L$
- (c) No equilibrium with three candidates exists

What is the intuition for these equilibria and their structure? In the case of a one-candidate equilibrium all entrants that are located closer to the median than the current entrant could implement their favorite policy and therefore the entry costs have to be high enough such that these citizens prefer accepting a sub-optimal policy over implementing their favorite policy by entering. The equilibrium where the candidate is located at the median position is a special case since the median candidate cannot be beaten by any candidate and therefore this equilibrium exists independent of the level of entry costs.

The two-candidate equilibria have to be symmetric since otherwise one of the two candidates obtains an absolute majority which means that the other candidate has no influence on the policy and prefers to stay out of the race. Furthermore, for very low entry costs the equilibrium cannot be too polarized. The reason is that such polarization would provide an opening for a moderate candidate to become formateur of the coalition and she would enter.

Finally, there can be no three-candidate equilibrium. The reason is that in all scenarios one of the extreme candidates would prefer an absolute majority of the center candidate over the situation where the other extreme candidate is part of the government.

Proposition 4 (comparative statics with policy-motivated candidates)

- (a) Proportional representation, with and without coalitions, yields higher polarization than plurality rule.
- (b) For proportional representation, an equilibrium with two centrist parties is more likely when coalitions are taken into account.

The intuition for part (a) of the proposition stems from the fact that with proportional representation an entrant has a different influence on the policy than under plurality voting. With a high degree of polarization an entrant can win a substantial fraction of the votes by entering in the center of the policy space. With plurality voting this entrant can implement her favorite policy and therefore has a strong incentive for entry. Under proportional representation she will have a smaller effect on the policy since at least one other candidate will also have an influence on the policy. This reduces the likelihood that polarization will be reduced due to entry at the center of the policy space.¹⁶

The intuition for the second part of the proposition is that with coalitions an extreme entrant (who would win many votes if the candidates are both centrist) will not be part of the coalition. The reason is that the formateur (which the entrant will never be) prefers a coalition with the closely aligned candidate and not the extreme entrant. Without coalitions on the other hand the extreme entrant has an influence on the policy and therefore a two-candidate equilibrium with little polarization is not sustainable.

3.3.2 The case of office-motivated candidates

Proposition 5 analyzes the case of plurality voting as modeled by Osborne and Slivinsky (1996) and is an application of their propositions 1-3.

Proposition 5 (Plurality voting and office-motivated candidates)

- (a) A single entrant at position X is an equilibrium iff
 - a. $X = 0.5$
- (b) Two candidates entering at position L and R is an equilibrium iff:
 - a. $R = 1 - L$ and $\frac{1}{6} \leq L < \frac{1}{2}$
- (c) Three entrants entering at position L , C and R is an equilibrium iff:
 - a. $L = \frac{2}{3} - C$ and $\frac{1}{3} < C < \frac{2}{3}$ and $R = \frac{4}{3} - C$

The reason that in the (only) one-candidate equilibrium the median citizen enters is that given the large office rents every citizen that can win against any candidate will enter. The only candidate that cannot be beaten is the median candidate. As in the case of policy-motivated candidates the two-candidate equilibrium has to be symmetric since otherwise

¹⁶ This is in line with theoretical work by Cox (1990) and recent empirical work by Matakos et al. (2013).

one of the candidate would neither get office rents nor have an influence on the implemented policy and would not enter. The structure of the three-candidate equilibrium is due to the fact that all candidates need to receive the same number of votes since otherwise the candidates with the least votes would prefer to stay out of the election.

Proposition 6 presents the equilibria for the case of proportional representation without coalitions and is based on claim 1, 2, 2* and 3 in Hamlin and Hjortlund (2001).

Proposition 6 (PR without coalitions and office-motivated candidates)

- (a) A single entrant at position X is an equilibrium iff
 - a. $X = 0.5$
- (b) Two candidates entering at position L and R is an equilibrium iff:
 - a. $c > \max\left\{\frac{1}{2}(1-R)^2; \frac{1}{2}L^2\right\}$ and $\max\left\{2-R-2L; \frac{R-L}{2}\right\} > L > R - \frac{2}{3}$ and $R > \min\left\{2-2R-L; \frac{2-R+L}{2}\right\}$ **AND**
 - b. $R+L \geq 1$ or $c < \frac{R^2-L^2}{2}$ **AND**
 - c. $R+L \leq 1$ or $c < \frac{2-R-L}{2}(R-L)$
- (c) Three entrants entering at position L , C and R is an equilibrium iff:
 - a. $R-L \geq \frac{2}{3}$ and $c > \max\left\{\frac{1}{2}(1-R)^2; \frac{1}{2}L^2\right\}$ **AND**
 - b. $C = R - 2L$ or $c < \frac{C^2-L^2}{2}$ **AND**
 - c. $C = 2 - 2R + L$ or $c < \frac{C^2-2C+2R-R^2}{2}$

The intuition for why the median candidate entering is the unique one-candidate equilibrium is the same as in the case of plurality voting: Any other candidate position would lead to entry by a more centrist candidate. The structure of the two-candidate equilibrium is determined by the trade-off between making sure that both candidates want to run for office (which implies costs cannot be too high and positions too close together) and deterring entry by other candidates (which means costs cannot be too low). The reason for the structure of the three-candidate equilibrium is that the center candidate needs to win (part of) the office rents since due to the uniform distribution of sincere voters she has no influence on the implemented policy. Furthermore, as in the two-candidate equilibrium costs can neither be too low nor too high as to ensure that the three candidates but no more want to enter.

Proposition 7 (PR with coalitions and office-motivated candidates):

- (a) A single entrant at position X is an equilibrium iff
 - a. $X = 0.5$
- (b) There is no equilibrium with two candidates entering.
- (c) Three entrants entering at position L , C and R is an equilibrium iff:
 - a. $L = \frac{1}{6}$ and $C = \frac{1}{2}$ and $R = \frac{5}{6}$
 - b. $C = \frac{1}{2}$ and $R = 1 - L$ and $L > \frac{1}{3}$

The reason that in the (only) one-candidate equilibrium the median citizen enters is the same as for the other two electoral rules: The only candidate that cannot be beaten is the median candidate. The reason for the non-existence of a two-candidate equilibrium is that there always exists an entrant that can join the coalition and which therefore would enter. Finally, it is noteworthy that in all three-candidate equilibria the extreme candidates have a weakly higher vote share than the center candidate. The intuition is that if the center candidate were to be the sole formateur there would always be an incentive for a moderate candidate to enter between the extreme and the center candidate to become part of the coalition.

Proposition 8 (comparative statics with office-motivated candidates):

- (a) Under proportional representation with coalitions, equilibria are more likely to involve multiple candidates.
- (b) Plurality rule leads to more polarization in three-party elections than PR with coalitions but PR without coalitions leads to even higher polarization.

Part (a) of the proposition follows from the result that with coalitions there are no equilibria with two candidates and therefore apart from the case where only the median citizen enters, the equilibrium is a multi-candidate outcome. Part (b) of the proposition highlights how taking coalitions into account changes the equilibrium structure. Coalitions allow a lower degree of polarization compared to plurality voting since under plurality voting the center candidate only enters when there is enough space between the extreme candidates for her to receive a third of the votes while with coalitions she is an attractive coalition partner and therefore will receive office rents even if she does not receive that many votes. If on the other hand one does not take coalitions into account, the result shows that that proportional representation leads to more polarized outcomes. The intuition is that in an equilibrium under plurality rule, all candidates receive office rents, which implies that the center candidate cannot win a strict plurality of the votes, which in turn is only possible if polarization is not too high. Under proportional representation the opposite is true and the center candidate needs to win office rents for her to enter which is only possible for a high degree of polarization. Finally, the reason that proportional representation is less polarized with coalitions than without is that with coalitions a large degree of polarization opens the door for moderate entrants that are very attractive coalition partners while if coalitions are not taken account, these moderates would only enter if they could win a plurality of the votes.

In conclusion, the comparison of equilibria across electoral rules leads to the following main findings: First, due to the majoritarian decision-making captured by coalition governments, proportional representation with coalitions allows for more centrist outcomes than in the absence of coalitions. Second, proportional representation without coalitions allows more polarized outcomes than plurality voting. Third, for office-motivated candidates proportional representation with coalitions is most conducive to multi-candidate outcomes.

3.4 Conclusions

In this chapter I employed the citizen-candidate paradigm to investigate the question of how distinct electoral systems influence the number of candidates running for office and the polarization of their policy positions. I introduce a way of modeling proportional representation that takes coalition governments explicitly into account and find that this leads –compared to ignoring coalitions– to candidate positions that are less polarized. This implies that the common criticism of proportional representation leading to high polarization has less bite once we take into account the incentives associated with coalition formation. For the case without coalition formation, I do find that plurality voting leads to more centrist outcomes than proportional representation. This is in line with the hypothesis put forth by Cox (1990) that proportional representation leads to more polarized parties. Furthermore, for the classical case of Downsian candidates, I find that proportional representation with coalitions is more conducive to multi-candidate equilibria than proportional representation without coalitions or plurality voting.

Overall, these theoretical results show that the dynamics associated with coalition formation have important implications for candidates' behavior under proportional representation. This analysis offers a first step to understanding how coalitions influence entry and candidates' policy choice and how these depend on the institutional environment, but a lot of work still remains to be done. A first important step would be to investigate how robust the results of this analysis are with respect to the specifics of the coalition formation process, for instance by employing a random formateur rule. Another avenue for future research is to allow for candidates that care about both policy and office rents. One could then investigate how the comparative statics across electoral rules change as candidates' relative concerns for office rents increase vis-à-vis their concerns for policy. An important question is also how the electoral equilibrium that results from the interplay between candidates and voters reacts to changes in the electoral system. To be able to answer this question one would need to allow for strategic voting¹⁷ or abstention. Especially allowing for abstention might be interesting since –as chapter 2 demonstrates– it has direct implications for the polarization of outcomes.

On a more general level the analysis reiterates the point made in the literature that ignoring the coalitions associated with proportional representation is not without effect on the equilibria and the comparative statics across electoral rules. Going forward we should therefore continue to integrate coalition governments into our analyses of proportional representation; not only in models that aim to understand election outcomes per se but also and especially in models that try to answer how electoral rules influence other outcomes such as taxation and redistribution.

¹⁷ De Sinopoli and Iannantuoni (2007) show that in the model of proportional representation without coalitions when strategic voting is allowed the voters engage in 'policy-balancing' (Kedar, 2009) which leads to only the most extreme candidates receiving votes.

Appendix 3.A: Proofs of propositions

Throughout the analysis x_A denotes the policy implemented in situation A . If A consist of one letter this implies that the player denoted by this letter determines the policy alone; if A consists of multiple letters the players denoted by these letters are part of the coalition determining the policy (i.e. x_{LC} denotes the policy implemented by a center-left coalition). Furthermore, U_B denotes a player's payoff in situation B and P_i is player i 's share of the votes.

3.A.1 Proof of proposition 1

This proposition depicts the equilibria for the case for plurality voting, with policy-motivated candidates. To prove the three parts of the proposition, we analyze all equilibria with up to three entrants.

Single party equilibrium with entry at position X

We first have to ensure that the player at position X wants to enter. If she stays out she will receive a payoff of $-\infty$ (since nobody enters). Therefore the player at position X will enter. Next, we have to ensure that no other player wants to enter. The potential entrant that has the most to gain from entering is located on the opposite site of the median with a distance that is slightly smaller than the distance between X and the median.

(a) $X < 0.5$

Denote the entrants position by $Z = 1 - X - \varepsilon$.

She prefers to stay out if the following condition holds:

$$-c < -(Z - X) \Leftrightarrow c > 1 - 2X - \varepsilon$$

(b) $X = 0.5$

No entrant can win the election

(c) $X > 0.5$

Denote the entrants position by $Z = 1 - X + \varepsilon$.

She prefers to stay out if the following condition holds:

$$-c < -(X - Z) \Leftrightarrow c > 2X - 1 - \varepsilon$$

Thus, entry by a candidate at position X is an equilibrium if:

(a) $0 \leq X < 0.5$ and $1 - 2X \leq c$

(b) $X = 0.5$ and $c < 0.25$

(c) $0.5 < X \leq 1$ and $2X - 1 \leq c$

Two party equilibrium with entry at L and R

The equilibrium has to be symmetric since otherwise one candidate loses for sure and will not enter. Therefore $R = 1 - L$.

The candidate at L enters if the following condition holds (by symmetry this is the same condition for the candidate at R):

$$-c - (0.5 - L) > -(R - L) \Leftrightarrow c < 0.5 - L$$

Given L and R, there are three types of potential entrants to consider:

(a) Entry by an extremist (wlog to the left of L)

Such an entrant can never win a plurality since player R does not lose any votes and still gets 50% of the votes. Therefore the effect of such an entrant is only that it makes party R the sole formateur. But given that she is to the left of candidate L the entrant dislikes this. Therefore this type of entrant has never an incentive to enter.

(b) Entry by a centrist voter (wlog to the left of $\frac{1}{2}$) not winning a plurality

By entering she takes away votes from L and R but given that she is closer to L this will lead to a plurality for candidate R. This is not in the interest of the entrant and therefore this type of entrant will not enter.

(c) Entry by a centrist voter that does win a plurality

Since the payoff is linear in the distance to the implemented policy all entrants have the same incentive to enter if they can obtain more votes than L and R. Furthermore all entrants between L and R will receive a vote share equal to $\frac{R-L}{2}$ while the vote share for candidates L and R is given by $\frac{0.5+L}{2}$. Therefore the entrant wins most votes if $L < \frac{1}{6}$. This implies that if $L \geq \frac{1}{6}$ no entrant can benefit from entry since she will never win.

Entry at positions L and 1-L is an equilibrium if:

$$\frac{1}{6} \leq L < \frac{1}{2} \text{ and } c < 0.5 - L$$

Three party equilibrium with entry at L, C and R

Both extreme candidates need to win a plurality of the votes since otherwise they prefer the center candidate to win which they can ensure by staying out of the race. The condition for this to be the case are:

$$(a) P_L = P_R \Leftrightarrow C + L = 2 - R - C \Rightarrow C = \frac{2-R-L}{2} \xrightarrow{L < C < R} 2 - 3R < L < \frac{2-R}{3}$$

$$(b) P_L > P_C \Leftrightarrow C + L > R - L \Rightarrow C > R - 2L \xrightarrow{\text{by (a)}} L > \frac{3R-2}{3}$$

There are now two cases to consider:

First, candidate C ties with the other candidates

This implies $L = \frac{2}{3} - C$, $R = \frac{4}{3} - C$ and $\frac{1}{3} < C < \frac{2}{3}$.

The candidate at position L enters if the following condition holds:

$$-c - \frac{1}{3}(C - L) - \frac{1}{3}(R - L) > -(C - L) \Leftrightarrow c < \frac{4}{3}C - \frac{2}{3}$$

Given that $c > 0$ this implies $C > \frac{1}{2}$.

The candidate at position R enters if the following condition holds:

$$-c - \frac{1}{3}(R - C) - \frac{1}{3}(R - L) > -(R - C) \Leftrightarrow c < \frac{2}{3} - \frac{4}{3}C$$

Given that $c > 0$ this implies $C < \frac{1}{2}$ and therefore this is not an equilibrium.

Second, the center candidate does not win a plurality of the votes

The candidate at position L enters if the following condition holds:

$$-c - \frac{1}{2}(R - L) > -(C - L) \Leftrightarrow c < 1 - R - L$$

The candidate at position R enters if the following condition holds:

$$-c - \frac{1}{2}(R - L) > -(R - C) \Leftrightarrow c < R + L - 1$$

Since the costs are positive these two conditions can never be satisfied at the same time.

There does not exist a three party equilibrium.

3.A.2 Proof of proposition 2

This proposition depicts the equilibria for the case for proportional representation without coalition formation, with policy-motivated candidates. To prove the three parts of the proposition, we analyze all equilibria with up to three entrants.

Single party equilibrium with entry at position X

We first have to ensure that the player at position X wants to enter. If she stays out she will receive a payoff of $-\infty$ (since nobody enters). Therefore the player at position X will enter. The potential entrant that has the most to gain from entering is the one located farthest away from X.

(a) $X \leq 0.5$

The relevant entrant is located at position 1. She does not enter if the following condition holds:

$$-c - \left(1 - \frac{1+X}{2}X - \frac{1-X}{2} * 1\right) < -(1-X) \Leftrightarrow c > \frac{1}{2}X^2 - X + 0.5$$

(b) $X \geq 0.5$

The relevant entrant is located at position 0. she does not enter if the following condition holds:

$$-c - \left(\frac{X}{2} * 0 - \frac{2+X}{2}X\right) < -X \Leftrightarrow c > \frac{1}{2}X^2$$

Entry at position X is an equilibrium if:

(a) $0 \leq X < \frac{1}{2}$ and $c > \frac{1}{2}X^2 - X + 0.5$

(b) $X = \frac{1}{2}$ and $0.125 < c < 0.25$

(c) $\frac{1}{2} < X \leq 1$ and $\frac{1}{2}X^2 < c$

Two party equilibrium with entry at L and R

The candidate at position L enters if:

$$-c - \left(\frac{R+L}{2}L + \frac{2-R-L}{2}R - L\right) > -(R-L) \Leftrightarrow c < \frac{R^2 - L^2}{2}$$

The candidate at position R enters if:

$$-c - \left(R - \frac{R+L}{2}L - \frac{2-R-L}{2}R\right) > -(R-L) \Leftrightarrow c < \frac{2-R-L}{2}(R-L)$$

The potential entrants with the most to gain are located at 0 and 1.

The entrant at position 0 stays out if:

$$-c - \left(\frac{R}{2} * 0 + \frac{2-R}{2} R - 0 \right) < - \left(\frac{R+L}{2} L + \frac{2-R-L}{2} R - 0 \right) \Leftrightarrow c > \frac{1}{2} L^2$$

The entrant at position 1 stays out if:

$$-c - \left(1 - \frac{1+L}{2} * L - \frac{1-L}{2} * 1 \right) < - \left(1 - \frac{R+L}{2} L - \frac{2-R-L}{2} R \right) \Leftrightarrow c > \frac{1}{2} (1-R)^2$$

Entry at positions L and R is an equilibrium if:

$$(a) 0 \leq L < \sqrt{2} - 1 ; \frac{L^2+1}{2} < R \leq 1 - L \text{ and } \frac{(1-R)^2}{2} < c < \frac{R^2-L^2}{2}$$

$$(b) 0 \leq L \leq \sqrt{2} - 1 ; 1 - L \leq R \leq 1 \text{ and } \frac{1}{2} L^2 < c < \frac{(2-R-L)*(R-L)}{2}$$

$$(c) \sqrt{2} - 1 < L < \frac{1}{2} ; 1 - \sqrt{1-2L} < R \leq 1 \text{ and } \frac{1}{2} L^2 < c < \frac{(2-R-L)*(R-L)}{2}$$

Three party equilibrium with entry at L, C and R

Since we assume sincere voting by uniformly distributed voters the implemented policy with candidates at positions L, C and R is:

$$\frac{C+L}{2} * L + \frac{R-L}{2} * C + \frac{2-R-C}{2} * R = \frac{L^2 + 2 * R - R^2}{2}$$

The implemented policy if C decides to not enter the race is:

$$\frac{L+R}{2} L + \frac{2-R-L}{2} * R = \frac{L^2 + 2 * R - R^2}{2}$$

This implies that candidate C has no influence on the implemented policy.

Therefore this situation cannot be an equilibrium.

3.A.3 Proof of proposition 3

To prove the proposition we analyze all equilibria with up to three entrants and thereby derive the three parts of proposition 1.

Single party equilibrium with entry at position X

We first have to ensure that the player at position X wants to enter. If she stays out she will receive a payoff of $-\infty$ (since nobody enters). Therefore the player at position X will enter. Next, we have to ensure that no other player wants to enter. The player that has the most to gain from entering is located on the opposite site of the median with a distance that is slightly smaller than the distance between X and the median.¹⁸ We can now consider three cases:

(a) $X < 0.5$

Denote the entrant's position by $Z = 1 - X - \varepsilon$. She prefers to stay out if the following condition holds:

$$-c < -(Z - X) \Leftrightarrow c > 1 - 2X - \varepsilon \xrightarrow{\varepsilon \rightarrow 0} c \geq 1 - 2X$$

(b) $X = 0.5$

No entrant can win the election.

(c) $X > 0.5$

Denote the entrant's position by $Z = 1 - X + \varepsilon$. She prefers to stay out if the following condition holds:

$$-c < -(X - Z) \Leftrightarrow c > 2X - 1 - \varepsilon \xrightarrow{\varepsilon \rightarrow 0} c \geq 2X - 1$$

Two party equilibrium with entry at positions L and R

The equilibrium has to be symmetric since otherwise one candidate loses for sure and does not enter. Therefore $R = 1 - L$. First, we need to make sure that both candidates prefer entry over staying out. The candidate at position L enters if the following condition holds (by symmetry this is the same condition for the candidate at R):

$$\begin{aligned} U_{enter} > U_{stay\ out} &\Leftrightarrow -c - (x_{LR} - L) > -(x_R - L) \Leftrightarrow \\ &-c - (0.5 - L) > -(R - L) \Leftrightarrow c < 0.5 - L \end{aligned}$$

Next, there are three types of entrants to consider.

First, an extreme entrant (without loss of generality located to the left of candidate L). Such an entrant never wants to enter. The reason is that the new coalition policy will be to the right of the old coalition policy. This follows from the observation that candidate R can

¹⁸ The reason is that this is the entrant that from the set of candidates that can win an absolute majority has most to lose from the policy that would result, if she does not enter. If this candidate has nothing to gain from entering, then no candidate does.

continue the coalition with candidate L and since R now has a higher weight the resulting policy lies to the right of the old policy. Since candidates only care about policy and given that candidate R can form a viable coalition with either of the two other candidates this implies that entry leads to a more right-wing policy than before. This is not in the interest of the extreme entrant and therefore she will not enter. The *second* type of entrant to consider, is located at position X between L and the median and does not become the formateur. By the same reasoning as above she also will not want to enter.¹⁹ The *third* type of entrant is located at position Y between candidate L and the median and wins a plurality of the votes. Since the entrants vote share is $\frac{R-L}{2}$ and candidate R's vote share is $\frac{2-R-Y}{2}$ this is the case if $Y > 3L$ (which given that Y is located to the left of the median implies that $L < \frac{1}{6}$). Furthermore, Y has to prefer a coalition with L over the grand coalition which is the case if $Y < \frac{\sqrt{36L^2-20L+17}+2L-1}{8}$ (which given $Y > 3L$ is possible if $L < \frac{\sqrt{8}-1}{14}$).²⁰ The reason is that the policy of the grand coalition is the same as the policy before entry and therefore entry is not in the interest of the entrant if she would form a grand coalition upon entering. Finally, the entrant prefers to stay out over entering and forming a coalition with L if the following condition holds:

$$\begin{aligned}
 U_{enter} < U_{stay\ out} &\Leftrightarrow -c - (Y - x_{LY}) > -(x_{LR} - Y) \Leftrightarrow \\
 & -c - \left(Y - \frac{(R-L)Y + (L+Y)L}{R+Y} \right) < -\left(\frac{1}{2} - Y \right) \\
 \xleftrightarrow{\text{using } R=1-L} c > & \frac{L^2 + LY - 0.5L - 0.5Y - 2Y^2 + 0.5}{1 - L + Y}
 \end{aligned}$$

The derivative of this expression with respect to Y is $\frac{1-2L}{(1-L+Y)^2} - 2 < 0$ and accordingly evaluating the expression at $Y = 3L$ (which is the position of the player most difficult to deter from entering) gives the relevant boundary for the cost of entry.

Therefore, entry at positions L and 1-L is an equilibrium if:

- (a) $0 < L < \frac{\sqrt{8}-1}{14}$ and $\frac{0.5-2L-14L^2}{1+2L} < c < 0.5 - L$ OR
 (b) $\frac{\sqrt{8}-1}{14} \leq L < \frac{1}{2}$ and $c < 0.5 - L$

Three party equilibrium with entry at L, C and R

To ensure that all candidates want to enter, no candidate can win an absolute majority since otherwise the losing candidates would prefer to stay out. Furthermore, an extreme candidate only enters if she becomes part of the coalition. The reason is that by staying out she can ensure that the center candidate wins which leads to a policy that is preferred to the

¹⁹ The same holds for an entrant located between the median and candidate R that does not win a plurality of the votes.

²⁰ Given that candidate L has fewer votes than candidate R and is also located closer to the entrant the entrant prefers a coalition with L over a coalition with R.

policy implemented by a coalition that she is not a part of. This leaves four cases to be considered.

I: The center party wins the plurality of votes and forms a grand coalition

If the coalition policy is to the left (right) of the center candidate's position candidate R (L) prefers to stay out to implement the center candidate's position as the policy. If the government's policy is equal to the center candidate's position the extreme candidates can save the entry costs without losing in terms of policy. Therefore, this cannot be an equilibrium.

II: The two extreme candidates are tied and each gets more votes than candidate C.

This situation arises if the following conditions hold:

$$(a) L + C = 2 - R - C \Leftrightarrow C = \frac{2-R-L}{2} \text{ (candidates L and R are tied)}$$

$$(b) L + C > R - L \Leftrightarrow C < R - 2L \xrightarrow{\text{using (a)}} R - L > \frac{2}{3} \text{ (candidate C receives fewest votes)}$$

First, we have to make sure that candidate L wants to enter. This is the case if:

$$\begin{aligned} U_{enter} > U_{stay\ out} &\Leftrightarrow -c - \left(\frac{1}{2}x_{LC} + \frac{1}{2}x_{CR} - L \right) > -(x_C - L) \Leftrightarrow \\ &-c - \left(\frac{(L+C)L + (R-L)C + (L+C)R + (R-L)C}{2R+2C} - L \right) > -(C-L) \\ \xrightarrow{c = \frac{2-R-L}{2}} &c < 1 - 0.5R - 1.5L - \left(\frac{(1-0.5R+0.5L)(R+L) + (R-L)(2-R-L)}{2+R-L} - L \right) \\ &\Leftrightarrow c < 3 + L + R - \frac{8R+4}{2-L+R} \end{aligned}$$

Candidate R enters if the following condition holds:

$$\begin{aligned} U_{enter} > U_{stay\ out} &\Leftrightarrow -c - \left(R - \frac{1}{2}x_{LC} - \frac{1}{2}x_{CR} \right) > -(R - x_C) \Leftrightarrow \\ &-c - \left(R - \frac{(L+C)L + (R-L)C + (L+C)R + (R-L)C}{2R+2C} \right) > -(R-C) \\ \xrightarrow{c = \frac{2-R-L}{2}} &c < 1.5R + 0.5L - 1 \\ &\quad - \left(R - \frac{(1-0.5R+0.5L)(R+L) + (R-L)(2-R-L)}{2+R-L} \right) \\ &\Leftrightarrow c < - \left[3 + L + R - \frac{8R+4}{2-L+R} \right] \end{aligned}$$

Combining these two conditions, we find that for both candidates R and L willing to enter we need that $c < \min \left\{ 3 + L + R - \frac{8R+4}{2-L+R}; - \left[3 + L + R - \frac{8R+4}{2-L+R} \right] \right\} \leq 0$ which is never satisfied. This implies that this is not an equilibrium.

III: All parties are tied

All parties are tied if:²¹

$$(a) R - L = L + C \Leftrightarrow C = R - 2L \text{ (C and L are tied)}$$

$$(b) R - L = 2 - R - C \Leftrightarrow C = 2 - 2R + L \stackrel{\text{by (a)}}{\Leftrightarrow} R = \frac{2}{3} + L \text{ (C and R are tied)}$$

We have to make sure that candidate L will enter. This is the case if:

$$\begin{aligned} U_{enter} > U_{stay\ out} &\Leftrightarrow -c - \left(\frac{1}{3}x_{LC} + \frac{1}{3}x_{LCR} + \frac{1}{3}x_{CR} - L \right) > -(x_C - L) \Leftrightarrow \\ -c - \frac{1}{3} \left(\frac{L+C}{2} - L \right) - \frac{1}{3} \left(\frac{R+C}{2} - L \right) - \frac{1}{3} \left(\frac{(R+L)L + (2-R-L)R}{2} - L \right) &> -(C-L) \\ \Leftrightarrow c < C - \frac{L+C+R+C+(R+L)L+(2-R-L)R}{6} &\Leftrightarrow \frac{4C-L-3R+R^2-L^2}{6} \\ \stackrel{c=R-2L}{\Leftrightarrow} c < \frac{R-9L+R^2-L^2}{6} \\ \stackrel{R=\frac{2}{3}+L}{\Leftrightarrow} c < \frac{10-60L}{54} \end{aligned}$$

Candidate R enters if:

$$\begin{aligned} U_{enter} > U_{stay\ out} &\Leftrightarrow -c - \left(R - \frac{1}{3}x_{LC} - \frac{1}{3}x_{LCR} - \frac{1}{3}x_{CR} \right) > -(R - x_C) \Leftrightarrow \\ -c + \frac{L+C}{6} + \frac{R+C}{6} + \frac{(R+L)L + (2-R-L)R}{6} &> C \\ \stackrel{c=R-2L}{\Leftrightarrow} c < \frac{9L-R-R^2+L^2}{6} \\ \stackrel{R=\frac{2}{3}+L}{\Leftrightarrow} c < \frac{60L-10}{54} \end{aligned}$$

Combining these two conditions, we find that for both candidates R and L willing to enter we need that $c < \min \left\{ \frac{10-60L}{54}; \frac{60L-10}{54} \right\} \leq 0$ which is never satisfied. This implies that this configuration is not an equilibrium.

²¹ Note, that the center candidate will form a consensus government instead of a two-party coalition.

IV: One extreme candidate (say candidate L) and the center candidate are tied and they each have more votes than the other extreme candidate.

This happens if:²²

(a) $L + C = R - L \Leftrightarrow C = R - 2L$ (candidates L and C are tied)

(b) $R - L > 2 - R - C \Leftrightarrow C > 2 - 2R + L \stackrel{\text{by (a)}}{\Leftrightarrow} R - L > \frac{2}{3}$ (candidate R gets fewer votes)

Whether candidate R enters depends on which coalition candidate L will form. We therefore have two situations to consider.

(a) L forms a center-left coalition

R enters if:

$$\begin{aligned}
 U_{enter} > U_{stay\ out} &\Leftrightarrow -c - \left(R - \frac{1}{2}x_{LC} - \frac{1}{2}x_{LCR} \right) > -(R - x_C) \Leftrightarrow \\
 -c - \frac{1}{2} \left(R - \frac{C+L}{2} \right) - \frac{1}{2} \left(R - \frac{(R+L)L + (2-R-L)R}{2} \right) &> -(R - C) \\
 \Leftrightarrow c < -\frac{R^2 - L^2 + 2R + 3C - L}{2} \\
 \stackrel{C=R-2L}{\Leftrightarrow} c < -\frac{R^2 - L^2 + 5R - 7L}{2} \\
 \stackrel{R-L > \frac{2}{3}}{\Leftrightarrow} c < -\frac{R^2 - L^2 + \frac{10}{3} - 2L}{2} < 0
 \end{aligned}$$

(b) L forms a coalition with candidate R

This situation arises if $\frac{C+L}{2} > \frac{(L+C)L + (2-R-C)R}{2-R+L}$, i.e. if the coalition with candidate R leads to a more left-wing policy than the coalition with candidate C. But in this case it is even less attractive than in case (a) for candidate R to enter instead of letting candidate C win an absolute majority. Therefore candidate R prefers to abstain.

Since for all four possible cases of three-candidate equilibria a violation of equilibrium conditions was detected we can conclude that no three-candidate equilibrium exists.

²² Note, that the center candidate will form a consensus government instead of a two-party coalition.

3.A.4 Proof of Proposition 4

Table 3A.1 shows the equilibria under the different electoral rules for the case of purely policy-motivated candidates.²³

Table 3A.1: Equilibria for purely policy-motivated candidates

	PL	PR	PR+C
One-candidate equilibrium	$0 \leq X < 0.5$ and $1 - 2X \leq c$ OR $X = 0.5$ OR $0.5 < X \leq 1$ and $2X - 1 \leq c$	$0 \leq X < 0.5$ and $\frac{1}{2}(1 - X)^2 < c$ OR $X = 0.5$ OR $0.5 < X \leq 1$ and $\frac{1}{2}X^2 < c$	$0 \leq X < 0.5$ and $1 - 2X \leq c$ OR $X = 0.5$ OR $0.5 < X \leq 1$ and $2X - 1 \leq c$
Two-candidate equilibrium	$R = 1 - L$ and $\frac{1}{6} < L < \frac{1}{2}$ and $c < 0.5 - L$	$0 \leq L < \sqrt{2} - 1$ and $\frac{L^2+1}{2} < R \leq 1 - L$ and $\frac{(1-R)^2}{2} < c < \frac{R^2-L^2}{2}$ OR $0 \leq L \leq \sqrt{2} - 1$ and $1 - L \leq R \leq 1$ and $\frac{L^2}{2} < c < \frac{(2-R-L)(R-L)}{2}$ OR $\sqrt{2} - 1 < L < \frac{1}{2}$ and $1 - \sqrt{1-2L} < R \leq 1$ and $\frac{L^2}{2} < c < \frac{(2-R-L)(R-L)}{2}$	$R = 1 - L$ and $0 < L < \frac{\sqrt{8}-1}{14}$ and $\frac{0.5-2L-14L^2}{1+2L} < c < \frac{1-2L}{2}$ OR $R = 1 - L$ and $\frac{\sqrt{8}-1}{14} < L < \frac{1}{2}$ and $c < 0.5 - L$

Notes. The table shows the equilibria for the three electoral rules. PL (PR; PR+C) denotes plurality voting (proportional representation without coalitions; proportional representation with coalitions). L, R and X denotes the candidates' positions in the policy space and c denotes the costs of entry.

We define the polarization of the equilibria as the distance between the left- and right-wing candidate's position, i.e. $R - L$.

²³ The equilibria for proportional representation without coalitions and plurality voting are derived in appendix B.

Table 3A.2, shows the possible levels of polarization for the different treatments. We find that the maximal polarization for plurality voting is $\frac{2}{3}$ while with proportional representation polarization can almost be maximal, i.e. 1. This proves part (a) of proposition 4, that proportional representation, with and without coalitions, yields higher polarization than plurality rule.

Part (b) of proposition 4 states that for proportional representation, an equilibrium with two centrist parties is more likely when coalitions are taken into account. Table 3A.2 shows this, since with coalitions the two candidates' positions can converge to the same position while without coalitions a polarization lower than $3 - 2\sqrt{2}$ is not sustainable.

Table 3A.2: Polarization of two party equilibria

PL	PR	PR+C
$R - L \in \left(0; \frac{2}{3}\right)$	$R - L \in \left(3 - 2\sqrt{2}; 1\right)$	$R - L \in (0; 1)$

Notes. The table shows the possible range of polarization of the two-candidate equilibria for the three electoral rules. PL (PR; PR+C) denotes plurality voting (proportional representation without coalitions; proportional representation with coalitions).

3.A.5 Proof of proposition 5

This proposition depicts the equilibria for the case for plurality voting, with office-motivated candidates. To prove the three parts of the proposition, we analyze all equilibria with up to three entrants.

Single party equilibrium with entry at position X

Any entrant that can win a majority will do so just to win the office rents.

Entry by a candidate at position X is an equilibrium if:

$$X = 0.5$$

Two party equilibrium with entry at L and R

The equilibrium has to be symmetric since otherwise one candidate loses for sure and will not enter. Therefore $R = 1 - L$. Since they both win office rents they will enter. There are three types of entrants to consider:

(a) Entry by an extremist (wlog to the left of L)

Such an entrant can never win a simple majority since player R does not lose any votes and still gets 50% of the votes. Therefore the effect of such an entrant is only that it makes party R the sole formateur. But given that she is to the left of candidate L the entrant dislikes this. Therefore this type of entrant has never an incentive to enter.

(b) Entry by a centrist voter (wlog to the left of $\frac{1}{2}$) not winning a plurality

By entering she takes away votes from L and R but given that she is closer to L this will lead to a majority for candidate R. This is not in the interest of the entrant and therefore this type of entrant will not enter.

(c) Entry by a centrist voter that does win a plurality

Any entrant that can win a plurality of the votes will enter. Given that the vote share for the center entrant $\frac{R-L}{2}$ while the vote share for candidates L and R is given by $\frac{0.5+L}{2}$ the entrant wins a plurality of the votes if $L \leq \frac{1}{6}$. This implies that if $L > \frac{1}{6}$ no entrant can benefit from entry since she will never win most votes.

Entry at positions L and 1-L is an equilibrium if:

$$\frac{1}{6} < L < \frac{1}{2}$$

Three party equilibrium with entry at L, C and R

Both extreme candidates need to tie and win a plurality of the votes since otherwise they prefer the center candidate to win which they can ensure by staying out of the race. The condition for this to be the case are:

$$(a) P_L = P_R \Leftrightarrow C + L = 2 - R - C \Rightarrow C = \frac{2-R-L}{2} \xrightarrow{L < C < R} 2 - 3R < L < \frac{2-R}{3}$$

$$(b) P_L \geq P_C \Leftrightarrow C + L > R - L \Rightarrow C \geq R - 2L \xrightarrow{\text{by (a)}} L \geq \frac{3R-2}{3}$$

There are now two cases to consider:

First, candidate C ties with the other candidates

This implies $L = \frac{2}{3} - C$, $R = \frac{4}{3} - C$ and $\frac{1}{3} \leq C \leq \frac{2}{3}$. Since all the entrants win office rents they will for sure enter. No extreme entrant wants to enter since this will result in a tie between the extreme candidate on the other side of the policy space and the center candidate which increases the expected distance to the implemented policy. An entrant that enters in the space between an extreme and the center candidate makes the extreme party on the other side of the policy space the formateur and therefore she does not want to enter.

Second, the center candidate does not win a plurality of the votes

Again the argument against entry by additional candidates from above holds. Furthermore the extreme candidates will enter for sure since they win office rents. We therefore only have to check under which conditions candidate C enters. We have three cases to consider:

- (a) If she does not enter L wins the election, which is the case for $R + L > 1$

Candidate C enters if:

$$-c - \frac{1}{2}(R - C) - \frac{1}{2}(C - L) > -(C - L) \xrightarrow{C = \frac{2-R-L}{2}} c < 1 - R - L < 0$$

- (b) If she does not enter L and R tie, which is the case for $R + L = 1$:

In this case C has no influence on the implemented policy and will therefore only enter if:

$$c < 0$$

- (c) If she does not enter R wins the election, which is the case for $R + L < 1$

Candidate C enters if:

$$-c - \frac{1}{2}(R - C) - \frac{1}{2}(C - L) > -(R - C) \xrightarrow{C = \frac{2-R-L}{2}} c < R + L - 1 < 0$$

Hence, this second case does not constitute an equilibrium.

Entry at positions L, C and R is an equilibrium if:

$$L = \frac{2}{3} - C, \frac{1}{3} \leq C \leq \frac{2}{3} \text{ and } R = \frac{4}{3} - C$$

3.A.6 Proof of proposition 6

This proposition depicts the equilibria for the case for proportional representation without coalition formation, with office-motivated candidates. To prove the three parts of the proposition, we analyze all equilibria with up to three entrants.

Single party equilibrium with entry at position X

Any entrant that can win a majority will do so just to win the office rents.

Entry by a candidate at position X is an equilibrium if:

$$X = 0.5$$

Two party equilibrium with entry at L and R

The candidate at position L enters if:

$$(a) R + L > 1$$

The entrant wins the office rents and therefore will enter for sure

$$(b) R + L = 1$$

The entrant shares office rents and therefore will enter for sure.

$$(c) R + L < 1$$

The entrant does not win the office rents and therefore only enters if the influence on the implemented policy is worth the costs of entry. This is the case if:

$$-c - \left(\frac{R+L}{2}L + \frac{2-R-L}{2}R - L \right) > -(R-L) \Leftrightarrow c < \frac{R^2 - L^2}{2}$$

The candidate at position R enters if:

$$(a) R + L > 1$$

The entrant does not win the office rents and therefore only enters if the influence on the implemented policy is worth the costs of entry. This is the case if:

$$-c - \left(R - \frac{R+L}{2}L - \frac{2-R-L}{2}R \right) > -(R-L) \Leftrightarrow c < \frac{2-R-L}{2}(R-L)$$

$$(b) R + L = 1$$

The entrant shares the office rents and therefore will enter for sure.

$$(c) R + L < 1$$

The entrant wins the office rents and therefore will enter for sure.

There cannot be any further entrants that would win a plurality of the votes since such an entrant would enter with certainty because the office rents go to the largest party..

An entrant at $X \leq L$ can win a plurality if:

$$X + L \geq R - X \text{ and } X + L \geq 2 - R - L \Leftrightarrow \max \left\{ 2 - R - 2L; \frac{R-L}{2} \right\} \leq X$$

Therefore to avoid entry we need $\max \left\{ 2 - R - 2L; \frac{R-L}{2} \right\} > L$.

An entrant at $L \leq X \leq R$ can win a plurality if:

$$R - L \geq L + X \text{ and } R - L \geq 2 - R - X \Leftrightarrow 2 - 2R + L \leq X \leq R - 2L$$

Therefore to avoid entry we need $R - L < \frac{2}{3}$.

An entrant at $X \geq R$ can win a plurality if:

$$2 - X - R \geq L + R \text{ and } 2 - X - R \geq X - L \Leftrightarrow X \leq \min \left\{ 2 - 2R - L; \frac{2-R+L}{2} \right\}$$

Therefore to avoid entry we need $R > \min \left\{ 2 - 2R - L; \frac{2-R+L}{2} \right\}$.

Next, consider entrants that do not obtain a plurality. They obtain no office rents but may be interested in affecting policies. The potential entrants with the most to gain in terms of policy are located at 0 and 1.

The entrant at position 0 stays out if:

$$-c - \left(\frac{R}{2} * 0 + \frac{2-R}{2} R - 0 \right) < - \left(\frac{R+L}{2} L + \frac{2-R-L}{2} R - 0 \right) \Leftrightarrow c > \frac{1}{2} L^2$$

The entrant at position 1 stays out if:

$$-c - \left(1 - \frac{1+L}{2} * L - \frac{1-L}{2} * 1 \right) < - \left(1 - \frac{R+L}{2} L - \frac{2-R-L}{2} R \right) \Leftrightarrow c > \frac{1}{2} (1-R)^2$$

All in all, entry at positions L and R is an equilibrium if any of the following sets of conditions holds:

- (a) $1 - L < R < \frac{3L+2}{3}; \frac{1}{6} \leq L \leq \frac{1}{3}$ and $\frac{L^2}{2} < c < \frac{2-R-L}{2} (R-L)$
- (b) $1 - L < R < 2 - 3L; \frac{1}{3} < L \leq \sqrt{2} - 1$ and $\frac{L^2}{2} < c < \frac{2-R-L}{2} (R-L)$
- (c) $1 - \sqrt{1-2L} < R < 2 - 3L; \sqrt{2} - 1 < L < \frac{4}{9}$ and $\frac{L^2}{2} < c < \frac{2-R-L}{2} (R-L)$
- (d) $R = 1 - L; \frac{1}{6} < L < \frac{1}{2}$ and $c > \frac{1}{2} L^2$
- (e) $\frac{2-L}{3} < R < \frac{3L+2}{3}; 0 \leq L \leq \frac{1}{6}$ and $(1-R)^2 < c < \frac{R^2-L^2}{2}$

$$(f) \frac{2-L}{3} < R < 1-L; \frac{1}{6} < L \leq \frac{1}{3} \text{ and } (1-R)^2 < c < \frac{R^2-L^2}{2}$$

$$(g) \frac{1+L^2}{2} < R < 1-L; \frac{1}{3} < L < \sqrt{2}-1 \text{ and } (1-R)^2 < c < \frac{R^2-L^2}{2}$$

Three party equilibrium with entry at L, C and R

Since candidate C has no impact on the implemented policy she has to win (part of) the office rents to be willing to enter. This implies:

$$R-L \geq L+C \text{ and } R-L \geq 2-R-C \Leftrightarrow 2-2R+L \leq C \leq R-2L \Rightarrow R-L \geq \frac{2}{3}$$

Candidate L enters if:

$$(a) R-L = L+C \text{ (she wins office rents) OR}$$

$$(b) -c - \left(\frac{(L+R)L + (2-L-R)R}{2} - L \right) > - \left(\frac{(C+R)C + (2-C-R)R}{2} - L \right) \Leftrightarrow c < \frac{C^2-L^2}{2} \quad (\text{the influence on the implemented policy makes entry worthwhile})$$

Candidate R enters if:

$$(a) R-L = 2-R-C \text{ (she wins office rents) OR}$$

$$(b) -c - \left(R - \frac{(L+R)L + (2-L-R)R}{2} \right) > - \left(R - \frac{(C+L)L + (2-C-L)C}{2} \right) \Leftrightarrow c < \frac{C^2-2C+2R-R^2}{2} \quad (\text{the influence on the implemented policy makes entry worthwhile})$$

There do not exist any potential entrants that can win a plurality of the votes. Therefore only entry for policy reasons needs to be considered. The largest incentives have the voters at 0 and 1.

The entrant at position 0 stays out if:

$$-c - \left(\frac{R}{2} * 0 + \frac{2-R}{2} R - 0 \right) < - \left(\frac{R+L}{2} L + \frac{2-R-L}{2} R - 0 \right) \Leftrightarrow c > \frac{1}{2} L^2$$

The entrant at position 1 stays out if:

$$-c - \left(1 - \frac{1+L}{2} * L - \frac{1-L}{2} * 1 \right) < - \left(1 - \frac{R+L}{2} L - \frac{2-R-L}{2} R \right) \Leftrightarrow c > \frac{1}{2} (1-R)^2$$

All in all, entry at positions L, C and R is an equilibrium if any of the following sets of conditions holds:

$$(a) C = \frac{2}{3} - L; R = \frac{2}{3} + L; L < \frac{1}{3} \text{ and } c > \max \left\{ \frac{1}{2} L^2; \frac{1}{2} (1-R)^2 \right\}$$

$$(b) C = R - 2L; R > \frac{2}{3} + L; L < \frac{1}{3} \text{ and } \max \left\{ \frac{1}{2} L^2; \frac{1}{2} (1-R)^2 \right\} < c < 2[L^2 - RL + L]$$

$$(c) C = 2 - 2R + L; \frac{2 - (\sqrt{2} - 1)L}{2} > R > \frac{2}{3} + L; L < \frac{2(\sqrt{2} - 1)}{3} \text{ and } \max\left\{\frac{1}{2}L^2; \frac{1}{2}(1 - R)^2\right\} < c < 2[1 - 2R + L - RL + R^2]$$

$$(d) 2 - 2R + L < C < R - 2L; R > \frac{2}{3} + L; L < \frac{1}{3} \text{ and } \max\left\{\frac{1}{2}L^2; \frac{1}{2}(1 - R)^2\right\} < c < \min\left\{\frac{C^2 - 2C + 2R - R^2}{2}; \frac{C^2 - L^2}{2}\right\}$$

3.A.7 Proof of proposition 7

This proposition depicts the equilibria for the case for proportional representation with coalition formation, with office-motivated candidates. To prove the three parts of the proposition, we analyze all equilibria with up to three entrants.

Single party equilibrium with entry at position X

The candidate at position X prefers entering over staying out since she wins the office rents. Furthermore, any entrant that can win a majority will enter to win the office rents. Therefore the only one-candidate equilibrium is the median player entering since she is the only candidate who cannot be defeated.

Two party equilibrium with entry at L and R

The equilibrium has to be symmetric since otherwise one candidate loses for sure and will not enter. Therefore $R = 1 - L$. Given that in this case both candidates receive half the office rents, they will enter.

An entrant at the extremes of the policy space can always ensure getting some of the office rents since her vote share will be strictly lower than the vote share of the candidate on her side of the policy space and therefore she would be the preferred coalition partner. Therefore only $L = 0$ could be an equilibrium. But in this case an entrant located at the center of the policy space can win a plurality of the votes, thereby guaranteeing herself a part of the office rents. Ergo, no two-candidate equilibrium exists.

Three party equilibrium with entry at L, C and R

To ensure that all candidates want to enter, no candidate can win an absolute majority since otherwise the losing candidates would prefer to stay out. This implies $L + C \leq 1$ (candidate L does not win an absolute majority) and $R + C \geq 1$ (candidate R does not win an absolute majority), which implies $L < \frac{1}{2} < R$.²⁴ The extreme candidates only enter if they are part of the coalition. The reason is that by staying out they can ensure that the center candidate wins, which leads to a policy that is preferred to the policy implemented by a coalition that she is not part of. This leaves five cases to be considered as potential equilibria:

I: The center party wins the plurality of votes and is indifferent between a center-left and center-right coalition

This is the case if:

- (a) $L + C = 2 - R - C \Leftrightarrow C = \frac{2-R-L}{2}$ (candidate L and R have the same vote shares)
- (b) $R - L > L + C \Leftrightarrow C < R - 2L \xrightarrow{\text{by (a)}} R - L > \frac{2}{3}$ (candidate C receives the most votes)

²⁴ Note, that the center candidate can never win an absolute majority.

(c) $C - L = R - C \xLeftrightarrow{\text{by (a)}} 2 - R - 3L = 3R + L - 2 \Leftrightarrow R + L = 1 \Rightarrow C = \frac{1}{2}$ (the center-left and a center-right coalitions' policies are equidistant from candidate C's position)

Given that in this situation all candidates receive office rents (in expectation), they all want to enter. Now we need to ensure that no other player wants to enter.

Let us consider an entrant located at position Y between candidates L and C. First, we can note that the entrant cannot become the formateur since her vote share is smaller than the center candidate's vote share. Therefore either candidate R or candidate C have a plurality of the votes. Candidate R will either form a coalition with C or L but never with the entrant (R and the entrant never have a majority) which always leads to a more right-wing policy than before entry. Therefore the entrant only wants to enter if the center candidate stays the formateur which happens if:

$$2 - R - C < R - Y \xLeftrightarrow{C=\frac{1}{2}; R=1-L} Y < 0.5 - 2L$$

The center party will form a coalition with the entrant if:²⁵

$$P_C + P_Y > 0.5 \Leftrightarrow R - Y + C - L > 1 \xLeftrightarrow{C=\frac{1}{2}; R=1-L} Y < 0.5 - 2L \text{ (the coalition is viable)}$$

$$C - L \leq 2 - R - C \xLeftrightarrow{C=\frac{1}{2}; R=1-L} L \geq 0 \text{ (C wants to form a coalition with the entrant)}$$

From this follows that to support the equilibrium we need that $\nexists Y \in (L; 0.5 - 2L) \Rightarrow L > \frac{1}{6}$. But $R - L > 2/3$ and $R = 1 - L$ imply that $L < \frac{1}{6}$. Therefore this is not an equilibrium.

II: The two extreme candidates are formateur

This is the case if the following conditions hold:

$$(a) L + C = 2 - R - C \Leftrightarrow C = \frac{2-R-L}{2} \xLeftrightarrow{L < C < R} 2 - 3R < L < \frac{2-R}{3} \text{ (They are tied)}$$

$$(b) L + C > R - L \Leftrightarrow C > R - 2L \xLeftrightarrow{\text{using (a)}} R - L < \frac{2}{3} \text{ (C has fewer votes)}$$

Since all candidates receive office rents they all want to enter. Now we have to make sure that no additional player wants to enter.

An entrant at position Z that is located between L and C

Candidate R will then become the sole formateur. To support this equilibrium it cannot be the case that the entrant will be part of the coalition (since then she would want to enter to get part of the office rents). The conditions for different coalitions being viable are:

²⁵ L+C only have 50% of the votes; C+R always has a majority

- R and Z: $P_Z + P_R = \frac{C-L}{2} + \frac{2-R-C}{2} > \frac{1}{2} \Leftrightarrow R + L < 1$
- R and L: $P_L + P_R = \frac{L+Z}{2} + \frac{2-R-C}{2} > \frac{1}{2} \Rightarrow Z > \frac{R-3L}{2}$
- R and C: $P_C + P_R = \frac{R-Z}{2} + \frac{2-R-C}{2} > \frac{1}{2} \Rightarrow Z < 1 - C = \frac{R+L}{2}$
- R, L and C: always larger than 50%

If a coalition between the entrant and candidate is viable it will be formed if it is the minimal-winning coalition, because this maximizes the partners' shares in the office rents. Since $\frac{R-3L}{2} < \frac{R+L}{2}$ if $Z < \frac{R-3L}{2}$ (i.e. a coalition with L is not viable) only the two-party coalitions with Z or C need to be considered.²⁶ In this case the entrant Z will be part of the coalition if $\frac{R-Z}{2} > \frac{C-L}{2} \Leftrightarrow Z < 1.5R + 1.5L - 1$. Therefore, if there exists a $Z \in \left[L; \min\left\{\frac{R-3L}{2}; \frac{3R+3L-2}{2}\right\} \right]$ and $R + L < 1$ this configuration cannot be an equilibrium. Given that such a Z always exists it is a necessary condition for the existence of the grand coalition equilibrium configuration that $R + L \geq 1$.

By the same reasoning, for an entrant at a position located between C and R we need $R + L \leq 1$. Therefore, from now on we will use $R = 1 - L$ which implies $C = \frac{1}{2}$ and $L > \frac{1}{6}$. Also, since we are now in a symmetric case without loss of generality we can restrict attention to entrants to the left of the median.

An entrant at $X < L$

Now the right-wing candidate will be a formateur and can certainly form a coalition with candidate L or C.²⁷ This also implies that a three-party coalition will never be formed since such a coalition is not minimal-winning. Therefore the entrant will be part of the coalition if:

$$P_X + P_R = L + 0.5X + 0.25 > 0.5 \text{ (it is viable)}$$

$$P_X < \min\{P_L; P_C\} \Rightarrow L + X < \min\{C - X; R - L\} \text{ (it is the preferred option)}$$

$$\Rightarrow \max\{0.5 - 2L; 0\} < X < \min\{0.25 - 0.5L; 1 - 3L; L\}$$

So to deter entry we need that such an X cannot exist. This is the case if $L < \frac{1}{6}$ or $L > \frac{1}{3}$. Since $L < \frac{1}{6}$ violates the assumption that the extreme candidates receive more votes than candidate C to support the equilibrium we need $L > \frac{1}{3}$. We also have to consider entry for policy reasons. Since a center-right coalition after entry leads to a worse (i.e. more right-

²⁶ A coalition of R and Z, if possible, is always preferred to the three-party coalition since $P_Z = \frac{0.5-L}{2} < P_L + P_C = \frac{R+L}{2}$.

²⁷ The vote shares of the different coalitions are: $P_{RX} = L + 0.5X + 0.25$, $P_{RL} = 0.5(1 + L - X) > 0.5$, $P_{RC} = 0.75 - 0.5L > 0.5$

wing) policy we only need to analyze the case where a left-right coalition will be formed (which is the case if $P_L < P_C \Leftrightarrow C - X < R - L \Rightarrow X > 2L - 0.5$).

The left-right policy is $\frac{(C-X)L+(2-R-C)R}{2-R-X} = \frac{0.5+L-LX-L^2}{1+L-X}$ which is increasing in X . We therefore evaluate it at most left-wing entry position possible since this leads to the most favorable outcome for the entrant. The policy for an entrant at $X = 2L - 0.5$ is $\frac{0.5+1.5L-3L^2}{1.5-L}$ which for $L > \frac{1}{3}$ is larger than $\frac{1}{2}$ (the expected policy without entry). Therefore no extreme candidate will enter to influence the policy.

Reconsidering an entrant at position Y between L and C .

This entrant will never be part of a two-party coalition since $P_Y + P_R = \frac{C-L+2-R-C}{2} = \frac{1}{2}$ and both a coalition with L ($P_L + P_R = \frac{C+L+2-R-C}{2} = \frac{1+L}{2}$) and C ($P_C + P_R = \frac{R-Y+2-R-C}{2} = \frac{1.5-Y}{2}$) are viable. This implies that the entrant will never receive any office rents. So the only reason for entry would be to influence the policy. If the center-right coalition forms this unambiguously moves the policy to the right. Therefore, entry might only occur if the left-right coalition will be formed, i.e. if $P_L < P_C \Leftrightarrow C + L < R - Y \Rightarrow Y < 0.5 - 2L$. But for $L > \frac{1}{3}$ it is the case that $0.5 - 2L < L$ and therefore a left-right coalition will never arise. Therefore $C = \frac{1}{2}$ and $R = 1 - L$ and $L > \frac{1}{3}$ constitute a set of equilibria.

III: All parties are tied

This happens if

$$(a) R - L = L + C \Leftrightarrow C = R - 2L \text{ (C and L are tied)}$$

$$(b) R - L = 2 - R - C \Leftrightarrow C = 2 - 2R + L \stackrel{\text{by (a)}}{\Leftrightarrow} R = \frac{2}{3} + L \Rightarrow C = \frac{2}{3} - L \text{ (C and R are tied)}$$

Since all candidates receive office rents they all want to enter. We again consider all possible types of entrants.

An entrant located at $X < L$.

She only wants to enter if she is a part of the coalition since otherwise the policy will move to the right, decreasing her payoff. Given that $P_C = P_R = \frac{1}{3}$, X is part of the coalition if $P_X = \frac{X+L}{2} > \frac{1}{6} \Rightarrow X > \frac{1}{3} - L$.²⁸ Since $X < L$ an extreme entrant that is able to join the coalition exists if $L > \frac{1}{6}$. This implies that only for $L \leq \frac{1}{6}$ can this configuration be supported as an equilibrium.

²⁸ Note, that in this case L is not a viable coalition partner since her vote share is less than $1/6$.

An entrant at $L < Y < C$

This leads to candidate R being the formateur. The different coalitions are viable if:

- R and Y: $P_Y = \frac{C-L}{2} > \frac{1}{6} \Rightarrow \frac{2}{3} - 2L > \frac{1}{3} \Rightarrow L < \frac{1}{6}$.
- R and L: $P_L = \frac{L+Y}{2} > \frac{1}{6} \Rightarrow Y > \frac{1}{3} - L$
- R and C if $P_C = \frac{R-Y}{2} > \frac{1}{6} \Rightarrow Y < \frac{1}{3} + L$.

Since for $L < \frac{1}{6}$ it is the case that $\frac{1}{3} + L < C = \frac{2}{3} - L$ there exist entrants such that for R only a coalition with L or Y is feasible. In this case to support the equilibrium we need that candidate L receives fewer votes than the entrant. This is the case if $C - L > L + Y \Rightarrow Y < \frac{2}{3} - 3L$. But $\exists Y \in \left[\max \left\{ \frac{1}{3} + L; \frac{2}{3} - 3L \right\}; \frac{2}{3} - L \right]$ (i.e. entrants that make only a coalition with the entrant or candidate L feasible and that are preferred to candidate L) and therefore we need $L \geq \frac{1}{6}$ (i.e. the moderate entrant is not a viable coalition partner) to support this equilibrium configuration. This only leaves the case where $L = \frac{1}{6}$ (which results in the perfectly symmetric situation) as an equilibrium candidate.

Again consider an entrant located at $X < L$. We established above that she will not enter to be part of a coalition, but we still need to confirm that she will not enter for policy reasons. Her entrance would move the policy to the right, however decreasing her payoff. The reason is that both candidate C and R will form a coalition with candidate L independently of the entrant's decision but if she enters this reduces candidate L's bargaining power and therefore the policy will move to the right.

Finally, consider an entrant at $\frac{1}{6} < Z < \frac{1}{2}$ which earns a vote share of $\frac{1}{6}$. Given that both L and C earn a vote share larger than $\frac{1}{6}$ also this type of entrant does not want to enter since she will not become a part of the coalition.

Therefore the perfectly symmetric situation constitutes an equilibrium.

IV: One extreme candidate (wlog candidate L) and the center candidate are formateur

This happens if:

- $L + C = R - L \Leftrightarrow C = R - 2L$ (L and C are tied)
- $R - L > 2 - R - C \Leftrightarrow C > 2 - 2R + L \stackrel{\text{by (a)}}{\Leftrightarrow} R - L > \frac{2}{3}$ (R has least votes)

Since all candidates receive office rents they all want to enter. We now analyze all potential entrants.

An entrant at $X < L$

A necessary condition for the entrant becoming candidate C's coalition partner is $\frac{R-L}{2} + \frac{L+X}{2} > \frac{1}{2} \Leftrightarrow X > 1 - R$ (which makes sure that she is a viable partner). Furthermore, it has

to be the case that $P_X < P_R \Leftrightarrow L + X < 2 - R - C \xleftrightarrow{C=R-2L} X < 2 - 2R + L$ (X is preferred over R).²⁹

Additionally, candidate L can form a coalition with candidate C if

$$P_L + P_C > \frac{1}{2} \Leftrightarrow R - L + C - X > 1 \xleftrightarrow{C=R-2L} 2R - 3L - X > 1 \Leftrightarrow X < 2R - 3L - 1$$

Should candidate L and the entrant both be a viable partners, the entrant becomes part of the coalition if:

$$P_X < P_L \Leftrightarrow L + X < C - X \Leftrightarrow X < \frac{C - L}{2} \xleftrightarrow{C=R-2L} X < \frac{R - 3L}{2}$$

This implies that for this situation to be an equilibrium we need that neither of the following conditions is satisfied:

- $1 - R < X < \min\left\{\frac{R-3L}{2}; 2 - 2R + L; L\right\}$ (L is a viable partner)
- $\max\{1 - R; 2R - 3L - 1\} < X < \min\{2 - 2R + L; L\}$ (L not viable)

It turns out these conditions can both be satisfied and therefore this situation is not an equilibrium.

V: One extreme candidate (wlog candidate L) is formateur and forms coalition with R

This happens if:

- (a) $1 \geq L + C > R - L \Leftrightarrow 1 - L \geq C > R - 2L$ (L has plurality of votes)
- (b) $R - L > 2 - R - C \Leftrightarrow C > 2 - 2R + L \xrightarrow{\text{by (a)}} R \geq \max\left\{0.5 + L; \frac{L+2}{3}\right\}$ (R is preferred)

Again we consider all possible entrants.

An entrant at $X > R$

She receive a vote share $P_X = \frac{2-X-R}{2}$ and therefore a two-party coalition with X is feasible if $P_X + P_L \geq \frac{1}{2} \Leftrightarrow X < 1 + C + L - R$. If furthermore $P_R + P_L \leq \frac{1}{2} \Leftrightarrow X \leq 1 - L$ (i.e. the left-right coalition is not viable) this coalition will be formed for certain.

Since $1 - L < 1 + C + L - R$ is implied by $C > R - 2L$ there are three cases to considered.

- $X < 1 - L$: The entrant is a viable coalition partner but candidate R is not. Since the entrant is preferred over a coalition with the (larger) center partner the entrant will enter.

²⁹ Since neither candidate C nor R loses votes, the center-right coalition is always viable.

- $1 - L < X < 1 + C + L - R$: Both the entrant and the right-wing candidate are viable coalition partners. If $P_X < P_R \Leftrightarrow 2 - X - R < X - C \Rightarrow X > \frac{2-R+C}{2}$ the entrant will be in the coalition. Since $C > R - 2L$ we have that $1 + C + L - R > \frac{2-R+C}{2}$ and therefore there always exists an entrant that wants to enter.
- $X > 1 + C + L - R$: Neither a two-party coalition with the entrant nor with candidate R is viable. But since the entrant and the right-wing candidate have the same combined vote share as candidate R had before the entry a three-party coalition with the entrant and candidate R will be formed. Therefore the entrant wants to enter.

Since there always exists an extreme entrant that will be part of the coalition this situation cannot be an equilibrium.

Conclusion

Entry at positions L , C and R is an equilibrium if:

(a) $L = \frac{1}{6}$, $C = \frac{1}{2}$ and $R = \frac{5}{6}$ OR

(b) $L > \frac{1}{3}$, $C = \frac{1}{2}$ and $R = 1 - L$

3.A.8 Proof of proposition 8

Table 3A.3 shows the equilibria under the different electoral rules for the case of purely office-motivated candidates.³⁰

Table 3A.3: Equilibria for purely office-motivated candidates

	PL	PR	PR+C
One-candidate equilibrium		$X = \frac{1}{2}$	
Two-candidate equilibrium	$R = 1 - L$ and $\frac{1}{6} < L < \frac{1}{2}$	$1 - L < R < \frac{3L+2}{3}$ and $\frac{1}{6} \leq L \leq \frac{1}{3}$ and $\frac{L^2}{2} < c < \frac{2-R-L}{2}(R-L)$ OR $1 - L < R < 2 - 3L$ and $\frac{1}{3} < L \leq \sqrt{2} - 1$ and $\frac{L^2}{2} < c < \frac{2-R-L}{2}(R-L)$ OR $1 - \sqrt{1-2L} < R < 2 - 3L$ and $\sqrt{2} - 1 < L < \frac{4}{9}$ and $\frac{L^2}{2} < c < \frac{2-R-L}{2}(R-L)$ OR $R = 1 - L$ and $\frac{1}{6} < L < \frac{1}{2}$ and $c > \frac{1}{2}L^2$ OR $\frac{2-L}{3} < R < \frac{3L+2}{3}$ and $0 \leq L \leq \frac{1}{6}$ and $(1-R)^2 < c < \frac{R^2-L^2}{2}$ OR $\frac{2-L}{3} < R < 1 - L$ and $\frac{1}{6} < L \leq \frac{1}{3}$ and $(1-R)^2 < c < \frac{R^2-L^2}{2}$ OR $\frac{1+L^2}{2} < R < 1 - L$ and $\frac{1}{3} < L < \sqrt{2} - 1$ and $(1-R)^2 < c < \frac{R^2-L^2}{2}$	Does not exist

³⁰ The equilibria for proportional representation without coalitions and plurality voting are derived in appendix B.

<p>Three-candidate equilibrium</p>	$L = \frac{2}{3} - C \text{ and}$ $\frac{1}{3} < C < \frac{2}{3} \text{ and}$ $R = \frac{4}{3} - C$	$C = \frac{2}{3} - L \text{ and}$ $R = \frac{2}{3} + L; L < \frac{1}{3} \text{ and}$ $c > \max\left\{\frac{1}{2}L^2; \frac{1}{2}(1-R)^2\right\}$ <p style="text-align: center;">OR</p> $C = R - 2L \text{ and}$ $R > \frac{2}{3} + L \text{ and}$ $L < \frac{1}{3} \text{ and}$ $\max\left\{\frac{1}{2}L^2; \frac{1}{2}(1-R)^2\right\}$ $< c < 2[L^2 - RL + L]$ <p style="text-align: center;">OR</p> $C = 2 - 2R + L \text{ and}$ $1 - \frac{(\sqrt{2}-1)L}{2} > R > \frac{2}{3} + L \text{ and}$ $L < \frac{2\sqrt{2}-2}{3} \text{ and}$ $\max\left\{\frac{1}{2}L^2; \frac{1}{2}(1-R)^2\right\} < c$ $< 2[1 - 2R + L - RL + R^2]$ <p style="text-align: center;">OR</p> $2 - 2R + L < C < R - 2L \text{ and}$ $R > \frac{2}{3} + L \text{ and}$ $L < \frac{1}{3} \text{ and}$ $\max\left\{\frac{1}{2}L^2; \frac{1}{2}(1-R)^2\right\} < c$ $< \min\left\{\frac{C^2 - 2C + 2R - R^2}{2}; \frac{C^2 - L^2}{2}\right\}$	$L = \frac{1}{6} \text{ and}$ $C = \frac{1}{2}$ <p style="text-align: center;">and $R = \frac{5}{6}$</p> <p style="text-align: center;">OR</p> $L > \frac{1}{3} \text{ and}$ $C = \frac{1}{2} \text{ and}$ $R = 1 - L$
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Notes. The table shows the equilibria for the three electoral rules. PL (PR; PR+C) denotes plurality voting (proportional representation without coalitions; proportional representation with coalitions). L, R, C and X denotes the candidates' positions in the policy space and c denotes the costs of entry.

Part (a) of proposition 8 states that under proportional representation with coalitions equilibria are more likely to involve multiple candidates. This can be seen from table 3A.3 since equilibria with two candidates exist for plurality voting and proportional representation without coalitions but not for proportional representation with coalitions. This implies that if the equilibrium involves more than one candidate, (note that such equilibria are the same for all electoral rules), the equilibrium with coalitions has at least three candidates while this is not the case for the other two rules.

Parts (b) of the proposition is concerned with the polarization of candidate positions. I again define the polarization of the equilibria as the distance between the left- and right-wing candidate's position, i.e. $R - L$. Table 3A.4 shows the possible range of polarization for the different electoral rules and types of equilibria.

From the table we see that proportional representation with coalitions leads to least polarized three candidate equilibria since polarization is at most $\frac{2}{3}$ while under plurality voting it is exactly $\frac{2}{3}$ and for proportional representation without coalitions it is at least $\frac{2}{3}$. This proves part (b) of the proposition.

Table 3A.4: Polarization of equilibria

	PL	PR	PR+C
Two-candidate equilibrium	$R - L \in \left(0; \frac{2}{3}\right)$	$R - L \in \left(0; \frac{2}{3}\right)$	Does not exist
Three-candidate equilibrium	$R - L = \frac{2}{3}$	$R - L \in \left(\frac{2}{3}; 1\right)$	$R - L \in \left(0; \frac{1}{3}\right) \cup \left\{\frac{2}{3}\right\}$

Notes. The table shows the possible range of polarization of two-candidate equilibria for the three electoral rules. PL (PR; PR+C) denotes plurality voting (proportional representation without coalitions; proportional representation with coalitions).

Chapter 4

Plurality Voting versus Proportional Representation in the Citizen-Candidate Model: An Experiment¹

4.1 Introduction

How do political institutions influence political outcomes and the resulting policies? This question has received a lot of attention in both political science and economics and led to much theoretical and empirical investigation of this question. A particular focus in this literature lies on understanding the differences in political outcomes between proportional representation and plurality (or first-past-the-post) voting. Whereas the previous chapter addressed this issue theoretically, this chapter will look for empirical evidence of the effects of these institutions.

While observational data have greatly improved our understanding of the effect of electoral institutions on political behavior it is very hard to isolate clear causal relationships with observational data since electoral rules are not randomly assigned but are the result of the specific country characteristics that most likely also have a direct effect on outcomes. Furthermore, when testing theoretical predictions it is often necessary to know the values of the underlying model parameters in order to be able to derive a clear theoretical benchmark. This often makes it hard to properly test the performance of a model with field data.

Laboratory experiments do not suffer from these challenges to the identification of causal effects since the researcher controls all relevant parameters of the political system, which enables a true *ceteris paribus* variation of the electoral rule and allows for a clear benchmark when testing a model. These advantages of the experimental method have led to a sharp increase in the use of experiments in political science (Druckman et al., 2006) and the political economy literature (Palfrey, 2012). For instance, the conventional wisdom that proportional representation leads to higher turnout than a first-past-the-post system has been studied extensively in the lab (Blais et al. 2014, Herrera et al. 2014, Kartal 2014, Labbé St-Vincent 2014 and Schram and Sonnemans 1996b). The results seem to confirm

¹ This chapter is based on Kamm (2014).

the theoretical prediction that proportional representation increases turnout only when the election is not close.

A question that has been explored much less in the experimental literature is how electoral institutions influence candidate behavior. This chapter contributes to this literature by implementing the citizen-candidate paradigm in a controlled laboratory experiment, which makes it possible to simultaneously study a candidate's entry decision and the resulting polarization of policy positions. To this aim I vary in the experiment the electoral rule and compare proportional representation to plurality voting. Additionally, I replicate two previous experiments (Cadigan 2005 and Elbittar and Gomberg 2008) by varying the costs of running for office.

The results from the experiment show the theoretically predicted differences between plurality voting and proportional representation. Proportional representation leads to more entry than plurality if the costs of running for office are low but for high costs there is no difference in entry behavior. This implies that more entry under proportional representation is an equilibrium phenomenon and not just due to some heuristic. If it were based on a heuristic (such as entering to influence the policy, without regard for payoffs) then the difference would appear independent of costs. Furthermore, as expected, an increase in the costs of running for office reduces the number of entrants. Overall the comparative statics predictions for the experiment are therefore confirmed. Nevertheless, entry rates are across the board higher than predicted.

The remainder of the paper is structured as follows. First, in the next section I present the citizen-candidate model and introduce the experimental design and the hypothesis. Next, section 4.3 presents the experimental results and section 4.4 concludes and discusses some avenues for possible future work.

4.2 Experimental design

4.2.1 The general set-up

The citizen-candidate model (Besley and Coate 1997 and Osborne and Slivinsky 1996) is based on the spatial approach of modeling politics.² An electorate of citizens is distributed over a policy space where each citizen is described by her ideal point (i.e. position) in the policy space. The defining feature of the model –from which it derives its name– is that each citizen can run for office by paying a cost c . After simultaneous decisions on whether to run for office, all the candidates and their positions in the policy space are announced and an election takes place. This election determines a policy x^* that will be implemented as well as the allocation of office rents, denoted by b .³

The utility for a citizen with ideal point x_i is assumed to take the following form

² For a more detailed discussion of the citizen-candidate paradigm, see chapter 3.

³ As in chapter 3, one can, think of these office rents as compensation for government work or perks from office but also as an improvement in opportunities upon leaving office.

$$U = -f(|x^* - x_i|) + b * W - c * R,$$

where $f \geq 0$; $f' > 0$; W is a dummy variable that is equal to 1 if the candidate secures the office rents and R is a dummy variable that is equal to 1 if the candidate runs for election.

For the experiment the model has to be somewhat simplified since I cannot implement the infinite number of potential candidates implied by a continuous distribution of citizens. Instead I choose five fixed positions with one potential candidate each as shown in Figure 4.1. Furthermore, there is a continuum of uniformly distributed voters whose voting behavior is automated in the experiment since the focus is on candidate behavior. I assume voters vote sincerely for the candidate located closest to their positions.

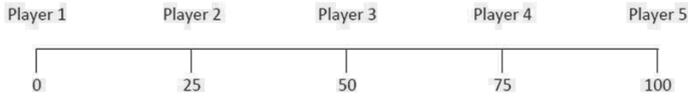


Figure 4.1: The players' positions

Notes. The figure shows the positions of the potential candidates.

The subject's payoff function is given by:⁴

$$100 - |x^* - x_i| + b \text{ (if winning the office rents)} - c \text{ (if running for office),}$$

where x^* denotes the policy implemented after the election, x_i is the subjects position in the policy space, b are the office rents and c are the costs of running for office. The constant is used to make losses unlikely so that I do not need to worry about loss aversion.

In the experiment I compare plurality voting and proportional representation. Under plurality voting the position of the candidate that receives the most votes is the implemented policy and this candidate receives all the office rents (ties are broken randomly). For modeling proportional representation I follow Hamlin and Hjortlund (2000) and assume that the implemented policy is the vote-weighted average of the candidates' positions. The office rents are awarded to the candidate that receives the most votes (ties are broken randomly).⁵ Should nobody enter, in both cases one candidate will randomly be chosen, whose position will be implemented as the policy. This candidate receives no office rents.

4.2.2 Treatments

The experiment consists of four between-subject treatments that are organized in a two-by-two structure as shown in Table 4.1. On the first dimension the costs of running for office

⁴ This implies that parties are not Downsian, i.e. completely office-motivated. For an experiment that uses purely office-motivated candidates see Bol et al. (2014).

⁵ This is obviously a stark simplification for the intricacies of proportional representation. See chapter 3 for a model that takes the coalition formation associated with proportional representation into account. I leave an experimental application of the model with coalition formation for future research.

are either low (8 points) or high (40 points). In the second dimension the voting rule is either plurality voting or proportional representation. The office rents b are 25 points and are awarded to the candidate that receives the most votes (ties broken randomly).

Varying the electoral rule enables me to investigate whether there is a difference in entry behavior when comparing proportional representation and plurality. Varying the cost of running for office achieves two things. First, it enables me to test the internal logic of the citizen-candidate model, i.e. whether a change in the parameters leads to the predicted change in behavior, and whether the performance of the model is different for distinct electoral rules. Second, it makes it possible to see whether a difference in entry behavior between the two electoral rules interacts with the costs of entry. This interaction is predicted for the parameters chosen, as discussed below. This can shed light on the question whether a difference in behavior is an equilibrium phenomenon or due to some non-equilibrium heuristic employed by the subjects. For instance, I expect higher entry under proportional representation only for low costs (see hypothesis (c) below). Should I observe higher entry for both costs levels this would suggest that the difference in entry is due a heuristic, f.i. entering to influence the policy, without regard for payoffs.

Table 4.1: Treatments

	Plurality	Proportional Representation
Low cost ($c=8$)	PL-low N=12	PR-low N=11
High cost ($c=40$)	PL-high N=12	PR-high N=12

Notes. Cell entries give the treatment acronym used throughout this paper, the number of independent observations ($N=\#$ groups) and the symmetric pure-strategy Nash equilibria (EQ) for each treatment.

4.2.3 Hypothesis

These treatments give rise to the Nash equilibrium predictions shown in Table 4.2 (I focus on symmetric Nash equilibria in pure strategies).⁶ Because three cells show multiple equilibria, I use a refinement based on the Quantal Response Equilibrium (QRE; McKelvey and Palfrey 1995). This refinement selects the Nash equilibrium to which the principal branch of the so-called multinomial logit correspondence converges.⁷ The predictions based on this refinement are indicated with an asterisk in Table 4.2 and imply three main treatment effects:

⁶ The reason for focusing on symmetric equilibria is that coordination on asymmetric equilibria is difficult given that positions are reassigned every round. Furthermore, only in treatment 3 (low costs and proportional representation) do asymmetric pure strategy equilibria exist where players 1, 3 and 4 or 2, 3 and 5 enter. In the experiment no group coordinated on this equilibrium. Equilibria were computed using Gambit 13.1.2, McKelvey et al. 2014.

⁷ QRE is a noisy best-response concept that has a better track record than Nash in explaining binary choice data in experiments (see Goeree and Holt, 2004). The principal branch is computed using Gambit (see fn. 6)

- (a) Cost effect: An increase in the costs of running for office leads to fewer players entering and less polarized entrants.
- (b) System effect: Under proportional representation (weakly) more players enter than under plurality voting.
- (c) Interaction effect: When costs are high the difference in entry between proportional representation and plurality voting is smaller than when costs are low.

These hypothesis follow straightforwardly from Table 4.2. Aside from these comparative statics predictions I will also investigate whether the subjects behave in line with the Nash equilibrium predictions and (in case of multiplicity) which of the equilibria are selected in the lab.

Table 4.2: Equilibrium predictions

	Plurality	Proportional Representation
Low cost ($c=8$)	50* OR 25 and 75	25 and 75* OR 0, 50 and 100
High cost ($c=40$)	50	50* OR 0 and 100

Notes. Cell entries give the symmetric pure-strategy Nash equilibria for each treatment. ‘*’ indicates the equilibrium selected by the principal branch of the QRE.

4.2.4 Experimental protocol

The experiment was conducted at the CREED laboratory at the University of Amsterdam in February 2014 and implemented using php/mysql.⁸ Participants were recruited using CREED’s subject database. In each of eight sessions, 25 or 30 subjects participated. Most of the 235 subjects in the experiment were undergraduate students of various disciplines.⁹ Earnings in the experiment are in ‘points’, which are converted to euros at the end of the experiment at an exchange rate of 100 points = 1€. The experiment lasted on average 75 minutes and the average earnings were 19€ (including a 7€ show-up fee).

After all subjects have arrived at the laboratory, they are randomly assigned to one of the computers. Once everyone is seated they are shown the instructions on their screen. After everyone has read these and the experimenter has privately answered questions, a summary of the instructions is distributed. This summary also contains a table that for all possible combination of entry decisions specifies what vote share each candidate receives and which policy will be implemented. Then, all subjects have to answer quiz questions that

⁸ For screenshots of the interface as well as the text of the instructions and the summary handout, see appendix 4.A.

⁹ 149 of the 233 participants that gave information on their field of study were students in business or economics.

test their understanding of the instructions. After everyone has successfully finished this quiz, the experiment starts. At the end of the session, all subjects answer a short questionnaire and are subsequently privately paid their earnings.

In each session the subjects participate in fifteen rounds of play and have to decide whether to run for office or not.¹⁰ Given the multiplicity of equilibria, learning and coordination are very important. To facilitate this, subjects stay in the same group of five subjects throughout the whole session (partners matching). Positions do change, however; in each round it is randomly determined which subject is located at which position in the policy space, i.e., positions are reallocated in each round.

The specific task in each round is presented as follows: subjects are informed about their position in the policy space. In all treatments I give the subjects the option to see the complete history in which they took part by clicking on a button.¹¹ Hence, they can see what they did in the past for different positions, what the other players' entry decision were and what the resulting implemented policy was. Furthermore, I provide them with a payoff calculator such that they can compute the payoffs they would get from different decisions by them and the other players, given their position in the current round.

After everyone has decided whether to enter, the computer casts the votes (according to a uniform distribution) and shows each subject the entry decision by all players, what vote share each candidate received, what policy is implemented, who received the office rents, and the payoff from the current round as well as the accumulated payoffs from past rounds.

4.3 Results

I start with presenting results for each treatment separately to investigate the degree to which the Nash equilibrium predictions are supported and, in case of multiple equilibria, which equilibrium was selected. Subsequently, I turn to the comparative statics predictions. An analysis of subject behavior at the individual level concludes the discussion of the results.

4.3.1 Within treatment analysis

Plurality voting with low costs

The theoretical prediction is that either only player 3 (the median player) enters (this is the equilibrium selected by the QRE refinement) or that the moderate players 2 and 4 enter. Figure 4.2 depicts per group the fraction of times that each position entered. This clearly shows that the one-candidate equilibrium is not selected (there are many entrants at other positions). Instead the moderate players have the highest entry rates. Using a Wilcoxon rank-sum test with the group average as unit of observation I find that the moderates have significantly higher entry rates than the median player ($p < 0.01$) and the median player has

¹⁰ I decided to not use a neutral frame but talk about 'candidates' and 'entry' to make it easier for subjects to understand the task.

¹¹ Subjects did not use this option very much. Overall, subjects only checked the history in 5% of the rounds.

a significantly higher entry rate than the extreme players ($p < 0.01$).¹² Figure 4.2 also clearly shows that the two-candidate equilibrium is not perfectly attained since the median player still enters quite often. In fact only 37% of the rounds (50% in the last 5 rounds) correspond perfectly to the two-candidate equilibrium (the one-candidate equilibrium is never observed). The likely reason for this over-entry by the median player is that given the low costs of entry the median player enters in the hope that one of the moderates will not enter which would make the median player the winner of the election (this only works in 5% of the elections).

The difference between the entry rates for all rounds and for the last five rounds indicates some learning. A Wilcoxon signed-rank test reveals that the median player is significantly less likely to enter in the last five rounds compared to the first five rounds ($p < 0.01$).¹³ Therefore behavior converges over time towards the two-candidate equilibrium.

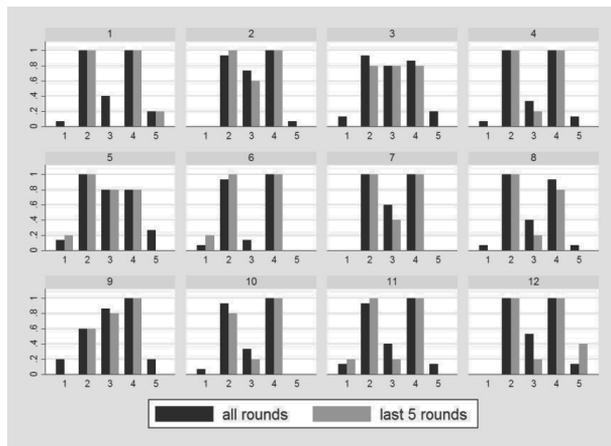


Figure 4.2: Entry under plurality voting with low costs

Notes. The figure shows the average entry rates by position (1 is position 0, 2 is position 25, 3 is position 50, 4 is position 75 and 5 is position 100) and group.

Regarding the election outcomes, I find that in 95% of the elections, one of the moderate candidates wins the election while in the remaining cases the median player does.¹⁴ This leads to an average policy of 49.0 and an expected distance of the policy to the median's preferences of 23.8 (very close to 25 predicted for the two-candidate equilibrium). Therefore, the election outcomes are in line with the Nash equilibria both in terms of the

¹² This result (as well as all other results for the within treatment analysis if not stated otherwise) are also significant at the 5%-level when restricting attention to the last five rounds (allowing for learning in earlier rounds).

¹³ For the extreme ($p=0.12$) and moderate ($p=0.62$) players no significant difference between entry rates in the first five and last five rounds is detected.

¹⁴ Given that for a risk-neutral player at the median position entry is only worthwhile if she wins more than 32% of the elections, the observed over-entry by the median player is not a best-response to the behavior observed in the experiment.

winner of the election and the policy outcomes, but do not support the equilibrium selected by the QRE refinement.

Plurality voting with high costs

For this parameter configuration the unique pure strategy equilibrium is for only the median player to enter. Figure 4.3 shows that this is predominantly the outcome for four of the nine groups (1,3,8 and 10). In three more groups (7, 9, 11) the median player has the highest entry rate. Nevertheless, behavior is quite heterogeneous across groups. Overall a Wilcoxon rank-sum test with the average per group as the unit of analysis shows that the median player has a significantly higher entry rate than the moderate players ($p=0.03$) and the extreme players have a significantly lower entry rate than the moderate players ($p<0.01$).

Again, behavior does not perfectly correspond to the prediction since only in 27% (for the last 5 rounds 36%) of the rounds the median player is the sole entrant.¹⁵ The reason for the deviation is that the moderates enter quite often. This could be attributed to a ‘joy of winning’. Given that the extreme players rarely enter, an entering moderate will win the election regularly (37%, see below), which might lead players to enter even though for the high entry costs it would be better to stay out and let the median player reap the office rents.

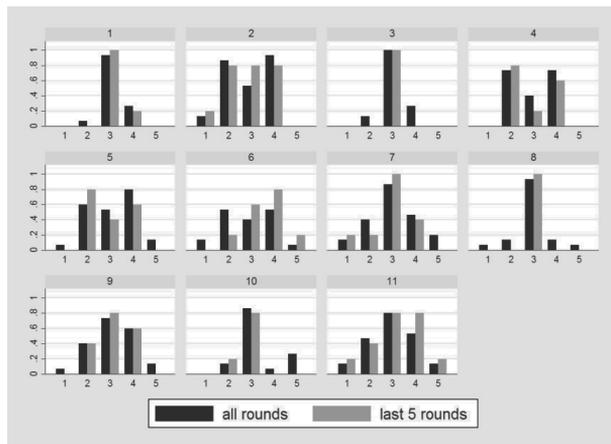


Figure 4.3: Entry under plurality voting with high costs

Notes. The figure shows the average entry rates by position (1 is position 0, 2 is position 25, 3 is position 50, 4 is position 75 and 5 is position 100) and group.

Regarding the election outcomes, I find that the average implemented policy is 51.1 and the observed distance to the median player’s position is 10.3. While the average policy is therefore close to the predicted value, its variance is larger than predicted. Furthermore, I

¹⁵ In this treatment no significant learning seems to occur since the entry rates do not significantly differ between the first five and last five rounds. The p-values of the Wilcoxon signed-rank test are $p=0.13$ for the extreme players, $p=0.14$ for the moderate players and $p=0.59$ for the median.

find that the median player wins only 59% of the elections (where the only symmetric pure strategy Nash equilibrium predicts that she will win all elections). In almost all of the remaining elections (37%) a moderate candidate wins.

Proportional representation with low costs

For this treatment the QRE refinement predicts a two-candidate equilibrium with the moderate players entering and the other Nash equilibrium consists of a three-candidate equilibrium where the extremes and the median player enter.¹⁶ Inspecting Figure 4.4 shows no support for the three-candidate equilibrium since in aggregate the extremes enter less than half the time. At the same time there is some (albeit quite weak) evidence for the two-candidate equilibrium since two groups (6 and 10) exhibit high entry rates by the moderates and low entry rates by the other players. In most other groups both the median and the moderate players enter frequently with the extremes having lower entry rates. A Wilcoxon rank-sum test shows that the moderates have significantly higher entry rates than the median player ($p < 0.01$) which is in line with the structure of the two candidate equilibrium. Overall 15% (for the last 5 rounds 27%) of the rounds exhibit entry by only the moderate players. The reason for this low rate of equilibrium play is the substantial entry by the median player. It is difficult to rationalize this behavior since the moderates have entry rates close to 100% which implies that the median player will not win the office rents and she has no influence on the implemented policy.

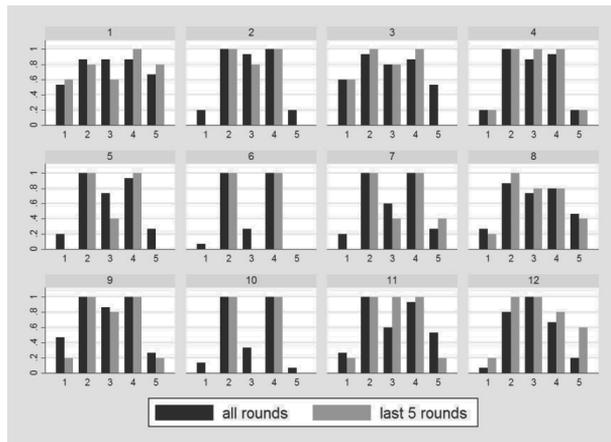


Figure 4.4: Entry under proportional representation with low costs

Notes. The figure shows the average entry rates by position (1 is position 0, 2 is position 25, 3 is position 50, 4 is position 75 and 5 is position 100) and group.

Analyzing learning over time by comparing behavior in the first five and last five rounds using a Wilcoxon signed-rank test shows that the extreme players significantly reduce their entry rates over time ($p = 0.01$) and that the median player enters weakly significantly ($p = 0.09$) less often in later rounds while the moderates significantly increase their entry

¹⁶ There are also two asymmetric equilibria where either players 1, 3 and 4 or players 2, 3, and 5 enter.

rates ($p=0.04$). These findings taken together imply that behavior may be converging towards the two-candidate equilibrium.

The election outcomes are broadly in line with the equilibrium selected by the QRE refinement since a moderate wins 86% of the elections while the median only wins 13% of the elections.¹⁷ Furthermore, the mean policy of 50.0 and the very low variance with a mean distance between the policy and the median of 2.0 are also in line with the theoretical prediction.

Proportional representation with high costs

In this treatment two pure strategy Nash equilibria exist. In the one selected by the refinement, only the median enters while in the other the two extreme players enter. Figure 4.5 clearly shows that the polarized equilibrium is not selected and five of the twelve groups (1,2,3,5,6,12) converge to a situation where the median player has the highest entry rates. Overall the entry rates of the median player are significantly higher than of the moderates ($p=0.04$) but in the last five rounds this difference is only weakly significant ($p=0.09$). In 25% of the rounds (30% for the last 5 rounds) behavior corresponds to the one-candidate equilibrium and most of the off-equilibrium behavior is due to very low entry rates across the board which might be due to the high entry costs combined with the complexity of the situation.

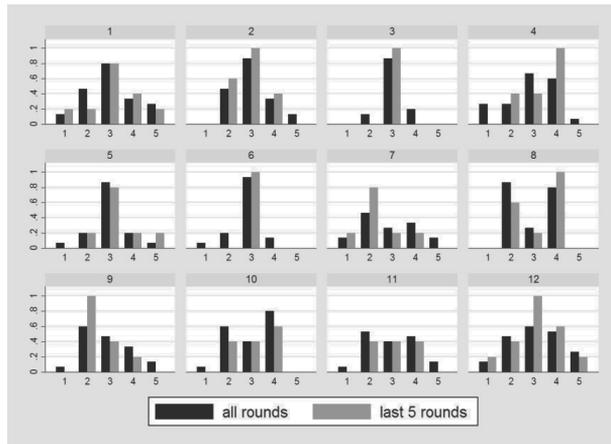


Figure 4.5: Entry under proportional representation with high costs

Notes. The figure shows the average entry rates by position (1 is position 0, 2 is position 25, 3 is position 50, 4 is position 75 and 5 is position 100) and group.

Investigating behavior over time I find that the moderates and the median players do not significantly change their behavior going from the first five to the last five rounds ($p=0.17$ for moderates and $p=0.84$ for the median player) while the extreme players reduce their

¹⁷ This winning rate is clearly below the cut-off of winning 32% of the elections that would make entry beneficial for a median player.

entry rates over time ($p=0.02$). The average policy of 49.4 is in line with the Nash equilibrium but the observed distance between implemented policy and the median is 9.4 which is larger than predicted. Furthermore the median player wins only 52% of the elections while a moderate player wins 42% of the elections.

Overall picture

Combining the results across treatments yields two conclusions. First, over time behavior converges towards equilibrium, which is an indication of learning. This is not necessarily the equilibrium selected by the refinement, however. Second, entry rates are substantially higher than theoretically predicted. This is a common finding in experiments on entry decisions, such as market entry games (Fischbacher and Thöni, 2008) or contest games (Cason et al., 2010), and was also found in previous experiments on the citizen-candidate model in a first-past-the-post setting (Cadigan, 2004, Elbittar and Gomberg, 2008).¹⁸ It is not my aim in this chapter to explain over entry per se. Instead, I now turn to the treatment effects observed in my data.

4.3.2 Comparative statics across treatments

The cost effect (hypothesis a) predicts that entry rates with high costs are lower than with low costs. Table 4.3 shows that this is the case in the experiment and a Wilcoxon rank-sum test shows that this difference is highly significant ($p<0.01$).¹⁹ The second part of the hypothesis predicts more polarized outcomes for low costs. Table 4.3 shows that this is indeed the case with the difference being significant using a Wilcoxon rank-sum test (p -value=0.01 for both proportional representation and plurality). Next, the system effect (hypothesis b) predicts that proportional representation leads to (weakly) higher entry while the interaction effect (hypothesis c) posits that the effect is positive for low costs and zero for high costs. Both predictions are supported since there is a significant difference for low costs ($p<0.01$) and no significant difference for high costs ($p=0.39$).²⁰

Table 4.3: Average number and polarization of entrants by treatment

	aver. number of entrants		Polarization	
	All rounds	Last 5 rounds	All rounds	Last 5 rounds
PL-low	2.6	2.4	22.0	22.5
PL-high	1.8	1.6	14.6	11.9
PR-low	3.2	3.0	23.3	23.0
PR-high	1.7	1.6	16.4	14.4

Notes. This table shows average number of entrants and their polarization across treatments. Polarization is defined as the average distance of an entrant's positions to the median voter's location.

¹⁸ The two most prominent explanations for this finding of over entry are risk attitudes and joy of winning. I did not measure risk-attitudes in this experiment but given that in treatment 3 (PR-low) the median player enters even though the entry rates of the moderates are close to 100%, risk cannot be the whole story (which is in line with Fischbacher and Thöni (2008) who find that risk-attitudes do not predict individual behavior in their market-entry experiment).

¹⁹ This reproduces the finding in Cadigan (2004) who also found less entry for higher costs of entry.

²⁰ There is no significant difference in the polarization of entry across electoral rules for either cost level.

The Nash equilibria predict for the distinct positions that increasing the entry costs under plurality rule has no effect on the extremes' entry decisions (since their entry is not part of the equilibrium under either cost of entry), it decreases the entry by moderates (since with high costs their entry is off-equilibrium) and it increases the entry for the median player (since with high costs her entering is the unique equilibrium). All three predictions are confirmed since the p-values are 0.41 for the extremes, $p < 0.01$ for the moderates and $p = 0.04$ for the median.

In equilibrium, increasing costs under proportional representation should decrease the entry for the moderates since their entry is not part of an equilibrium with high costs. I expect no effect for the extremes since the equilibrium in the high cost case where they would enter is quite unstable (and not selected by the refinement). For the median I would then expect more entry under high costs since the others are entering less. While for the moderates ($p < 0.01$) the expectations are confirmed for the extremes and for the median I do not find the predicted effect. For the extremes I find a significant reduction in entry ($p < 0.01$) when costs increase and for the median the sign of the effect is opposite to the prediction, though the effect is insignificant ($p = 0.37$). A reason might be that there is a general tendency to reduce entry when costs increase and this dominates the effect of the change in equilibrium.

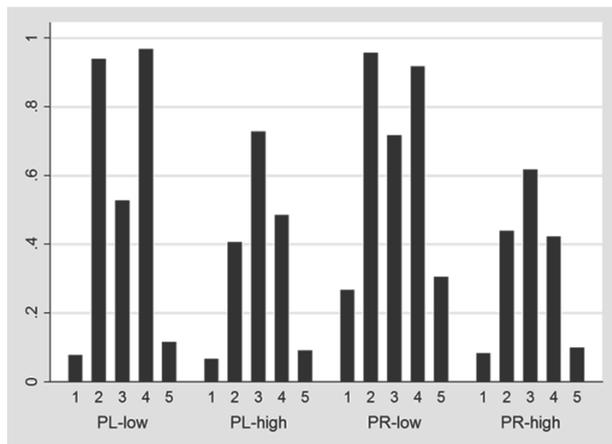


Figure 4.6: Entry by position and treatment

Notes. The figure shows the entry rates by position (1 is position 0, 2 is position 25, 3 is position 50, 4 is position 75 and 5 is position 100) averaged over rounds and groups for each treatment.

Comparing entry rates across electoral rules I find that the higher entry rates under proportional representation compared to plurality rule when the costs of entry are low are driven by an increase in the entry rates of the extreme ($p < 0.01$) and median ($p = 0.07$) while there is no difference for the moderate players ($p = 0.41$). When entry costs are higher there is no difference across electoral rule in the entry rate for any of the positions. The p-values are 0.69 for the extremes, 0.94 for the moderates and 0.25 for the median.

In summary, my data provide support for the three main hypothesis. With high costs of running for office, entry is lower and entrants are less polarized (cost effect), and proportional representation leads to more entry (system effect) but only if costs are low (interaction effect).

4.3.3 Individual level analysis

The analysis at the individual level focuses on two questions. First, are the observed patterns of behavior at the aggregate level also present at the individual level? Second, how do subjects learn in the game and what can explain that behavior evolves towards equilibrium over time?

To investigate the treatments effect at the individual level, Table 4.4 presents the results from logit regressions by voters' positions with standard errors clustered at the group level. As independent variables I include treatment dummies and to test for learning over time I also include the round a decision was made as independent variable.

Table 4.4: Logit regressions for entry decision by position

	0 or 100	25 or 75	50
PL-high	-.02	-.65 ^{***}	.18 ^{**}
PR-low	.18 ^{***}	-.06	.17 ^{**}
PR-high	-.01	-.65 ^{***}	.08
Round	-.01 ^{***}	-.01 ^{**}	-.01 ^{***}

Notes. The table shows the marginal effects of treatment dummies in a logit regression with the entry decision as the dependent variable. 'Round' denotes the round a decision was made in. Standard errors are clustered at the group level. * (**, ***) denotes that the coefficient is significantly different from zero at the 10% (5%; 1%)-level.

As at the aggregate level, in line with learning I find that for all positions entry significantly decreases over time. For the players at the extremes of the policy space I find that high costs decrease entry for both electoral rules but this effect is only significant for proportional representation. The insignificant difference for plurality voting is in line with theory since under both cost levels extreme players are predicted to stay out. Furthermore, for low costs proportional representation leads to more entry which can be explained by entry being a possible equilibrium choice under proportional representation while it is not so for plurality voting.

For moderate players higher costs significantly reduce entry but the electoral rule has no significant effect. This is in line with the results at the aggregate level that the effect of the electoral rule is driven by the extremes' and median's behavior. For the median player I find in line with the results at the aggregate level that proportional representation significantly increases entry for low costs but not for high costs ($p= 0.25$). Furthermore, costs of entry matter for plurality voting ($p= 0.04$) but not for proportional representation ($p= 0.29$) which was not predicted by theory. Overall, the results at the individual level are in line with the result found in the analysis at the aggregate level.

To further analyze the learning process I employ logit regressions with standard errors clustered at the group level. As independent variables I include a subject's position in a given round ('extreme' if the position is 0 or 100 and 'moderate' if the position is 25 or 75) and the round of a decision. Furthermore, to capture myopic best-response behavior I include 'BR', a dummy variable that is equal to one if entry is a best response to the previous round's choices, and to capture learning by imitation I include 'Copy', a dummy variable that is equal to one if the player at this position entered last round. Table 4.5 shows the resulting marginal effects.

Table 4.5: Logit regressions for entry decision by treatment

	PL-low	PL-high	PR-low	PR-high
Extreme	-.48 ^{***}	-.50 ^{**}	-.28 ^{***}	-.38 ^{***}
Moderate	.48 ^{***}	-.15	.25 ^{***}	-.09
Round	-.02 ^{***}	-.01 ^{**}	-.01 ^{**}	-.01 ^{**}
BR	.17 ^{***}	.11 ^{**}	.13 [*]	.12 ^{**}
Copy	.20 [*]	.15 ^{**}	.25 ^{***}	.15 ^{**}

Notes. The table shows the marginal effects of a logit regression with the entry decision as the dependent variable. 'Extreme' ('Moderate') denotes a subject's position of 0 or 100 (25 or 75), 'BR' is equal to one if entry is a best-response to last rounds behavior, 'Round' denotes the round a decision was made in and 'Copy' is equal to one if the player at this position entered in the previous round. Standard errors are clustered at the group level. * (**, ***) denotes that the coefficient is significantly different from zero at the 10% (5%; 1%)-level.

In all treatments entry becomes less likely over time, which is in line with the observed convergence of behavior to equilibrium and the initial over-entry relative to equilibrium entry rates. Furthermore, in all treatments entry being a best response to previous rounds' behavior increases the probability of entry by about 13 percentage points and this difference is (marginally) significant. Also the variable capturing learning by imitation leads to an increase in the entry probability of around 20 percentage points and this effect is (marginally) significant.

The results at the individual level for the differences across positions are again in line with what I observed at the aggregate level. Both for plurality voting and proportional representation low costs lead to significantly higher entry rates for the moderates than for the median while the extreme players are least likely to enter. This is in line with the equilibrium predictions since in both cases there exists an equilibrium where only the moderate players enter. For the treatments with high costs I find that the median player has the highest entry rates but the difference with the moderates' entry rates is not significant. The sign of the effect is in line with the predictions; the non-significance of the result likely stems from the observed over-entry. Again, the extremes have significantly the lowest entry rates when costs are high.

4.4 Conclusions

In this chapter I implement the citizen-candidate model in the laboratory with the aim of investigating how candidate entry behavior differs between proportional representation and plurality voting. I find that (as predicted by the model) when entry costs are low, proportional representation increases entry compared to plurality rule. As also predicted there is no such effect for high costs. This indicates that the higher entry under proportional representation with low costs can be attributed to strategic play in line with equilibrium as opposed to using some simple heuristic like entering to influence the policy. Furthermore, I find support for the prediction of a cost effect since for higher entry costs fewer candidates enter and their positions are less polarized. Finally, I replicate the well-known finding of over-entry compared to Nash equilibrium predictions.

Overall, the experimental results are in line with the citizen-candidate model (notwithstanding the substantial over-entry), which supports the usefulness of the citizen-candidate approach. Obviously, experiments can only be one part of an empirical evaluation of the predictive power of the paradigm. But, given the advantages of laboratory control and the difficulties involved with testing the model in the field (especially with a multiplicity of equilibria), experiments can play an important role by offering a test bed for different institutional environments. In this spirit this paper offers the first experimental analysis of proportional representation in the citizen-candidate paradigm. Nevertheless, many other aspects of the citizen-candidate paradigm remain to be explored. Future experimental work should try to investigate the robustness of the model's predictions to changes in the underlying assumptions, f.i. with respect to the available information²¹ or the institutional framework. Given the results from the theoretical analysis of proportional representation with coalition formation presented in chapter 3 a natural next step would be to implement the model of proportional representation with coalitions in the current experimental design and to investigate which of the rich pattern of comparative statics predicted in chapter 3 is observed when human subjects participate in such a laboratory experiment.

²¹ A good starting point are the results found by Großer and Palfrey (2014).

Appendix 4.A: Instructions and screenshots of the experiment

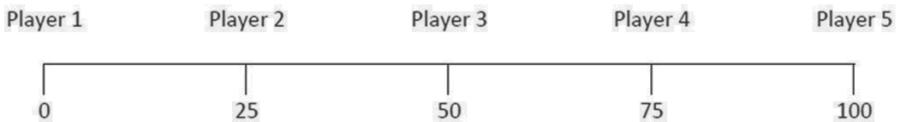
In this appendix, I provide the instructions that the subjects read on their computer monitors. I also give the summary of the instructions that was handed out to subjects after they had read these on-screen instructions. Finally, I provide screenshots of the user interface of the experiment.

4.A.1 Instructions²²

Welcome to this experiment on decision-making. Please carefully read the following instructions. If you have any questions, please raise your hand, and we will come to your table to answer your question in private.

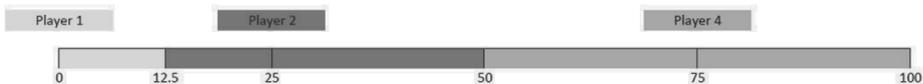
In this experiment you will earn points. How many points you earn depends on your choices and the choices of the other participants in this experiment as well as potentially chance. At the end of the experiment, your earnings in points will be exchanged for money at a rate of two eurocent for each point. This means that for each 50 points you earn, you will receive 1 euro. Your earnings will be paid privately to you in cash at the end of the experiment.

In this experiment you will play the role of a potential candidate that has to decide whether to run in an election or not. Your goal is to influence the implemented policy in your favor and to get as many votes as possible. Specifically in each election there are five types of players (i.e. potential candidates) that are located along the line from 0 to 100. You can see where they are located in the figure below.



The share of votes that a candidate receives depends on the entry decision by the other players. A candidate receives the part of the line that is closest to him. Below you see a few examples that show what this means.

Example I



Players 1, 2 and 4 enter in this situation. The vote share for candidate 1 is given by the proportion of the line that is closest to him. Everything to the left of the midpoint between

²² I provide here the instructions used for the treatment Plurality-low. The instructions for other treatments are analogous and available upon request.

her position (0) and player 2's position (25) is closest to candidate 1. This implies that her vote share is given by 12.5% (the length of the yellow area). For candidate 2, we can note that everything to the right of the 12.5 (the midpoint to candidate 1) and her own position is closest to him. Furthermore everything between her position and 50 (the midpoint between her and candidate 4's position) is closest to him. This implies a total vote share of 37.5% (12.5% from the left and 25% from the right of her position, the red area). Finally candidate 4's vote share is given by the remaining 50% (the green area).

Example II



In this case players 1, 3 and 5 enter. Candidate 1 receives a vote share of 25% since the midpoint between her own and candidate 3's position is at 25 (the yellow area). Also candidate 5 receives 25% of the votes since the difference between 100 (his own position) and 75 (the midpoint between candidate 3 and 5's positions) is 25. Therefore candidate 3 receives the remaining 50% of the votes.

Example III



Now we consider a situation where everyone enters. Candidate 1 receives 12.5% of the votes since the midpoint between her own and candidate 2's position is 12.5. Since in this situation candidates 1 and 5 are completely symmetric candidate 5's vote share is also 12.5%. Candidate 2's vote share (the length of the blue area) is given by the difference between 25 and 12.5 (the midpoint to candidate 1) and the difference of 37.5 (the midpoint between candidate 2 and 3's position) and 25. The vote share is therefore 25%. Since also candidate 2 and 4 are symmetric candidate 4's vote share is 25% as well. Finally candidate 3 receives the remaining 25% of the votes.

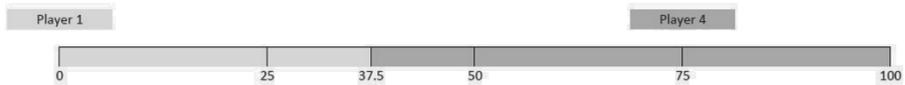
Example IV



Compared to the situation in example III player 2 is now not entering. We can note that this does not influence the vote shares for candidates 4 and 5. This is easiest seen by realizing that the length of the orange and green area does not change between example 3 and 4. The reason is that only the closest entrant to your position, i.e. candidate 3 and 5 (4) for player 4 (5) matter for the size of the vote share. Player 1's vote share does change since she now gets some of the votes that candidate 2 used to get. she now receives 25% of the votes

(doubling her vote share) since the midpoint between her position and the one of the closest entrant (candidate 3) is 25. Also candidate 3 gets some of the votes that candidate 2 used to get and now has a vote share of 37.5%.

Example V

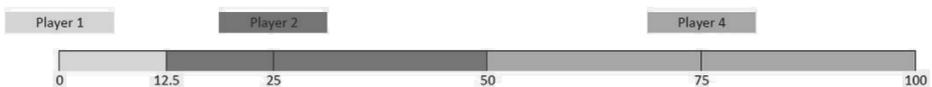


Finally, let consider a situation where only two candidates enter. Player 1's vote share is equal to the length of the yellow area and is given by the distance between 0 (his own position) and the midpoint between 0 and candidate 4's position of 75. This means that she receives 37.5% of the votes and candidate 4 receives the remaining 62.5% of the votes.

On the back of the handout with the summary of the instructions you can find a table that gives you the vote share for all possible situations that can arise in this experiment.

Depending on the vote shares that the different candidates received a policy (which is a point on the line) will be implemented. The implemented policy will be equal to the position of the candidate that received the highest vote share. Should there be multiple candidates with the largest vote share one candidate's position will be randomly picked to be the winner and her position will be the implemented policy. Should no player enter one player's position will randomly be picked to be the implemented policy. Below you can see (with the examples from the previous page) how it works.

Example I



Player 4 received 50% of the votes and therefore has the highest vote share of all candidates. Player 4's position of 75 will therefore be the implemented policy.

Example II



The implemented policy is 50 since player 3's vote share of 50% is the highest any candidate received in this election.

Example III



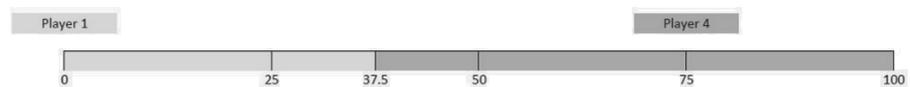
Players 2, 3 and 4 all received 25% of the votes. We are therefore in a situation where chance decide which candidate's position. With equal probability the implemented policy will be 25, 50 and 75.

Example IV



Player 3 received 37.5% of the votes which is more than any other candidate received. So the implemented policy will be 50.

Example V



Player 4 received an absolute majority and therefore she has won the election and her position of 75 will be implemented.

Your earnings (in points) in a given election are given by the following equation:

100 – distance between the implemented policy and your position – 8 (if you decided to run in this round) +25 (if you received the highest vote share in this round)

The costs of eight points you only have to pay if you decide to enter the election and the bonus of 25 points you earn if you receive the highest vote share in the election. Should there be multiple candidates with the highest vote share one will be randomly picked to receive the bonus. Furthermore if nobody enters nobody will receive the bonus. Below you find a calculator tool (which will also be available during the experiment) which gives you the opportunity to compute the payoff for a given player type for a given configuration of players' behavior.

Here you can compute the (expected) earnings for each possible combination of entry decisions.

Player 1 (choose one) ▼ Player 2 (choose one) ▼ Player 3 (choose one) ▼ Player 4 (choose one) ▼ Player 5 (choose one) ▼

The experiment will last for 15 rounds each consisting of a single election. For all rounds you will stay in the same group, meaning that the players in your group do not change during the experiment. In each round it will be randomly determined which type of player

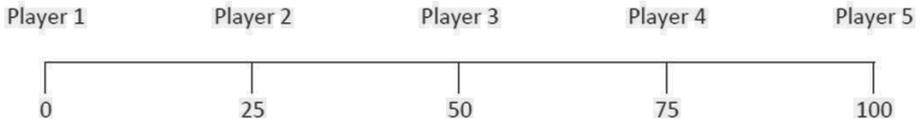
each of the group members is (i.e. at which position they are located) but there will always be one player of each type.

After all 15 rounds have been played your earnings will be added up and exchanged at a rate of two eurocent for each point.

4.A.2 Printed summary of instructions

Summary Instructions

- The experiment lasts for 15 rounds
- You will stay in the same group of five players throughout all 15 rounds
- In each round you will be randomly assigned to one of the five positions shown in the figure below. In your group there will always be one player at each of the five positions.

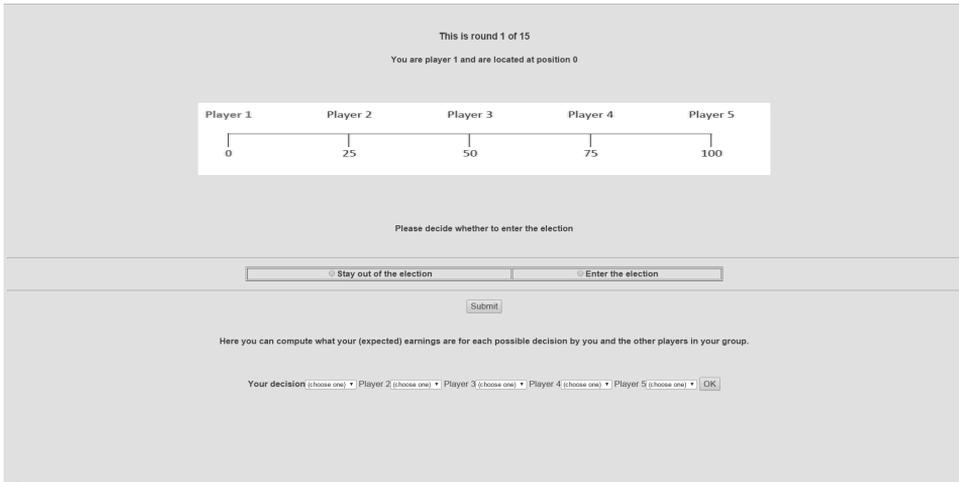


- Your choice is whether to pay the entry costs of 8 points to run in the election or to stay out of the election
- Based on the decision of all players in your group the computer will cast votes for each of the candidates running for election. On the back of this sheet you can see what the vote shares for the different players will be for all possible configuration of decisions.
- Based on the vote share a policy will be implemented in a given round. The policy is equal to the position of the candidate that receives the highest vote share. Ties are broken randomly.
- Furthermore the player that receives the highest vote share receives a bonus of 25 points. Ties are again randomly broken. If nobody enters no player receives the bonus.
- Your payoff per round is
 $100 - \text{distance between the implemented policy and your position} - 8$ (if you decided to run in this round) $+25$ (if you received the highest vote share in this round)
- Your final payoff is 1 Euro for every 50 points.

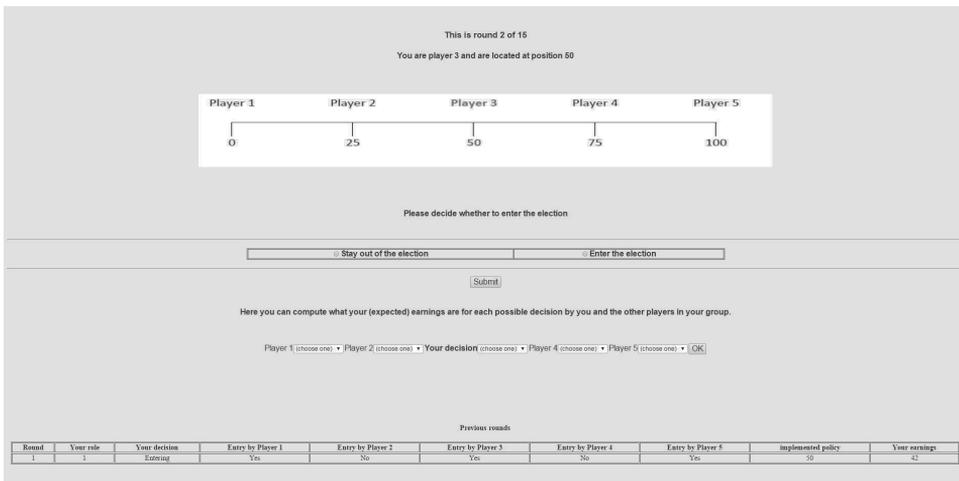
PX denotes player X and VX the vote share she receives. Yes (No) denotes that this player is (not) entering.

P1	P2	P3	P4	P5		V1	V2	V3	V4	V5
Yes	Yes	Yes	Yes	Yes		12.5%	25.0%	25.0%	25.0%	12.5%
Yes	Yes	Yes	Yes	No		12.5%	25.0%	25.0%	37.5%	0.0%
Yes	Yes	Yes	No	Yes		12.5%	25.0%	37.5%	0.0%	25.0%
Yes	Yes	Yes	No	No		12.5%	25.0%	62.5%	0.0%	0.0%
Yes	Yes	No	Yes	Yes		12.5%	37.5%	0.0%	37.5%	12.5%
Yes	Yes	No	Yes	No		12.5%	37.5%	0.0%	50.0%	0.0%
Yes	Yes	No	No	Yes		12.5%	50.0%	0.0%	0.0%	37.5%
Yes	Yes	No	No	No		12.5%	87.5%	0.0%	0.0%	0.0%
Yes	No	Yes	Yes	Yes		25.0%	0.0%	37.5%	25.0%	12.5%
Yes	No	Yes	Yes	No		25.0%	0.0%	37.5%	37.5%	0.0%
Yes	No	Yes	No	Yes		25.0%	0.0%	50.0%	0.0%	25.0%
Yes	No	Yes	No	No		25.0%	0.0%	75.0%	0.0%	0.0%
Yes	No	No	Yes	Yes		37.5%	0.0%	0.0%	50.0%	12.5%
Yes	No	No	Yes	No		37.5%	0.0%	0.0%	62.5%	0.0%
Yes	No	No	No	Yes		50.0%	0.0%	0.0%	0.0%	50.0%
Yes	No	No	No	No		100.0%	0.0%	0.0%	0.0%	0.0%
No	Yes	Yes	Yes	Yes		0.0%	37.5%	25.0%	25.0%	12.5%
No	Yes	Yes	Yes	No		0.0%	37.5%	25.0%	37.5%	0.0%
No	Yes	Yes	No	Yes		0.0%	37.5%	37.5%	0.0%	25.0%
No	Yes	Yes	No	No		0.0%	37.5%	62.5%	0.0%	0.0%
No	Yes	No	Yes	Yes		0.0%	50.0%	0.0%	37.5%	12.5%
No	Yes	No	Yes	No		0.0%	50.0%	0.0%	50.0%	0.0%
No	Yes	No	No	Yes		0.0%	62.5%	0.0%	0.0%	37.5%
No	Yes	No	No	No		0.0%	100.0%	0.0%	0.0%	0.0%
No	No	Yes	Yes	Yes		0.0%	0.0%	62.5%	25.0%	12.5%
No	No	Yes	Yes	No		0.0%	0.0%	62.5%	37.5%	0.0%
No	No	Yes	No	Yes		0.0%	0.0%	75.0%	0.0%	25.0%
No	No	Yes	No	No		0.0%	0.0%	100.0%	0.0%	0.0%
No	No	No	Yes	Yes		0.0%	0.0%	0.0%	87.5%	12.5%
No	No	No	Yes	No		0.0%	0.0%	0.0%	100.0%	0.0%
No	No	No	No	Yes		0.0%	0.0%	0.0%	0.0%	100.0%
No	No	No	No	No		One player's position is randomly implemented				

4.A.3 Screenshots of the interface



Notes. The screen subjects saw when making a decision.



Notes. The screen subjects saw when making a decision; the table at the bottom of the screen shows an example of the history box.

Election outcome in round 1

In this round you decided to enter the election

The distribution of votes received by the players in this round is:



This voting pattern led to an implemented policy located at 50. Furthermore player 3 won the election and earned the bonus.

Given that your position is 0 and you decided to enter the election, your earnings for this round are $100 - 50 - 8 = 42$ and your accumulated earnings are 134

Click [here](#) to go to the next round.

Notes. The screen subjects saw after an election was over.

Chapter 5

Bargaining in the Presence of Condorcet Cycles: The Role of Asymmetries¹

5.1 Introduction

The Condorcet Paradox arises when transitive individual preferences lead to intransitive collective preferences. It has been studied in the Social Choice literature for a very long time (see Arrow, 1963, and Black, 1958). Furthermore, it is more than simply a theoretical curiosity; it has been empirically observed in both small and large-scale settings (for a survey of the empirical detection of the paradox see van Deemen, 2014). The question then arises: How do groups manage to resolve the paradox to reach a decision? We consider this question in the strategic bargaining framework introduced by Baron and Ferejohn (1989) and investigate how asymmetries in payoffs and in the probability of being able to make a proposal affect behavior. To do so we implement the model by Herings and Houba (2010) in a controlled laboratory experiment and vary the symmetry of payoffs and recognition probabilities.

The reasons for employing a controlled laboratory experiment are two-fold. First, with observational data it is virtually impossible to test the model's performance since its underlying parameters are unknown and therefore we are not able to compute the theoretical benchmark necessary to test the theory. Furthermore, the institutional rules of the bargaining process are not exogenously assigned, which makes causal statements problematic. In the laboratory we do not have these problems since we control the underlying parameters and can vary institutions under *ceteris paribus* conditions. The second reason for employing an experiment is that the equilibrium outcomes result from subtle strategic effects of asymmetries and therefore players' bounded rationality or non-selfish preferences might cause systematic deviations from the theoretical predictions. An example of such systematic deviation is presented in a series of papers by Frechette et al. (2003, 2005a, and 2005b) who demonstrate that players under-exploit their proposer power in bargaining games since they anticipate that the unequal outcomes resulting from completely exploiting their bargaining power will not be accepted by the other players. If

¹ This chapter is based on Kamm and Houba (2015).

this type of deviation from equilibrium occurs, we will be able to observe it directly in our experimental data.

From the experiment two main results arise: First, subjects are underexploiting their bargaining power and accept proposals too often.² This finding might be caused by subjects' risk aversion and is in line with results McKelvey (1991) reports for a related experiment. His experiment differs from ours in two main ways: For one thing, he only varies the payoffs and implements symmetric recognition probabilities while we vary both and for another thing, he is interested in testing the predictive power of the Baron & Ferejohn model and focuses therefore on the point predictions while we are mainly interested in the comparative statics effects of asymmetries in payoffs and recognition probabilities. The second main result that arises from the experiment is that for asymmetric recognition probabilities we observe systematic deviations from the model predictions. In comparison, subjects' change in behavior when going from symmetric to asymmetric payoffs is more in line with the theory when recognition probabilities are symmetric. The systematic deviations for asymmetric recognition probabilities do not only arise relative to the risk-neutral Nash equilibrium but also when a quantal response equilibrium –with risk-aversion and noise parameters estimated using experimental data– is used as theoretical benchmark. We therefore conclude that subjects have a harder time understanding the strategic implications of asymmetric recognition probabilities than asymmetric payoffs and rely on heuristics when dealing with asymmetric recognition probabilities. One such heuristic that is consistent with the data would be to equate recognition probabilities with bargaining power.

The remainder of this chapter will be structured as follows: In the next section we present the experimental design; then section 5.3 describes the experimental results. Section 5.4 concludes with a summary of the results and a discussion of potential avenues for future research.

5.2 Experimental design

5.2.1 The game³

The game consists of a group of three players that has to decide which of three available options to implement. Bargaining proceeds as follows: In each round one player is randomly chosen (as in Baron and Ferejohn, 1989) to make a proposal (where a proposal is an announcement of one of the three available alternatives). Subsequently, the other two members sequentially vote whether to accept or reject this proposal. The order is such that first the player that receives a higher payoff from the proposal must vote.⁴ Given that we assume majority voting and since the proposer is assumed to be in favor of her own

² Interestingly, this leads to a proposer power that is larger than predicted, which is contrary to the common finding of lower proposer power, see for instance Palfrey (2013) and the references therein. The most likely explanation is our limited proposal space. Whereas previous studies were characterized by a (nearly) continuous proposal space, our subjects can choose from only three possible proposals.

³ The game is obtained by adding a risk of breakdown to the game presented by Herings and Houba (2010).

⁴ The reason for sequentially voting is to eliminate the equilibrium where both vote in favor of the proposal since they believe that the other will vote 'yes'.

proposal the third group member is only asked to vote if the first vote was a ‘no’. If a proposal is adopted the payoffs associated with the proposed alternative are implemented. If the proposal is rejected the game continues to the next period with probability δ while with probability $1 - \delta$ bargaining breaks down and everyone receives a payoff of zero.

To generate a Condorcet paradox we assume the structure of payoffs (denoted in points) shown in Table 5.1.

Table 5.1: Payoffs

	Alternative I	Alternative II	Alternative III
Payoff player 1	9	4	0
Payoff player 2	0	β	4
Payoff player 3	4	0	9

Notes. β denotes player 2’s payoff associated with her favorite alternative

5.2.2 Treatments

The experiment consists of four between-subject treatments that are constructed in the 2x2 configuration shown in Table 5.2.

Table 5.2: Treatments

	Symmetric payoffs	Asymmetric payoffs
Symmetric recognition probabilities	SymPaySymRec N=10 78 subjects	AsymPaySymRec N=5 45 subjects
Asymmetric recognition probabilities	SymPayAsymRec N=7 51 subjects	AsymPayAsymRec N=7 51 subjects

Notes. Cell entries give the treatment acronym used throughout this chapter as well as the number of independent matching groups N and subjects for each treatment. The reason for having more sessions of treatment SymPaySymRec is that we accidentally implemented one session of this treatment when we planned on running treatment AsymPayAsymRec.

The first treatment dimension varies whether the alternatives are symmetric with respect to payoffs. In the symmetric case every player gets 9 (4, 0) points when her favorite (middle, worst) option is implemented, i.e. $\beta = 9$. When payoffs are asymmetric player 2 gets 15 points instead of 9 points when her favorite alternative is implemented, i.e. $\beta = 15$.

The second treatment dimension varies the probability that a player will be the proposer in any given period. In the symmetric treatments each player has a probability of 1/3 to be the proposer while in the asymmetric treatments player 1 is the proposer with a probability of only 10% while players 2 and 3 each have a probability of 45% of being the proposer.

Table 5.3 shows the resulting stationary subgame perfect Nash equilibria assuming risk-neutrality and a probability of continuation after each rejected proposal of $\delta = 0.9$ (the equilibria are derived in appendix 5.A). We only report the probabilities for accepting and proposing the middle alternative since the best alternative will always be accepted while

the worst alternative will never be proposed or accepted and therefore an equilibrium is completely described by the behavior regarding the middle option.

Table 5.3: Equilibria

	SymPaySymRec	SymPayAsymRec	AsymPaySymRec	AsymPayAsymRec
Accept M	100	48	39	21
	100	23	58	18
	100	100	73	100
Propose M	0	0	0	0
	0	0	0	0
	0	13	0	10
Expected payoff	4.3	4.4	4.4	4.5
	4.3	4.4	4.4	4.5
	4.3	2.8	4.4	3.3

Notes. Cell entries give the Nash equilibrium probability of accepting (proposing) the middle option and the expected equilibrium payoffs by treatment and player role assuming risk-neutrality and a continuation probability $\delta = 0.9$

5.2.3 Hypothesis

From the equilibrium predictions we derive two sets of hypothesis.⁵

1. Effect of recognition probabilities
 - a. For players 1 and 2 asymmetries reduce the likelihood of accepting the middle option
 - b. For player 3 asymmetries increase the frequency of accepting the middle option when payoffs are asymmetric
 - c. Asymmetric recognition probabilities increase player 3's frequency of proposing the middle option and do not affect the other players' proposing behavior.
 - d. Asymmetric recognition probabilities reduce player 3's payoff and have no substantial effect on the other players' payoff
2. Effect of payoff structure
 - a. For players 1 and 2 asymmetries reduce the likelihood of accepting the middle option
 - b. For player 3 asymmetries decrease the frequency of accepting the middle option when probabilities are symmetric
 - c. The payoff structure does not affect proposing behavior
 - d. Introducing payoff asymmetries increases payoffs but this change is only substantial for player 3's payoff when the probabilities are asymmetric

⁵ With the exception of 1(b) and 2(b) these hypotheses are also robust with respect to noisy decision-making as modeled by the quantal response equilibrium (McKelvey and Palfrey, 1995) and mild risk-aversion. For 1(b) mild risk-aversion is sufficient to make the treatment effect disappear while with noisy decision-making the acceptance rate is predicted to increase independently of the payoff structure. In case of 2(b) either mild risk-aversion or noisy decision-making lead to the treatment effect disappearing. In Appendix 5.B we present a model specification combining noisy decision-making with substantial risk-aversion.

The intuition for these hypotheses is not always obvious and relies on complex reasoning regarding best-response patterns. For instance the hypothesis that player 2 does not have a higher expected payoff when she gets more points for her best alternative or that player 1 does not suffer a reduction in expected earnings when she is less likely to be the proposer are both unintuitive, but follow from the equilibrium analyses.⁶

5.2.4 Experimental Protocol

The experiment was conducted at the CREED laboratory at the University of Amsterdam in December 2013 and February 2014 and implemented using php/mysql.⁷ Participants were recruited using CREED's subject database. In each of nine sessions, 18, 24 or 27 subjects participated. Most of the 225 subjects in the experiment were undergraduate students of various disciplines.⁸ Earnings in the experiment are in 'points', which are converted to euros at the end of the experiment at an exchange rate of 10 points = 1€. The experiment lasted on average 80 minutes and the average earnings were 19€ (including a 7€ show-up fee).

After all subjects have arrived at the laboratory, they are randomly assigned to one of the computers. Once everyone is seated they are shown the instructions for the first part of the experiment on their screen.⁹ After everyone has read these and the experimenter has privately answered all questions, a summary of the instructions is distributed. Then, all subjects have to answer quiz questions that test their understanding of the instructions. After everyone has successfully finished this quiz, the experiment starts. When everyone has finished part I the instructions for part II are shown on the screen and again a summary is distributed and a quiz has to be passed before part II begins. Finally, after everyone has finished part II the instructions for part III are shown on the screen and subjects make their decision for part III. At the end of the session, all subjects answer a short questionnaire and are privately paid their cumulative earnings from the three parts.

To make sure that subjects have an incentive to think carefully about their choices, for part I of the experiment the game was as described above but with 10-times the payoffs.¹⁰ Subjects were informed that in this part they would participate in a bargaining game, that they stay the same player throughout the first part and that they will never meet the two other group members in part II and part III of the experiment. The game started in period 1 with subjects learning their role (player 1, 2, or 3) and applied the strategy method, i.e., everyone decided on their proposal before one proposal was randomly chosen to be voted on. If the first voter (the non-proposing group member that likes the proposal better) votes 'yes' part I of the experiment ends and the payoffs according to the implemented

⁶ In general all the results rely on the effect a parameter change has on the 'cost' of making a player accept a proposal. For instance, the lower recognition probability of player 1 makes her 'cheaper' to satisfy which implies that she gets her middle option more often and less often receives her lowest payoff.

⁷ For screenshots of the interface as well as the text of the instructions and the summary handout, see Appendix 5.C.

⁸ 148 of the 225 participants were students in business or economics.

⁹ They are informed that there will be three parts in the experiment but not what these parts will entail.

¹⁰ This does not have any effect on the equilibrium predictions, provided the risk-neutrality also holds at this payoff level.

alternative are realized. If the first voter votes ‘no’ the second voter has to decide. If she accepts the first part ends and payoffs are realized. If she rejects, then with probability 0.9 the game moves to the next period, which proceeds exactly the same as period 1. With the remaining probability bargaining breaks down, part I ends and all group members earn zero points.

Part II works in a way similar to part I, but the payoffs are not multiplied by ten and this part consists of 10 bargaining games which allows for learning to take place. Each game works as described for part I but after each round groups are randomly re-matched and every subject is randomly assigned one of the three roles within the group. For econometric reasons this re-matching is not done using the complete group of subjects in the laboratory but is based on independent matching groups (i.e. subgroups) of size 6 or 9.¹¹

In part III we measure risk-aversion using the task proposed by Eckel and Grossmann (1998). Subjects have to choose one of seven lotteries with varying payoff for winning and losing but all with a winning probability of 50%.

5.3 Results

Given that it is always optimal to accept the best option if offered and accepting or proposing the worst option are dominated strategies,¹² we focus in the analysis of the results on the acceptance and proposing behavior with respect to the middle option. After briefly discussing the results from part I of the experiment, the remainder of this section will focus on an in-depth analysis of behavior observed in part II of the experiment. In a first step we present a within-treatment analysis that investigates whether observed behavior corresponds to the equilibrium predictions. Next, we investigate what might cause the deviations from the theory and present results for the quantal response equilibrium with risk-aversion and noise parameter fitted to the observed data. Finally, we analyze differences across treatments and investigate the effect of asymmetries on subjects’ behavior.

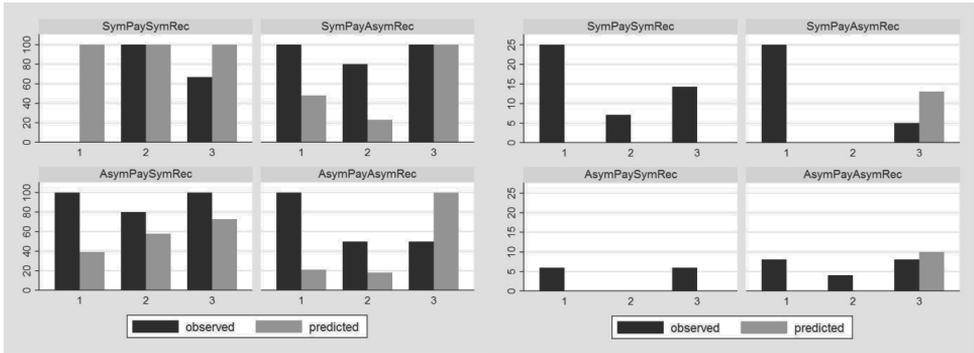
5.3.1 Analysis of part I

Overall, subjects accept and propose the middle option more often than predicted, which leads to faster agreement than predicted (see Figure 5.1). As a result we have only few observations of proposing behavior and even fewer acceptance decisions (for instance in treatment SymPaySymRec not a single player 1 was proposed her middle option¹³). We therefore do not investigate the differences in behavior using a detailed statistical analysis but instead focus on three stylized facts that we will compare to what we find in part II of the experiment.

¹¹ Subjects were simply told that they would be rematched with other participants.

¹² Indeed, in line with theory the worst option is almost never proposed (14 out of 2697 decisions) and rarely accepted (6 out of 173 decisions) and the frequencies do not vary much by treatment. Furthermore, the best option is almost never rejected (1 out of 57 decisions).

¹³ Recall that alternative II is the middle option for player 1. It is the best option for player 2, who hardly ever proposes it.



(a) frequency of accepting middle option (b) frequency of proposing middle option

Figure 5.1: Accepting and Proposing the Middle Option in Part I

Notes. The figure shows the average frequency of accepting and proposing the middle option observed in part I of the experiment, split by role and treatment and compares them to the Nash equilibrium predictions.

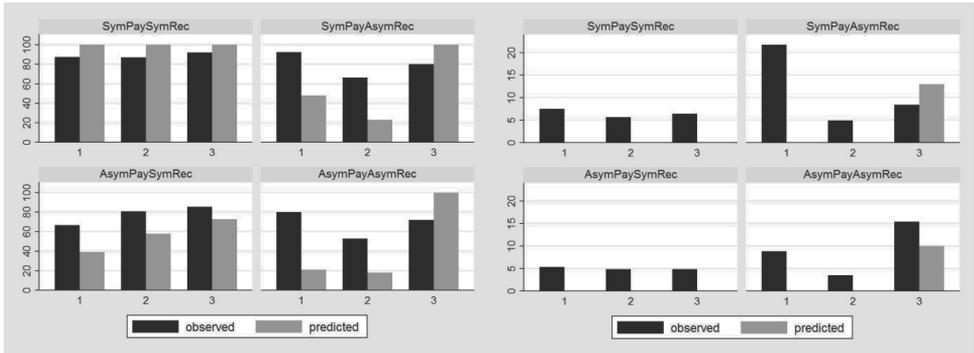
First, the already mentioned higher overall acceptance rates are especially pronounced for player 1. For instance when she is the ‘weak’ player who has a low recognition probability, she always accepts her middle option while in the predicted equilibrium she should frequently reject her middle option. As discussed below, a similar pattern is also observed in part II of the experiment. Second, when the game is completely symmetric (SymPaySymRec) players frequently propose their middle option while they are predicted to always propose their best option. This may be because with the high payoffs in part I, breakdown would be socially very costly and the payoff of one’s second favorite option is still substantial. This, in addition to learning, would also explain why in part II of the experiment we observe behavior that is closer to equilibrium (there, the best option is almost always proposed). Third, in treatment SymPayAsymRec it is not (the predicted) player 3 that is mostly likely to propose her middle option. Instead, and similar to part II of the experiment, player 1 very frequently proposes her middle option.

5.3.2 Analysis part II

Within-treatment analysis

For treatment SymPaySymRec, where all players are completely symmetric, Figure 5.2 shows behavior that is quite close to the prediction of immediate agreement (i.e., players propose their best option and the other player for whom this is the middle option almost always accepts). Though all players sometimes reject the middle option, this only happens rarely and does not significantly vary by player (p-value: 0.29).¹⁴ Furthermore, sometimes a player proposes the middle option but this happens only occasionally and the frequency does not significantly vary across players (p-value: 0.61).

¹⁴ Unless mentioned otherwise all p-values are taken from a logit regression with proposing (accepting) the middle option as dependent variable and standard errors clustered at the matching group level. All regression results are reported in Appendix 5.D. We also ran nonparametric tests, and all p-values were in the same order of magnitude as reported here. Hence, the conclusions reported here are robust to testing non-parametrically.



(a) frequency of accepting middle option (b) frequency of proposing middle option

Figure 5.2: Accepting and Proposing the Middle Option in Part II

Notes. The figure shows the average frequency of accepting and proposing the middle option observed in part II of the experiment split by role and treatment and compares them to the Nash equilibrium predictions.

In treatment SymPayAsymRec, where player 1 has a lower recognition probability, we find systematic deviations from the theory. As we can see, player 1 is proposing her middle option regularly while in the predicted equilibrium she should only propose her favorite option. For player 3 we observe the opposite, the middle option is proposed less often than predicted. This results in player 1 being significantly more likely to propose the middle option than player 3 (p-value < 0.01) who in turn is significantly more likely to propose the middle option than player 2 (p-value: 0.04). With respect to the acceptance behavior in this treatment, we observe that behavior does not differ as much as predicted across players since players 1 and 2 accept the middle option more often than predicted. Furthermore, it is not the case player 3 is most likely to accept her middle option. Instead player 1 has the highest acceptance rate¹⁵ while player 3's behavior is statistically indistinguishable from player 2's behavior (p-value: 0.30).

For the treatment with asymmetric payoffs and symmetric recognition probabilities (AsymPaySymRec) we find that the proposing behavior is in line with the predictions since everyone is almost always proposing the best alternative and there is no difference across players (p-value: 0.88). For the accepting behavior we again find that the difference between players is smaller than predicted and that all players accept their middle options more often than predicted. We find that there is no significant difference between player 1 and 2 (p-value: 0.09) or between player 2 and 3 (p-value: 0.36) but player 3 accepts her middle option significantly more often than player 1 does (p-value: 0.03). Overall, we find some support for the equilibrium predictions since proposing behavior and the ranking of acceptance rates is as predicted even though the differences in acceptance behavior are not as pronounced as predicted.

In the treatment where both payoffs and recognition probabilities are asymmetric (AsymPayAsymRec) we find that players 1 and 3 are proposing the middle option more

¹⁵ The difference between players 1 and 2 is significant at the 1%-level while the difference 1-3 gives a p-value of 0.08.

frequently than predicted. This results in player 2 being significantly less likely to propose the middle option than player 1 (p-value: 0.04) who in turn has an insignificantly lower probability of proposing the middle option than player 3 (p-value: 0.09). For the acceptance behavior we find similar results to treatment SymPayAsymRec: players 1 and 2 accept their middle option substantially more often than predicted. Given that this effect is stronger for player 1 we observe a significantly higher acceptance rate by player 1 compared to player 2 (p-value: 0.02), which is not in line with the small predicted difference in acceptance rates. Furthermore, we do not find that player 3's acceptance rate is the highest but it is statistically indistinguishable from the other players' behavior (p-values are 0.49 and 0.15 for player 1 and 2, respectively). Overall, we find only limited support for the equilibrium predictions since the middle option is proposed not only by player 3 and the pattern of acceptance rates is not in line with theory.

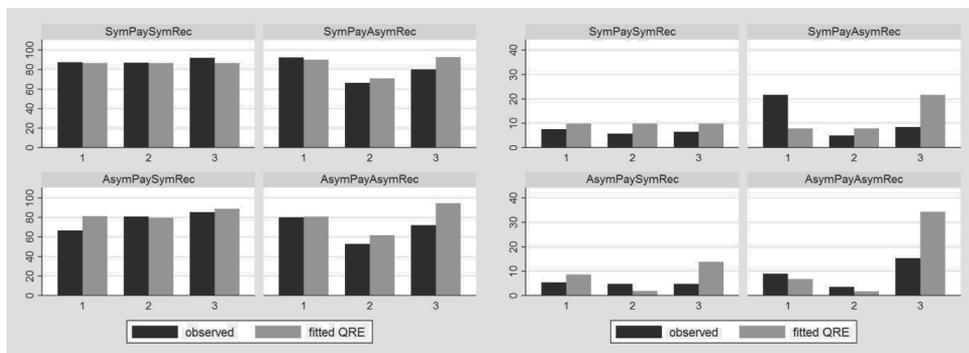
Combining all these results, two main observations arise. First, subjects do not fully exploit their bargaining power when making their acceptance decision since they often accept their middle option. This is in line with findings reported by McKelvey (1991) who investigated the predictive power of the Baron & Ferejohn model with symmetric recognition probabilities and asymmetric payoffs in a laboratory experiment. Second, we find mixed support for the equilibrium predictions. The perfectly symmetric treatment corresponds nicely to the predictions and while asymmetric payoffs by themselves have less of an effect on behavior than expected, the general pattern is still in line with predictions. For the treatments with asymmetric recognition probabilities we find almost no support for the equilibrium predictions since the patterns of both acceptance and proposing behavior are far from what is predicted.

This begs the question as to the causes of these deviations from equilibrium. In the following analysis we will consider two possible channels that might be at work: risk-aversion and noisy decision-making. The finding that players overall are more accommodating in their acceptance behavior would be in line with players being risk-averse since risk-averse players are less willing to take the gamble of rejecting their middle option in the hope of getting their favorite option in a future period.¹⁶ Furthermore, we know that humans are not always able to solve for the best-response as necessary for playing the Nash equilibrium but are often observed to find a 'better-response', i.e. they tend to choose better options more often than worse options. This idea is captured by the quantal response equilibrium concept, which assumes that the probability of choosing an action increases in the associated payoff. Previous experimental work (for instance, Goeree and Holt 2005) has shown that this equilibrium concept outperforms Nash equilibrium predictions in explaining experimental data. It has been successfully applied to experiments on strategic bargaining (Battaglini and Palfrey 2014; Nunnari and Zupal 2014).

¹⁶ An analysis of decision-making at the individual level shows no systematic or substantial influence of risk-aversion and gender on behavior. Detailed results of this analysis are presented in Appendix 5.D.

We operationalize these two channels by using the experimental data to estimate, first, the parameter α of the CRRA utility function x^α and, second, the noise parameter λ of the quantal response equilibrium. This results in estimates of $\alpha = 0.44$ and $\lambda = 3.6$. The former is in line with previous work that estimated α 's in the range of 0.3 to 0.6 (see Battaglini and Palfrey 2014 and references therein). For these estimated parameters, Figure 5.3 shows the choice probabilities predicted by the quantal response equilibrium.

Considering the acceptance decisions, we see that observed behavior is quite close to the quantal response predictions.¹⁷ Instead of being more accommodating than predicted (as in the Nash equilibrium) subjects are actually less likely to accept than predicted. Turning to the proposing decision, we see that even with the fitted model we are not able to accurately capture proposals when the recognition probabilities are asymmetric. As when using Nash equilibrium as a solution concept, the 'weak' player 1 is proposing the middle option more often than predicted and player 3 doing so less often than predicted.



(a) frequency of accepting middle option (b) frequency of proposing middle option

Figure 5.3: QRE for accepting and Proposing middle option in part II

Notes. The figure shows the average frequency of accepting and proposing the middle option observed in part II of the experiment split by role and treatment and compares them to the quantal response equilibrium for the estimated noise-parameter $\lambda=3.6$ and risk-aversion parameter $\alpha=.44$.

Overall, we can conclude that while noisy decision-making and risk-averse subjects can explain most of the deviations from the Nash equilibrium when probabilities are symmetric, the adjusted model still falls short in explaining all of the effects of asymmetric recognition probabilities. This suggests that it is easier for subjects to understand the strategic effects of asymmetric payoffs than of asymmetric recognition probabilities and that players therefore rely on heuristics to deal with asymmetric recognition probabilities.

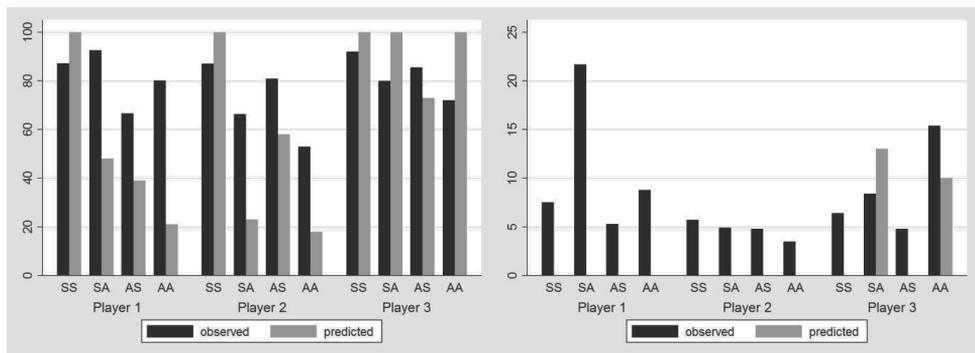
One possible heuristic that players might employ when confronted with asymmetric recognition probabilities is suggested by player 1's behavior of accepting and proposing the middle option more often than predicted. This heuristic would be to equate recognition probabilities with bargaining power. In this case player 1 would think that she is in a weak

¹⁷ Given that the QRE predictions have two parameters that are based on observed behavior it is obvious that it will give a better fit than the Nash equilibrium predictions.

bargaining position, which would lead her to become more accommodating in her accepting and proposing behavior.

Comparison across treatments

First, we consider the effect of going from symmetric to asymmetric recognition probabilities. As Figure 5.4 shows, for both payoff configurations this asymmetry is predicted to lead to a decrease in the acceptance rates of players 1 and 2 (Hypothesis 1a) while player 3's acceptance behavior should only be affected when payoffs are asymmetric (Hypothesis 1b). We find only partial support for these hypotheses. As predicted player 2 reduces her probability of accepting the middle option (for symmetric payoffs, p-value <0.01; for asymmetric payoffs, p-value: 0.03) when recognition probabilities become asymmetric. Additionally, when payoffs are symmetric the recognition probability does not significantly affect player 3's acceptance rate (p-value: 0.10). On the other hand for asymmetric payoffs asymmetric recognition probabilities do not significantly increase the probability that player 3 accepts her middle option but decreases it (albeit insignificantly; p-value: 0.49). Furthermore, player 1 increases her acceptance rate instead of decreasing it, when recognition probabilities are asymmetric and with asymmetric payoffs this reduction is even significant (for symmetric payoffs p-value: 0.35 and for asymmetric payoffs 0.05).



(a) frequency of accepting middle option (b) frequency of proposing middle option

Figure 5.4: Accepting and Proposing middle option in part II

Notes. The figure contrasts for each role and treatment the average observed frequency of accepting and proposing the middle option with the Nash equilibrium predictions. SS (SA, AS, AA) denotes the treatment with symmetric (symmetric, asymmetric, asymmetric) payoffs and symmetric (asymmetric, symmetric, asymmetric) recognition probabilities.

The deviations from the theoretically predicted effect of asymmetric recognition probabilities are even more pronounced with respect to proposing behavior. The predicted increase in the frequency of proposing the middle option by player 3 is only significant when payoffs are asymmetric (p-values are 0.50 for symmetric and 0.04 for asymmetric payoffs) while for symmetric payoffs player 1 significantly increases the probability of proposing the middle option when payoffs are asymmetric (p-value <0.01). While the absence of a significant effect on player 2's behavior (p-values are 0.69 for symmetric and 0.46 for asymmetric payoffs) and the fact that the middle option is only regularly proposed

when probabilities are asymmetric are in line with predictions overall our data do not provide much support for Hypothesis 1c.

Table 5.4: Predicted and observed payoffs in part II

	SymPaySymRec	SymPayAsymRec	AsymPaySymRec	AsymPayAsymRec
observed	4.6	3.1	4.7	3.8
	4.0	6.3	5.3	8.4
	4.4	3.6	4.6	3.7
predicted	4.3	4.4	4.4	4.5
	4.3	4.4	4.4	4.5
	4.3	2.8	4.4	3.3

Notes. Cell entries give the observed and predicted payoffs by treatment and player role assuming risk-neutrality and continuation probability $\delta = 0.9$

The observed deviations from theory in accepting and proposing the middle option also result in payoff consequences of asymmetric recognition probabilities that differ from the predicted effect. Hypothesis 1d states that asymmetric probabilities reduce player 3's average payoff while both player 1's and 2's payoff remain unchanged. This implies that having a lower recognition probability should not hurt player 1. The data presented in Table 5.4 show that player 3 indeed suffers a significant reduction in payoffs but we also see that player 2 increases her payoff at the expense of player 1 (all changes are significant at the 1%-level).

We now turn to the effects of payoff asymmetries. For accepting behavior we expect that asymmetric payoffs reduce player 1's and 2's propensity to accept their middle option (Hypothesis 2a) while only affecting player 3's behavior when recognition probabilities are symmetric (Hypothesis 2b). The observed behavior is broadly in line with these predictions but the decrease in the probability of accepting the middle option is only significant for player 1 when recognition probabilities are symmetric (p-value: 0.05) and for player 2 when they are asymmetric (p-value <0.01). Furthermore, player 3 shows a lower probability of accepting the middle option when payoffs are asymmetric but this effect is not significant (p-value: 0.23 when probabilities are symmetric and .49 for the asymmetric case).

With respect to proposing behavior we expect payoff asymmetry to play no role (Hypothesis 2c). While this is what we observe when recognition probabilities are symmetric (p-values are 0.39, 0.73 and 0.42 for players 1, 2 and 3) this prediction is not supported when recognition probabilities are asymmetric. Now payoff asymmetries significantly reduce player 1's probability of proposing her middle option (p-value <0.01) and significantly increases the frequency of player 3 proposing her middle option (p-value: 0.04). In sum, hypothesis 2c is only supported for symmetric recognition probabilities.

For the average payoffs shown in Table 5.4 we expect to find no effect of asymmetric payoffs for players 1 and 2 and an increase for player 3 when the recognition probabilities are asymmetric (Hypothesis 2d). The predictions that player 2 is unable to exploit the increased payoff associated with her favorite option is not observed in the laboratory since

player 2 is able to significantly increase her payoff (p-value <0.01 for both recognition probabilities). For asymmetric recognition probabilities it is not player 3 that significantly increases her payoffs but player 1 (p-value: 0.02 for player 1 and 0.78 for player 3).

Overall, from the between-treatment comparison a similar picture to the one found in the within-treatment analysis arises: Subjects do not react to asymmetries as predicted by theory and the deviations are more pronounced with asymmetric recognition probabilities than with asymmetric payoffs, indicating that subjects have more difficulties understanding the strategic effects of asymmetric recognition probabilities.

5.4 Conclusions

In this chapter we implemented in a controlled laboratory experiment the model of strategic bargaining in the presence of Condorcet cycles formulated by Herings and Houba (2010). To investigate the effect of asymmetries on bargaining behavior we varied the payoff structure (comparing symmetric payoffs to a situation where one player is advantaged) and the recognition rule (comparing symmetric recognition probabilities to a situation where one player has a lower probability of being recognized).

While subjects' behavior corresponds nicely to the equilibrium predictions when the game is perfectly symmetric, deviations from theory begin to appear when asymmetries are introduced. The two main deviations we observe are: First, subjects are more accommodating than expected and regularly accept their middle option; this might be due to risk-aversion. Second, subjects do not react to asymmetries in the way predicted by theory. While introducing asymmetric payoffs when recognition probabilities are symmetric leads to a change in the predicted direction (albeit less than expected), with asymmetric recognition probabilities substantial and systematic deviations from the theory arise. The most pronounced aspect of these deviations is that the player with the low recognition probability is much more accommodating than predicted, since she accepts and proposes the middle option more often than theory prescribes. A very similar result also arises for the tenfold payoffs employed in part I of the experiment. It is partly supported by a theoretical benchmark consisting of a quantal response equilibrium with risk-aversion and noise parameters estimated using our experimental data. A possible explanation for this finding could be that subjects use a heuristic that equates recognition probabilities and bargaining power which would lead the 'weak' player with the low recognition probability to be more accommodating than predicted.

Our finding that the strategic effect of asymmetries in recognition probabilities is difficult for subjects to comprehend warrants further investigation. First of all, the robustness of this phenomenon could be explored by running other games with random recognition rules – including the general class of Markov recognition processes studied in, e.g., Herings and Houba 2015– and experimentally varying the probabilities. Another possibility would be to run our experimental design again and give subjects more opportunity for learning either by letting them play the game for more rounds or by giving them more extensive feedback on their own and other players' decisions. Should the finding that players have problems

with asymmetric recognition prove to be robust one could in a second step look for the underlying causes for this.¹⁸ In conclusion, this chapter offers a first step towards understanding the effect of asymmetric recognition probabilities in bargaining institutions on behavior. Given the importance and prevalence of strategic bargaining in determining political and economic outcomes we are looking forward to further work in this direction. Our results suggest that there is still much we do not understand.

¹⁸ Possible mechanisms could be incorrect beliefs about other players' strategies or subjects having correct beliefs but not reacting optimally to them. This could be explored by eliciting beliefs or adapting the design employed by Esponda and Vespa (2014) for studying strategic voting and letting subjects play against a computer that follows a known strategy.

Appendix 5.A: Nash equilibrium analysis

In this appendix, we apply the concept of stationary subgame perfect Nash equilibrium, abbreviated as Nash equilibrium, to a player's decision whether to propose her best or middle option and whether or not to accept her middle option. It can be shown that each player's expected equilibrium payoff lies strictly between the utility of receiving her worst and best option. Therefore, if a player is proposed her best option, her best response is to accept it and if she is offered her worst option, she should reject it. Furthermore, proposing one's worst option is dominated by proposing the middle option, because the latter will be accepted.

Player i 's strategy is then fully described by two probabilities; P_i^{acc} , the probability of accepting her middle option whenever it is proposed to her and P_i^{prop} , the probability of proposing her middle option and with complementary probability proposing the best option. We will use the following notation: u_i^j denotes player i 's utility from player j 's best option; θ_i is the probability that player i is the proposer and δ denotes the probability that the game continues to the next period when a proposal has been rejected.

With monetary payoff distributions in the experiment given by

$$(9; 0; 4) ; (4; \beta; 0) ; (0; 4; 9)$$

with β equal to either 9 or 15, j 's best option is $j - 1$ ($j + 1$)'s middle (worst) option with the convention that $j + 1 = 4$ means 1 and $j - 1 = 0$ means 3.

The ex-ante expected utility π_i of player i is then given by :

$$\begin{aligned} \pi_i = & \theta_1 \{ P_1^{prop} * u_i^2 + (1 - P_1^{prop}) * [P_3^{acc} * u_i^1 + (1 - P_3^{acc}) * \delta * \pi_i] \} \\ & + \theta_2 \{ P_2^{prop} * u_i^3 + (1 - P_2^{prop}) * [P_1^{acc} * u_i^2 + (1 - P_1^{acc}) * \delta * \pi_i] \} \quad (1) \\ & + \theta_3 \{ P_3^{prop} * u_i^1 + (1 - P_3^{prop}) * [P_2^{acc} * u_i^3 + (1 - P_2^{acc}) * \delta * \pi_i] \} \end{aligned}$$

The ex-ante expected utility consists of the expected utility of possible and stochastically-reached agreement in the current bargaining round plus the present value of the ex-ante expected equilibrium utility of continuing after the current bargaining round, i.e. π_i . The current-period expected utility depends on who is recognized as the proposing player and whether this player proposes her middle option that is accepted immediately, or her best option that is randomly accepted.

The equilibrium conditions for player i 's probability of accepting the middle option are given by:

$$\begin{aligned} P_i^{acc} > 0 & \Rightarrow u_i^{i-1} \geq \delta * \pi_i \\ P_i^{acc} < 1 & \Rightarrow u_i^{i-1} \leq \delta * \pi_i \end{aligned} \quad (2)$$

The intuition is that if player i accepts (rejects) the middle option with positive probability, then the utility of the middle option cannot be smaller (larger) than the expected

continuation utility of rejecting the offer. In particular, if player i randomly accepts her middle option, $0 < P_i^{acc} < 1$, then both implications of (2) have to hold, and consequently, player i 's ex-ante expected equilibrium utility is given by $\pi_i = \delta^{-1} * u_i^{i-1}$.

The equilibrium conditions for player i 's probability of proposing the middle option are given by:

$$\begin{aligned} P_i^{prop} > 0 &\Rightarrow u_i^{i-1} \geq P_{i-1}^{acc} * u_i^i + (1 - P_{i-1}^{acc}) * \delta * \pi_i \\ P_i^{prop} < 1 &\Rightarrow u_i^{i-1} \leq P_{i-1}^{acc} * u_i^i + (1 - P_{i-1}^{acc}) * \delta * \pi_i \end{aligned} \quad (3)$$

The intuition is that if player i proposes the middle (best) option with positive probability, then the utility of the middle option cannot be lower (higher) than the expected utility arising from player i 's best option being accepted with probability P_{i-1}^{acc} by player $i - 1$, whose middle option it is, and the complementary probability that player i 's best option is rejected and bargaining continues to the next round with probability $(1 - P_{i-1}^{acc}) * \delta$. In particular, if player $i - 1$ always accepts her middle option for sure, $P_{i-1}^{acc} = 1$, then the implication of (3) cannot hold, and consequently, player i always proposes her best alternative for sure, $P_i^{prop} = 0$. Therefore, player i randomly proposing the middle option requires sufficiently large probabilities of acceptance of the middle option by player $i - 1$.

Table 5A.1: Nash equilibrium

	SymPaySymRec	SymPayAsymRec	AsymPaySymRec	AsymPayAsymRec
Accept M	100	48	39	21
	100	23	58	18
	100	100	73	100
Propose M	0	0	0	0
	0	0	0	0
	0	13	0	10

Notes. Cell entries give the probability of accepting (proposing) the middle option and the expected equilibrium payoffs by treatment and player role for the Nash equilibrium.

Deriving Nash equilibria is a routine exercise that is tedious because it involves going through four cases, each related to the number of players with $P_i^{prop} > 0$, and each of these cases has several subcases, each related to $P_i^{acc} > 0$ or $P_i^{acc} < 0$. We refer to Herings and Houba (2010) for an illustration of how to derive equilibria under $\delta = 1$ and omit a detailed derivation in this appendix. For our numerical predictions, we will assume that the players have identical CRRA utility functions of the form $u(x) = x^\alpha$ and risk neutrality ($\alpha = 1$). Table 5A.1 shows the Nash equilibrium for this case and $\delta = 0.9$ as in the experiment. We briefly discuss each case.

SymPaySymRec

In the Nash equilibrium, each player always accepts the middle option, $P_i^{acc} = 1$, and for each player it is then trivially optimal to always propose the best option, $P_i^{prop} = 0$.

Consequently, there is immediate agreement and we have $\pi_i = \frac{u_i^{i-1} + u_i^i}{3}$. Under CRRA and $\delta = 0.9$, the equilibrium condition for acceptance becomes $4^\alpha \geq \delta * \pi_i$, which can be rewritten as $\alpha * \ln(\frac{9}{4}) \leq \ln(3 * \delta^{-1} - 1)$ and holds for $\alpha \leq 1.04$. This range of α 's includes the entire range of risk averse parameter values.

AsymPaySymRec

In the Nash equilibrium, all players randomly accept the middle option with a probability strictly between zero and one, and each player always proposes the best option, $P_i^{prop} = 0$.

By (2) random acceptance implies that $\pi_i = \delta^{-1} * u_i^{i-1}$ and always proposing the best option requires $u_i^{i-1} \leq P_{i-1}^{acc} * u_i^i + (1 - P_{i-1}^{acc}) * \delta * \pi_i$. For risk neutrality, this sets up the following set of equilibrium conditions

$$\pi_1 = \frac{1}{3} [P_3^{acc} * 9 + (1 - P_3^{acc}) * 4 + 4 + (1 - P_2^{acc}) * 4] = 4 * \delta^{-1}$$

$$\pi_2 = \frac{1}{3} [P_1^{acc} * 15 + (1 - P_1^{acc}) * 4 + 4 + (1 - P_3^{acc}) * 4] = 4 * \delta^{-1}$$

$$\pi_3 = \frac{1}{3} [P_2^{acc} * 9 + (1 - P_2^{acc}) * 4 + 4 + (1 - P_1^{acc}) * 4] = 4 * \delta^{-1}$$

$$4 \leq P_3^{acc} * 9 + (1 - P_3^{acc}) * \delta * \pi_1$$

$$4 \leq P_1^{acc} * 15 + (1 - P_1^{acc}) * \delta * \pi_2$$

$$4 \leq P_2^{acc} * 9 + (1 - P_2^{acc}) * \delta * \pi_3$$

which solves for $\delta = 0.9$ as $P_1^{acc} = 0.38$, $P_2^{acc} = 0.57$ and $P_3^{acc} = 0.72$.

For α 's in the range from 0.64 to 0.93, the equilibrium slightly changes. All players still always propose their best option, player 1 and 2 randomize in accepting, and consequently $\pi_1 = \pi_2 = 4^\alpha * \delta^{-1}$ as before, and $P_3^{acc} = 1$, which by (2) imposes the equilibrium condition $\pi_3 \leq 4^\alpha * \delta^{-1}$. This gives the following set of equilibrium conditions

$$\pi_1 = \frac{1}{3} [9 + 4 + (1 - P_2^{acc}) * 4] = 4 * \delta^{-1}$$

$$\pi_2 = \frac{1}{3} [P_1^{acc} * 15 + (1 - P_1^{acc}) * 4 + 4] = 4 * \delta^{-1}$$

$$\pi_3 = \frac{1}{3} [P_2^{acc} * 9 + (1 - P_2^{acc}) * 4 + 4 + (1 - P_1^{acc}) * 4] \leq 4 * \delta^{-1}$$

$$4 \leq P_3^{acc} * 9 + (1 - P_3^{acc}) * \delta * \pi_1$$

$$4 \leq P_1^{acc} * 15 + (1 - P_1^{acc}) * \delta * \pi_2$$

$$4 \leq P_2^{acc} * 9 + (1 - P_2^{acc}) * \delta * \pi_3$$

from which we obtain

$$P_1^{acc} = \frac{3 \cdot \delta^{-1} - 2}{\left(\frac{15}{4}\right)^{\alpha} - 1} \text{ and } P_2^{acc} = \left(\frac{9}{4}\right)^{\alpha} + 2 - 3 \cdot \delta^{-1}$$

SymPayAsymRec and AsymPayAsymRec

In these two treatments, player 3 proposes the middle option with positive probability. In the equilibrium, player 1 and 2 always propose the best option and randomly accept the middle option, $P_1^{prop} = P_2^{prop} = 0$ and $0 < P_1^{acc}$; $P_2^{acc} < 1$, player 3 randomly proposes her middle option and always accepts the middle option for sure, $0 < P_3^{prop} < 1$ and $P_3^{acc} = 1$.

Like before, random acceptance imposes $\pi_1 = \pi_2 = 4^{\alpha} \cdot \delta^{-1}$ and player 3's acceptance of the middle option for sure requires $\pi_3 \leq 4^{\alpha} \cdot \delta^{-1}$. Through (3), randomly proposing by player 3 imposes $P_2^{acc} \cdot 9^{\alpha} + (1 - P_2^{acc}) \cdot \delta \cdot \pi_3 = 4^{\alpha}$ and always proposing the best option by players 1 and 2 requires $u_i^{i-1} \leq P_{i-1}^{acc} \cdot u_i^i + (1 - P_{i-1}^{acc}) \cdot \delta \cdot \pi_i$ ($i = 1; 2$). This leads to the following set of equilibrium conditions

$$\pi_1 = 0.1 \cdot 9^{\alpha} + .45 \cdot [4^{\alpha} + (1 - P_3^{prop}) \cdot (1 - P_2^{acc}) \cdot 4^{\alpha} + P_3^{prop} \cdot 9^{\alpha}] = 4 \cdot \delta^{-1}$$

$$\pi_2 = .45 \cdot [P_1^{acc} \cdot u_2^2 + (1 - P_2^{acc}) \cdot 4^{\alpha} + (1 - P_3^{prop}) \cdot 4^{\alpha}] = 4 \cdot \delta^{-1}$$

$$\pi_3 = .55 \cdot 4^{\alpha} + .45 \cdot (1 - P_1^{acc}) \cdot \delta \cdot \pi_3 \leq 4^{\alpha} \cdot \delta^{-1}$$

$$4 \leq P_3^{acc} \cdot 9 + (1 - P_3^{acc}) \cdot \delta \cdot \pi_1$$

$$4 \leq P_1^{acc} \cdot u_2^2 + (1 - P_1^{acc}) \cdot \delta \cdot \pi_2$$

$$P_2^{acc} \cdot 9^{\alpha} + (1 - P_2^{acc}) \cdot \delta \cdot \pi_3 = 4^{\alpha}$$

Although it is possible to derive a closed-form solution, where after several substitutions π_3 solves a quadratic equation, this solution is rather cumbersome. For that reason, we resorted to numerical methods to investigate equilibrium conditions and robustness with respect to α . For $\alpha = 1$, the probabilities for SymPayAsymRec are given by

$$P_1^{acc} = 0.49; P_2^{acc} = 0.24; P_3^{prop} = 0.14$$

with all equilibrium conditions satisfied, and similar for AsymPaySymRec, we find

$$P_1^{acc} = 0.21; P_2^{acc} = 0.18; P_3^{prop} = 0.11$$

with all equilibrium conditions satisfied. With respect to robustness, our numerical simulations show that this equilibrium structure holds for α above 0.71 and in case of SymPayAsymRec, and for α above 0.52 in case of AsymPayAsymRec.

To summarize, our closed-form solutions and numerical results indicate that the equilibrium probabilities do change quantitatively to changes in the CRRA risk coefficient parameter α . However, the investigation of robustness also shows that the hypotheses

formulated in the main text do not change qualitatively and that these are quite robust with respect to the risk coefficient parameter α .

Appendix 5.B: Quantal response analysis

In this analysis we apply the concept of noisy best-response as captured by the quantal response equilibrium to a player's decision whether to propose her best or middle option and whether to accept her middle option. For the case where a player is proposed her best (worst) option we assume that the player does not make any mistakes and follows the intuitively optimal strategy of accepting (rejecting) her best (worst) option. Furthermore, the player will never propose her worst option.

Player i 's strategy is therefore described by two probabilities; P_i^{acc} , the probability of accepting her middle option and P_i^{prop} , the probability of proposing her middle option. We will assume that the players have identical CRRA utility functions of the form $u(x) = x^\alpha$. We will furthermore use the following notation: u_i^j denotes player i 's utility from option j ; θ_i is the probability that player i is the proposer; δ denotes the probability that the game continues to the next period after a proposal has been rejected and λ is the noise parameter of the quantal response equilibrium (where the larger is λ , the closer behavior is to the behavior predicted by the Nash equilibrium).

The expected utility π_i of player i is then given by :

$$\begin{aligned} \pi_i = & \theta_1 \{ P_1^{prop} * u_i^2 + (1 - P_1^{prop}) * [P_3^{acc} * u_i^1 + (1 - P_3^{acc}) * \delta * \pi_i] \} \\ & + \theta_2 \{ P_2^{prop} * u_i^3 + (1 - P_2^{prop}) * [P_1^{acc} * u_i^2 + (1 - P_1^{acc}) * \delta * \pi_i] \} \\ & + \theta_3 \{ P_3^{prop} * u_i^1 + (1 - P_3^{prop}) * [P_2^{acc} * u_i^3 + (1 - P_2^{acc}) * \delta * \pi_i] \} \end{aligned}$$

Player i 's probability of accepting the middle option is given by:¹⁹

$$P_i^{acc} = \frac{\exp(\lambda * u_i^{i+1})}{\exp(\lambda * u_i^{i+1}) + \exp(\lambda * \delta * \pi_i)}$$

where the numerator captures the utility when accepting the middle option and the additional term in the denominator captures the expected utility when rejecting the offer.

Player i 's probability of proposing the middle option is given by:²⁰

$$P_i^{prop} = \frac{\exp(\lambda * u_i^{i+1})}{\exp(\lambda * u_i^{i+1}) + \exp(\lambda * [P_{i-1}^{acc} * u_i^i + (1 - P_{i-1}^{acc}) * \delta * \pi_i])}$$

where the numerator captures the utility associated with proposing her (with certainty accepted) middle option and the additional term in the denominator captures the expected utility when proposing the best option.

The three payoff functions and the six equations for the probabilities form a set of equations and the quantal response equilibrium is given by the solution to this fixed point

¹⁹ For ease of notation we define $u_i^{i+1=4} = u_i^1$.

²⁰ For ease of notation we define $P_{i-1=0}^{acc} = P_3^{acc}$

problem. Table 5.B1 shows the quantal response equilibrium for the risk-aversion parameter ($\alpha = 0.44$) and the noise parameter ($\lambda = 3.6$) that are derived using a maximum likelihood estimation using the data from our experiment.

Table 5B.1: Quantal response equilibrium

	SymPaySymRec	SymPayAsymRec	AsymPaySymRec	AsymPayAsymRec
Accept M	87	90	81	81
	87	71	80	62
	87	93	89	95
Propose M	10	8	9	7
	10	8	2	2
	10	22	14	34
Expected payoff	4.7	3.7	5.1	4.5
	4.7	5.3	6.8	7.6
	4.7	3.8	4.3	3.3

Notes. Cell entries give the probability of accepting (proposing) the middle option and the expected equilibrium payoffs by treatment and player role for the quantal response equilibrium with $\alpha=0.44$ and $\lambda=3.6$

Appendix 5.C: Instructions and screenshots of the experiment

In this appendix, we provide the instructions that the subjects read on their monitors. We also give the summary of the instructions that was handed out to subjects after they had read these on-screen instructions. Finally, we provide screenshots of the user interface of the experiment.

5.C.1 Instructions²¹

Welcome to this experiment on decision-making. Please carefully read the following instructions. If you have any questions, please raise your hand, and we will come to your table to answer your question in private.

In this experiment you will earn points. At the end of the experiment, your earnings in points will be exchanged for money at rate 10 eurocent for each point. This means that for each 10 points you earn, you will receive 1 euro. Additionally, you will receive a show-up fee of 7 euros. Your earnings will be privately paid to you in cash at the end of the experiment.

This experiment consists of 3 parts. You will first receive the instructions for the first part. The instructions for the second part you will only receive once the first part is done. The instructions for the third part you will receive after the second part is done.

Instructions for part I

In the first part of the experiment you will be randomly matched with two other persons in the lab with whom you will never interact in parts II and III of this experiment. Your group of three consists of a player 1, a player 2 and a player 3. These roles are randomly determined in the beginning of the first part of the experiment and the roles stay the same throughout the first part of the experiment.

The task that the group has to perform is to select one out of three alternatives that then determines the payoffs in this round. In the table below you see the payoffs assigned to each type of player by the different alternatives. Remember that each point is worth 10 cents.

Alternative 1	Alternative 2	Alternative 3
Player1: 90 points	Player1: 40 points	Player1: 0 points
Player 2: 0 points	Player 2: 150 points	Player 2: 40 points
Player 3: 40 points	Player 3: 0 points	Player 3: 90 points

The process of choosing an alternative is organized by periods. In each period all group members submit a proposal (being one of the three alternatives) they want the other group members to vote on. After every group member has submitted a proposal one of the

²¹ We provide here the instructions used for the treatment AsymPayAsymRec. The instructions for other treatments are analogous and available upon request.

proposals is randomly chosen to be voted on. The probabilities for the different players are presented in the table below.

Player 1	Player 2	Player 3
33.3%	33.3%	33.3%

As you can see the proposal by player 1 has a lower chance of being put up for a vote than the a proposal by players 2 or 3.

The proposal of the selected player (the "proposer") is then communicated to the other two group members which then can vote to accept or reject the proposal. The voting procedure works as follows: First the player who earns a higher payoff from the proposal gets to cast his vote. Given that the proposer supports his own proposal the proposal is accepted if the first voter accepts the proposal. In this case the first part of the experiments ends and the payoffs for this part are computed according to the chosen alternative. After this the experiment moves to the second part of the experiment.

If the first voter rejects the offer the remaining group member (who is not the proposer) gets to cast his vote. If he votes yes the proposal is accepted, the payoffs for this part are computed according to the chosen alternative and the experiments moves to the second part.

Should also the second group member reject the proposal two things can happen: With probability 90% the game continues to the next period and again proposals have to be submitted. With a 10% chance the game ends after a proposal was rejected and payoffs for the first part are zero for all group members. Furthermore the experiment moves to part II.

Instructions for part II

The second part of the experiment consists of 10 rounds. In each round you will play a similar game to the one in part I.

In each round you will be randomly matched with two other persons in the lab (that can not be the same persons you interacted with in part I). Again, a group of three always consists of a player 1, a player 2 and a player 3. These roles are randomly determined in every round. This means, for instance, that you can be player 1 in one round and player 2 in another round.

As in part I the task that the group has to perform is to select one out of three alternatives that then determines the payoffs in this round. In the table below you see the payoffs assigned to each type of player by the different alternatives. Please note that the payoffs are different from part I.

Alternative 1	Alternative 2	Alternative 3
Player1: 9 points	Player1: 4 points	Player1: 0 points
Player 2: 0 points	Player 2: 15 points	Player 2: 4 points
Player 3: 4 points	Player 3: 0 points	Player 3: 9 points

The process of choosing an alternative is organized as in part I. As a reminder: This means that in each period all group members submit a proposal (being one of the three alternatives) they want the other group members to vote on. After every group member has submitted a proposal one of the proposals is randomly chosen to be voted on. The probabilities for the different players are presented in the table below and are the same as in part I.

Player 1	Player 2	Player 3
33.3%	33.3%	33.3%

The game proceeds than in the same fashion as in part I: The proposal of the selected player is communicated to the other two group members which then can vote to accept or reject the proposal. First the player who earns a higher payoff from the proposal gets to cast his vote. If this first voter accepts the proposal the proposal is accepted. In this case the round ends and the payoffs for this round are computed according to the chosen alternative. After this the experiment moves to the next round.

If the first voter rejects the offer the remaining group member (who is not the proposer) gets to cast his vote. If he votes yes the proposal is accepted and the experiments moves to the next round.

Should also the second group member reject the proposal two things can happen: As in part I with probability 90% the round continues to the next period and again proposals have to be submitted. With a 10% chance the rounds ends after a proposal was rejected and payoffs for this round are zero for all group members. Furthermore the experiment moves to the next round.

After all 10 rounds have passed the payoffs from all rounds are added it up and exchanged at a rate of 10 cent per point.

Instructions for part III

The third part of the experiment only consists of the choice described below. Again each point is worth ten cent.

In the table below, we present six different options. Please select one of the options.

Your earnings will depend on the outcome of a fair coin toss. Every option shows the amount in points you earn in case a head shows up or a tail shows up.

When determining your total earnings for this experiment, the computer will "toss a coin" and add an amount according to the outcome of the toss and the choice you made to your earnings of parts 1 and 2. The outcome of the coin toss will be determined after you submitted your choice and will be shown to you on the next page.

	Your earnings when coin indicates heads	Your earnings when coin indicates tails
Option 1	25 points	25 points
Option 2	33 points	21 points
Option 3	41 points	17 points
Option 4	49 points	13 points
Option 5	57 points	9 points
Option 6	62 points	5 points
Option 7	65 points	0 points

5.C.2 Printed summary of instructions

Summary instructions: Part I

- The experiment consists of three parts; these are the instructions for the first part
- You will be in a group of three players. A group always consists of a player 1, a player 2 and a player 3.
- For the whole first part you will be player 1 or player 2 or player 3.
- Your task is to decide which of three alternatives (see below) to implement

	Alternative 1	Alternative 2	Alternative 3
Payoff player 1	90	40	0
Payoff player 2	0	90	40
Payoff player 3	40	0	90

- The process of choosing an alternative is organized by periods. In each period every player will propose an alternative to the other two players. The proposal of only one player will be randomly chosen to be voted upon and then be shown to the other two players.
- The probability that a given player's proposal is chosen is given below

	Player 1	Player 2	Player 3
probability	33.3%	33.3%	33.3%

- The voting procedure works as follows:
 1. Out of the two players who are not the proposer, the player who has a higher payoff from the proposal gets to cast his vote first. If he accepts this proposal is implemented.
 2. If the proposal gets rejected by the first voter the other player who is not the proposer gets to cast his ballot. If he votes "Yes" the proposal is accepted. If he also votes "No" the proposal is rejected.
- If the proposal is accepted, this proposal is implemented and everyone gets the payoffs associated with this alternative. The first part of the experiment ends then.
- If the proposal is rejected, two things can happen:
 1. In 1 out of 10 cases: the first part of the experiment ends and everyone receives a payoff of zero for this part.
 2. In 9 out of 10 cases: the game continues to the next period where again proposals are made and voted upon.

At the end of the experiment each point is worth ten cents and together with a show-up fee of 7€ you will receive these earnings in private at the end of the experiment together with your earnings of parts two and three of the experiment.

Summary instructions: part II

- The experiment consists of three parts; these are the instructions for the second part
- This part consists of 10 rounds
- In each round you will be in a group of three players. A group always consists of a player 1, a player 2 and a player 3.
- In each round you will be player 1 or player 2 or player 3.
- After each round you get randomly rematched with two other persons in the lab and be randomly assigned player 1 or player 2 or player 3.
- Your task in each round is to decide which of three alternatives (see below) to implement

	Alternative 1	Alternative 2	Alternative 3
Payoff player 1	9	4	0
Payoff player 2	0	9	4
Payoff player 3	4	0	9

- The process of choosing an alternative is organized by periods. In each period every player will propose an alternative to the other two players. The proposal of only one player will be randomly chosen to be voted upon and then be shown to the other two players.
- The probability that a given player's proposal is chosen is given below

	Player 1	Player 2	Player 3
probability	33.3%	33.3%	33.3%

- The voting procedure works as follows:
 3. Out of the two players who are not the proposer, the player who has a higher payoff from the proposal gets to cast his vote first. If he accepts this proposal is implemented.
 4. If the proposal gets rejected by the first voter the other player who is not the proposer gets to cast his ballot. If he votes "Yes" the proposal is accepted. If he also votes "No" the proposal is rejected.
- If the proposal is accepted, this proposal is implemented and everyone gets the payoffs associated with this alternative.
- If the proposal is rejected, two things can happen:
 3. In 1 out of 10 cases: the round ends and everyone receives a payoff of zero for this round.
 4. In 9 out of 10 cases: the round continues to the next period where again proposals are made and voted upon.
- At the end of the experiment each point is worth ten cents and together with a show-up fee of 7€ you will receive these earnings in private at the end of the experiment together with your earnings of parts one and three of the experiment.

5.C.3 Screenshots of the interface

This is period 1 in round 1 of 5

You are player 1

Which alternative do you want to propose?

Player 1: 70 points Player 2: 0 points Player 3: 40 points <input type="radio"/> Alternative 1	Player 1: 40 points Player 2: 70 points Player 3: 0 points <input type="radio"/> Alternative 2	Player 1: 0 points Player 2: 40 points Player 3: 70 points <input type="radio"/> Alternative 3
---	---	---

Submit

Notes. The screen subjects saw when making a decision for which option to propose.

This is period 2 in round 3 of 5

You are player 1

Which alternative do you want to propose?

Player 1: 70 points Player 2: 0 points Player 3: 40 points <input type="radio"/> Alternative 1	Player 1: 40 points Player 2: 70 points Player 3: 0 points <input type="radio"/> Alternative 2	Player 1: 0 points Player 2: 40 points Player 3: 70 points <input type="radio"/> Alternative 3
---	---	---

Submit

History of past rounds:

Round	Period	Role	Proposal	Year decision	Result
1	1	1	0	Propose	Alternative 2 chosen

Notes. The screen subjects saw when making a decision for which option to propose; the table at the bottom of the screen shows an example of the history box.

Player 2 was chosen to be the proposer in this period. He proposed alternative 2.

You are player 1

Do you want to accept this proposal??

Player 1: 40 points Player 2: 70 points Player 3: 0 points <input type="radio"/> Yes	<input type="radio"/> No
---	--------------------------

Submit

Notes. The screen subjects saw when deciding whether to accept a proposal.

Proposal in periode 1 of round 1

Player 2's proposal was accepted by both players. Therefore alternative 2 will be implemented.

Your resulting payoff in this round is therefore 70 points.

Your accumulated payoff after this round is 110 points.

Click [here](#) to go to the next round.

Notes. The screen subjects saw after a proposal was accepted.

Proposal in periode 1 of round 1

The proposal was rejected by both players.

Click [here](#) to go to the next period.

Notes. The screen subjects saw after a proposal was rejected.

The bargaining broke down. Therefore you do not earn any points from this rounds.

Your accumulated payoff after this round is 0 points.

Click [here](#) to go to the next round.

Notes. The screen subjects saw when bargaining broke down.

Appendix 5.D: Regression analysis for part II

For the analysis of part II of the experiment we employ logit regressions with the decision to accept or propose the middle option as the dependent variable and standard errors clustered at the matching group level. To investigate within treatment variations across roles we run regressions with the subject's role in a given round as independent variable. Table 5D.1 shows the results of this regression by treatment.

Table 5D.1: Logit regressions by treatment

	SymPay SymRec	SymPay AsymRec	AsymPay SymRec	AsymPay AsymRec
Accepting the middle option				
Player 2	-.00	-.28 ^{***}	.11 [*]	-.28 ^{**}
Player 3	.05	-.21 [*]	.16 ^{**}	-.10
Proposing the middle option				
Player 2	-.02	-.13 ^{***}	-.01	-.06 ^{**}
Player 3	-.01	-.09 ^{***}	-.01	.05 [*]

Notes. The table shows the marginal effects of a logit regression with the decision to accept (propose) the middle option as the dependent variable. 'Player 2' ('Player 3') is equal to one if the player's role is player 2 (player 3). Standard errors are clustered at the matching group level. * (**; ***) denotes that the coefficient is significantly different from zero at the 10% (5%; 1%)-level.

Table 5D.2: Behavior over time by role and treatment

	SymPay SymRec	SymPay AsymRec	AsymPay SymRec	AsymPay AsymRec
Accepting the middle option				
Player 1	-.000	-.002	-.030	-.002
Player 2	.010	-.018	-.038 ^{***}	-.040
Player 3	.010	.014 ^{**}	-.019	.011
Proposing the middle option				
Player 1	-.008	-.014	-.011	-.005
Player 2	-.010 ^{***}	-.005	-.005	-.005
Player 3	-.004 [*]	-0.05	-0.000	.015 ^{***}

Notes. The table shows the marginal effects of a logit regression with the decision to accept (propose) the middle option as the dependent variable and the round of the decision as independent variable run separately for each role and treatment. Standard errors are clustered at the matching group level. * (**; ***) denotes that the coefficient is significantly different from zero at the 10% (5%; 1%)-level.

To investigate behavior over time we also ran regressions with the decision round as independent variable for each role and treatment separately. Table 5D.2 shows the results. As we can see for most roles and treatments there are no significant changes in behavior over time but overall the direction of the change is in line with behavior getting slightly closer to equilibrium over time. The sole exception is the proposal behavior of player 3 in

the treatments with asymmetric probabilities where the direction of the change is away from the equilibrium choice probabilities.

To investigate the treatments effect on the acceptance and proposing decision table 5D.3 presents the results from logit regressions with treatment dummies as independent variables run separately by players' role.

Table 5D.3: Logit regression by role

	Player 1	Player 2	Player 3
Accepting the middle option			
SymPayAsymRec	.07	-.27 ^{***}	-.16 [*]
AsymPaySymRec	-.21 [*]	-.09	-.08
AsymPayAsymRec	-.07	-.39 ^{***}	-.24 ^{***}
Proposing the middle option			
SymPayAsymRec	.14 ^{***}	-.01	.02
AsymPaySymRec	-.03	-.01	-.02
AsymPayAsymRec	.02	-.02	.09 ^{**}

Notes. The table shows the marginal effects of a logit regression with the decision to accept (propose) the middle option as the dependent variable. 'SymPayAsymRec' ('AsymPaySymRec', 'AsymPayAsymRec') is equal to one if the treatment has asymmetric (symmetric, asymmetric) recognition probabilities and the payoffs are symmetric (asymmetric, asymmetric). Standard errors are clustered at the matching group level. * (**, ***) denotes that the coefficient is significantly different from zero at the 10% (5%; 1%-)level.

To test the treatment effects regarding the payoffs we ran linear regressions for each role with a player's payoffs as the dependent variable and treatment dummies as independent variables. The results are shown in table 5D.4.

Table 5D.4: Effect of treatments on payoffs

	Player 1	Player 2	Player 3
SymPayAsymRec	-1.5 ^{***}	2.3 ^{***}	-0.8 ^{***}
AsymPaySymRec	0.1	1.3 ^{**}	0.2
AsymPayAsymRec	-0.8 ^{***}	4.4 ^{***}	-0.7 ^{**}

Notes. The table shows the coefficients of a linear regression with a player's payoff as the dependent variable. 'SymPayAsymRec' ('AsymPaySymRec', 'AsymPayAsymRec') is equal to one if the treatment has asymmetric (symmetric, asymmetric) recognition probabilities and the payoffs are symmetric (asymmetric, asymmetric). Standard errors are clustered at the matching group level. * (**, ***) denotes that the coefficient is significantly different from zero at the 10% (5%; 1%-)level.

Finally, we investigate whether there are gender effects in data and what effect subjects' elicited risk-aversion has on their decision to propose and accept the middle option. The results shown in Table 5D.5 indicate that a subject's gender is not an important determinate of behavior since most coefficients are small and insignificant. Furthermore, for the acceptance decision most of the 'risk' coefficients are negative (as we would expect since more risk-averse players have a lower value of the variable 'risk' and are ceteris paribus more likely to accept their middle option) if we aggregate choices over all

treatments and roles the coefficient is not significant (p-value: 0.41).²² The same holds true for the proposing behavior where again the majority of the coefficients are negative but overall there is no significant effect of the risk-variable (p-value: 0.54).²³

Table 5D.5: Effect of risk-aversion and gender

		SymPay SymRec	SymPay AsymRec	AsymPay SymRec	AsymPay AsymRec
Accepting the middle option					
Player 1	male	.032	-.017	.236	.015
	risk	-.000	-.022*	-.027	.021
Player 2	male	-.022	-.091	-.170*	-.219*
	risk	-.006	-.002	-.024	.027
Player 3	male	-.043	-.169	.157*	<i>omitted</i>
	risk	-.021**	.047	-.074	-.010
Proposing the middle option					
Player 1	male	-.067**	-.036	.036	-.012
	risk	.002	.003	-.016	.006
Player 2	male	-.056	.018	-.049	-.020
	risk	-.007	-.015	.003	-.008
Player 3	male	-.017	.056	.000	-.024
	risk	-.003	-.017	-.014	.004

Notes. The table shows the marginal effects of a logistic regression with the decision to accept (propose) the middle option as the dependent variable. ‘Male’ is equal to one if the subject is male and ‘risk’ is equal to the choice made in the risk-elicitation task in part III of the experiment (possible values are 1-7 where higher number indicate less risk-averse preferences). Standard errors are clustered at the matching group level. * (**, ***) denotes that the coefficient is significantly different from zero at the 10% (5%; 1%)-level.

²² If we aggregate choices only over treatments but run regression for separate roles we find that the effect of ‘risk’ is only significantly negative for player 3 with p-values of 0.96 (0.77; 0.05) for player 1 (2;3). When aggregating over players and running separate regressions by treatments the only significant effect is a positive coefficient in treatment AsymPayAsymRec (p-value <0.01) while in the other three treatments the coefficients are negative and insignificant (SymPaySymRec: 0.25; SymPayAsymRec: 0.87; AsymPaySymRec: 0.43).

²³ If we aggregate choices only over treatment and have separate regressions for different roles all coefficients are insignificant (player 1: 0.63; player 2: 0.11; player 3: 0.30). The same holds true for aggregating by treatment (SymPaySymRec: 0.72; SymPayAsymRec: 0.50; AsymPaySymRec: 0.27; AsymPayAsymRec: 0.96)

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Summary

Political actors exert enormous influence over our daily lives. Their influence on economic activities cannot be underestimated. Voters determine the distribution of political power, political candidates choose policy platforms that they intend to enact if elected, and legislators bargain to arrive at laws. Understanding political actors' behavior is therefore essential for explaining economic outcomes. This thesis follows the tradition of the political economy literature and considers the effect of institutional rules on the behavior of three types of political actors: voters, candidates, and negotiators. It does so by combining insights from game-theoretic models and controlled laboratory experiments.

In chapter 2 (which is joint work with Arthur Schram), *A Simultaneous Analysis of Turnout and Voting under Proportional Representation – Theory and Experiments*, we address the question whether a voter's turnout decision and her selection of a party (or candidate) interact. Specifically, we consider whether an extreme vote is more likely to be observed when voting is voluntary than in systems of compulsory voting and how the voluntary or mandatory nature of turnout affect strategic voting.¹

Even though voting has been studied for a long time up to now such questions have mostly been ignored and instead much of the literature has focused on either analyzing the determinants of a voter's turnout decision or on trying to explain her party choice. We argue that this might miss important dynamics, especially in a system of proportional representation that gives rise to incentives for strategic voting. To address this potential interaction effect we present a theoretical model of voting in a system of proportional representation and complement this with data from a controlled laboratory experiment.

Our theoretical analysis predicts three effects. First, a *Polarization Effect*: Voters who cast a vote are more likely to vote for an extreme party when there is a possibility to abstain than when voting is mandatory. The mechanism underlying this effect is that voluntary voting reduces the extent of strategic voting by the more extreme voters. The intuition is related to the fact that extremist voters are more likely to cast a vote (the second effect). As a consequence, the election becomes more of a run-off between the extreme parties than in the mandatory voting case. In turn, this reduces the expected benefit from voting strategically for a more moderate party. We denote the second effect, that extremist voters are more likely to turn out, as the *Extremist Effect*. The intuition here is that there is more at stake for extreme voters because the worst-case scenario (the other extreme winning the

¹ Strategic voting is defined as abandoning the most preferred party to favorably influence the election outcome.

election) is worse than for centrist voters. The third effect is the *Turnout Effect*: voters are more likely to vote when the polarization of party positions increases. Here, the reason is that increased differences across parties put more at stake in the elections for all voters.

We test these theoretical predictions using a laboratory experiments that in a between-subjects design varies the polarization of party positions and whether voting is mandatory or voluntary. Our experimental results provide support for the predictions, though only weak support is found for the *Polarization Effect* of voluntary voting when the parties are relatively close. The observed turnout rates exhibit the predicted feature that polarization boosts turnout and extreme voters are more likely to vote than centrist voters. This latter difference is not as pronounced as theoretically expected because centrist voters turn out substantially more often than predicted.

Obviously, the results from the laboratory experiment cannot give a definitive answer as to whether these effects are also present in the field. We therefore complement the experimental data with three empirical exercises that each address one of the three effects. To identify the *Polarization Effect* we make use of the fact that both the Netherlands and Belgium used to have mandatory voting and that both abolished it (Netherlands in 1970) or stopped enforcing the penalty for abstaining (Belgium in 2003). Given the similarity of these countries in terms of political system and political views, we compare the extent of extreme voting between the two countries in the two elections following the policy change in one. As predicted by our model, we find that polarization increases dramatically in the country that abolished compulsory voting while no substantial change is observed in the comparison country. Using data from the Comparative Study of Election Systems, the Eurobarometer and the Dutch Election Study we also find the predicted pattern that more extreme voters have higher turnout rates. Furthermore, a case study of the Netherlands shows a positive correlation between the polarization of the party system and turnout rates.

Given that theory, laboratory data and empirical evidence all provide supportive evidence for the interaction effects between party choice and turnout, we conclude that they are to be reckoned with when studying voter behavior.

In chapters 3 and 4, I turn my attention to candidate behavior. Since, similar to the case of voter behavior studied in chapter 2, an interaction effect might exist between a candidate's entry decision and her policy choice I use the citizen-candidate paradigm (Osborne and Slivinsky, 1996, Besley and Coate, 1997) to study candidate behavior. This paradigm makes it possible to study entry and policy choice simultaneously by assuming that citizens have fixed positions in the policy space (which are common knowledge) and each citizen can run for office. It is obvious that this model can be used to analyze entry behavior but by investigating where in the policy space the entrants are located I can also gain insights into the policy choice, for instance how polarized entrants' positions will be in equilibrium.

In chapter 3, *Plurality Voting versus Proportional Representation in the Citizen-Candidate Model: The Role of Coalitions*, I address the question how the number of candidates and their polarization varies between plurality voting and proportional representation. The main contribution of the chapter is to investigate how the difference between the electoral

systems depends on the details of modelling proportional representation. Up to now the standard approach in the literature has been to model government policy in a system of proportional representation as the weighted average of all candidates' policy positions. I argue that this misses one of the defining characteristics of proportional representation, the presence of coalition governments. Therefore, I introduce a model of proportional representation with coalition formation where only the members of the government coalition have an influence on the policy and the members of the coalition proportionally share the office rents.

I then derive the Nash equilibria for the case of purely policy-motivated and purely office-motivated (i.e. 'Downsian') candidates. The theoretical analysis leads to three main results. First, taking the coalitions associated with proportional representation into account leads – compared to ignoring coalitions – to candidate positions that are less polarized. This implies that the common criticism of proportional representation leading to high polarization has less bite once we take into account the incentives associated with coalition formation. Second, for the case without coalition formation, I do find that plurality voting leads to more centrist outcomes than proportional representation. This is in line with the hypothesis put forth by Cox (1990) that proportional representation leads to more polarized outcomes. Third, for the classical case of Downsian candidates, I find that proportional representation with coalitions is more conducive to multi-candidate equilibria than proportional representation without coalitions or plurality voting.

In chapter 4, *Plurality Voting versus Proportional Representation in the Citizen-Candidate Model: An Experiment*, I address the question of the difference in candidate behavior between plurality voting and proportional representation using a controlled laboratory experiment. In the laboratory I implement the citizen-candidate model with five potential candidates that are equally spaced along a one-dimensional policy space and vary the electoral system and the costs of running for office in a between-subject design employing a partner matching.

Theory predicts an (intuitive) cost effect, where higher costs of running for office reduce the number of entrants. Furthermore, when the costs of running for office are low proportional representation is predicted to lead to more entry while with high costs no such difference is expected. This makes it possible to investigate whether more entry under proportional representation is an equilibrium phenomenon or simply due to some heuristic. If it were based on a heuristic (such as entering to influence the policy, without regard for payoffs) then the difference should appear independently of costs.

The results from the experiment are broadly in line with the theory and I observe the predicted comparative statics effect for the electoral system and the costs of running for office. At the same time the data exhibit substantial over-entry compared to the Nash equilibrium predictions, which is a common finding in experiments on entry and contest games. The over-entry might be explained by a joy of winning effect, i.e. a non-monetary benefit from winning the election.

Combining the findings from chapters 3 and 4 gives rise to two main conclusions. First, the citizen-candidate paradigm is supported by experimental evidence, which strengthens confidence in the usefulness of this approach. Second, if we want to analyze the effects of proportional representation we have to accept the challenge of incorporating coalition formation and the associated incentives into our models. An obvious follow-up building on these two conclusions would be to add the model of proportional representation with coalitions presented in chapter 3 to the experimental framework of chapter 4.

In joint work with Harold Houba, chapter 5, *Bargaining in the Presence of Condorcet Cycles: The Role of Asymmetries*, investigates the role of asymmetries in strategic bargaining. We focus on the case where no Condorcet winner, i.e. an alternative that beats any other alternative in a pair-wise vote, exists, since otherwise the Condorcet winner is very likely to be implemented irrespective of the details of the bargaining institution. We analyze the situation using the strategic bargaining model by Baron & Ferejohn (1989), where in each bargaining round one player is randomly chosen to make a proposal that the other players then vote on.

Building on work by Herings and Houba (2010), who theoretically analyze a very similar game, we set up a controlled laboratory experiment in which three players have to choose which of three options to implement. In a between-subjects design we vary whether the options are symmetric or whether one player gets a higher payoff from her best option than the other two players. The second parameter we vary is the probability that a given player will be able to make a proposal. We contrast the symmetric situation where all players are equally likely to be the proposer to the situation where one player has a lower probability of being the proposer.

From the experiment two main results arise: First, subjects are underexploiting their bargaining power and accept proposals too often, which might be caused by subjects' risk aversion. The second main result is that for asymmetric probabilities we observe systematic deviations from the model predictions. In comparison, subjects' change in behavior when going from symmetric to asymmetric alternatives is more in line with the theory when probabilities are symmetric. The systematic deviations for asymmetric probabilities not only arise relative to the risk-neutral Nash equilibrium but also when a quantal response equilibrium –with risk-aversion and noise parameters estimated using the experimental data– is used as the theoretical benchmark. We therefore conclude that subjects have a harder time understanding the strategic implications of asymmetric recognition probabilities than asymmetric payoffs and rely on heuristics when dealing with such asymmetric recognition. One such heuristic that is consistent with the data would be that subjects equate the probability of being the proposer with a player's bargaining power.

Samenvatting (Summary in Dutch)¹

Politieke actoren hebben een grote invloed op ons dagelijks leven. Ook de invloed die ze hebben op economische activiteiten is moeilijk te overschatten. Kiezers bepalen de verdeling van de politieke macht, politici kiezen hun standpunten en wetgevers onderhandelen over de te maken wetten. Daarom is het van wezenlijk belang het gedrag van deze politieke actoren te begrijpen als we economische uitkomsten willen verklaren. Dit proefschrift staat in de traditie van de politieke economie en onderzoekt het effect van institutionele regelgeving op het gedrag van drie groepen politieke actoren: Kiezers, politici en onderhandelaars. Hiervoor wordt gebruik gemaakt van speltheoretische modellen en gecontroleerd laboratorium onderzoek.

In het tweede hoofdstuk (in samenwerking met Arthur Schram), *A Simultaneous Analysis of Turnout and Voting under Proportional Representation – Theory and Experiments*, kijken we naar de interactie tussen de beslissing van de kiezer om te gaan stemmen en haar stemgedrag. In het bijzonder onderzoeken we of er meer op extreme (linkse of rechtse) partijen wordt gestemd in een systeem zonder stemverplichting dan in een met stemverplichting. Daarnaast bestuderen we het effect van een stemverplichting op de beslissing om strategisch te stemmen (dat wil zeggen niet op de partij die het dichtst bij de eigen voorkeur ligt).

Verkiezingen worden al heel lang bestudeerd, door zowel politicologen als economen. Toch zijn de bovenstaande vragen in belangrijke mate genegeerd. Dit omdat de meeste studies ofwel de partijkeuze van de kiezers onderzoeken, ofwel de beslissing om al dan niet te gaan stemmen. Wij betogen juist dat er samenhang bestaat tussen deze twee beslissingen, met name in een systeem van evenredige vertegenwoordiging, en dat dit kan leiden tot strategisch stemmen. Om deze samenhang goed te bestuderen presenteren wij een theoretisch model voor kiesgedrag met evenredige vertegenwoordiging en presenteren we zowel de theoretisch uitkomsten als de resultaten van een laboratorium experiment waarin het model getoetst wordt.

De theoretische analyse voorspelt drie effecten. Ten eerste een *Polarization Effect*: Kiezers stemmen eerder op een extreme partij als er geen stemverplichting bestaat dan wanneer dit wel het geval is. Dit is omdat kiezers die zelf extreme standpunten hebben eerder geneigd zijn strategisch te stemmen (op een minder extreme partij) als ze verplicht zijn een stem uit te brengen. Daarnaast zijn het juist deze meer extreme kiezers die als er geen verplichting is een belang hebben om te stemmen; dit duiden we aan als een *Extremist Effect*. De

¹ I thank Ben Loerakker and Arthur Schram for the translation. All errors remain my own.

intuïtie hierbij is dat het voor deze meer extreme kiezers veel vervelender is als een partij aan de andere kant van het politieke spectrum de verkiezingen (mede) wint, dan dat het voor meer gematigde kiezers is. Het laatste effect is het zogenoemde *Turnout Effect*: Als de partijen verder uit elkaar komen te liggen in het politieke spectrum gaan kiezers eerder stemmen (als dit niet al verplicht is). Het belang voor de kiezers neemt immers toe als de mogelijke uitkomsten extremer worden.

Deze voorspellingen van het model hebben we vervolgens getoetst in het laboratorium, waarin we zowel de afstand tussen de partijen als het bestaan van een stemverplichting hebben gevarieerd. De experimenten bevestigen de theoretische voorspellingen, hoewel het *Polarisation Effect* relatief zwak blijkt te zijn. Extreme kiezers stemmen weliswaar vaker dan meer gematigde kiezers, zoals de theorie voorspelt, maar dit effect is minder groot dan voorspeld omdat gematigde kiezers aanmerkelijk vaker een stem uitbrengen dan voorspeld.

Uiteraard geven laboratorium experimenten alleen geen compleet beeld van de situatie in de buitenwereld. Daarom hebben we ook drie verschillende empirische onderzoeken gedaan naar de drie voorspelde effecten. Voor het *Polarisation Effect* hebben we gekeken naar de situatie in België (rond 2003) en Nederland (rond 1970). In beide landen bestond er aanvankelijk een stemverplichting. Deze werd in Nederland in 1970 afgeschaft en in België werd in 2003 de straf op het niet stemmen geschrapt. Gezien de vele overeenkomsten tussen beide landen, zowel in politieke voorkeuren als in politieke systemen, vergelijken we het aantal stemmen op extreme partijen in de twee verkiezingen voor de verandering met het aantal in de twee verkiezingen na de verandering. Zoals door ons model voorspeld, neemt het aantal stemmen op extreme partijen toe in het land dat de verplichting heeft afgeschaft (Nederland in 1970 en België in 2003) en blijft het aantal gelijk in het land waar de wetgeving gelijk is gebleven (België in 1970 en Nederland in 2003). Vervolgens vinden we met gegevens van de *Comparative Study of Election Systems*, de *Eurobarometer* en de *Nederlandse Verkiezings Studie* ook ondersteuning voor de voorspelling dat meer extreme kiezers vaker stemmen dan zij die minder extreme voorkeuren hebben. Daarnaast laat een studie voor Nederland ook een positieve correlatie zien tussen de polarisatie van de politieke partijen en de verkiezingsopkomst.

Aangezien de theorie, de empirische analyse en de data uit het laboratorium alle duidelijk maken dat er een samenhang bestaat tussen de beslissing om te gaan stemmen en de keuze voor een bepaalde partij, concluderen we dat er rekening met deze effecten dient te worden gehouden bij het bestuderen van het politieke proces.

In het derde en vierde hoofdstuk richt ik me op de kandidaten. Hier kijk ik of er een samenhang bestaat tussen het besluit van een politicus om zich kandidaat te stellen en haar beleidskeuzen. Om dit te onderzoeken maak ik gebruik van het *citizen-candidate paradigm* (Osborne and Slivinsky, 1996, Besley and Coate, 1997). Dit maakt het mogelijk om de kandidaatstelling en beleidskeuze tegelijkertijd te bestuderen. Het model veronderstelt dat iedere kiezer zich op een vaste (en algemeen bekende) plek in het beleidsspectrum bevindt en dat alle kiezers zich ook kandidaat kunnen stellen voor een politiek ambt. Door te kijken

welke kiezers zich kandidaat stellen en hoe vaak, verkreeg ik inzicht in zowel de kandidaatstelling op zich als in de samenhang met de positie van de kandidaten.

Het derde hoofdstuk, *Plurality Voting versus Proportional Representation in the Citizen-Candidate Model: The Role of Coalitions*, beantwoordt de vraag hoe het aantal kandidaten en de polarisatie van de kandidaten afhangt van de keuze tussen een systeem van evenredige vertegenwoordiging of een dat beslist bij meerderheid van stemmen. De belangrijkste bijdrage van dit hoofdstuk is het onderzoeken hoe het modelleren van het systeem van evenredige vertegenwoordiging uitwerkt op de verschillen tussen deze electorale systemen. Tot nu toe was het in de literatuur gebruikelijk om overheidsbeleid in een systeem met evenredige vertegenwoordiging weer te geven als het gewogen gemiddelde van de posities van de kandidaten. Ik beargumenteer echter dat deze manier van modelleren een belangrijk aspect van evenredige vertegenwoordiging over het hoofd ziet, namelijk het vormen van coalitie regeringen. Daarom introduceer ik in dit hoofdstuk een model voor een systeem met evenredige vertegenwoordiging dat er expliciet vanuit gaat dat coalitie-regeringen zullen worden gevormd en dat alleen de kandidaten die binnen de coalitie vallen invloed hebben op het gevoerde beleid.

Vervolgens leid ik de Nash evenwichten af voor een situatie met kandidaten die gemotiveerd worden door het te voeren politiek. Deze theoretische analyse levert drie belangrijke resultaten op. Allereerst blijkt dat coalitievorming leidt tot minder polarisatie tussen de kandidaten. Dit houdt onder meer in dat de veelgehoorde kritiek op systemen met evenredige vertegenwoordiging, namelijk dat ze zouden leiden tot meer polarisatie, minder relevant is als men ook rekening houdt met coalitievorming. Daarnaast toont de analyse aan dat, als men geen rekening houdt met coalitievorming, een meerderheidsstelsel inderdaad leidt tot meer gecentreerde uitkomsten dan een stelsel van evenredige vertegenwoordiging. Dit komt overeen met een eerder door Cox (1990) gevonden resultaat, dat evenredige vertegenwoordiging leidt tot meer polarisatie. Tenslotte komt naar voren dat, als men uitgaat van kandidaten die alleen gemotiveerd zijn door een streven naar macht, evenredige vertegenwoordiging met coalitievorming resulteert in meer evenwichten waar meerdere kandidaten zich verkiesbaar stellen dan evenredige vertegenwoordiging zonder coalitievorming of een meerderheidsstelsel.

In het vierde hoofdstuk, *Plurality Voting versus Proportional Representation in the Citizen-Candidate Model: An Experiment*, bekijk ik in een gecontroleerd laboratorium experiment het verschil in het gedrag van kandidaten in een stelsel met evenredige vertegenwoordiging en een meerderheidsstelsel. In deze experimenten gebruik ik het *citizen-candidate* model met vijf potentiële kandidaten die gelijk verdeeld zijn over een eendimensionaal politiek spectrum. Hierbij varieer ik het electorale stelsel en de kosten van de kandidaatstelling tussen verschillende experimentele sessies.

De theorie voorspelt een kosteneffect, waarbij hogere kosten voor het deelnemen aan de verkiezingen leiden tot minder kandidaten. Daarnaast voorspelt de theorie dat er bij lage kosten meer kandidaten zullen toetreden in een stelsel met evenredige vertegenwoordiging dan in een meerderheidsstelsel en dat een dergelijk verschil niet bestaat als de kosten voor

deelname hoog zijn. Dit maakt het mogelijk om te kijken of het verschil in het (empirisch waargenomen) aantal deelnemende kandidaten tussen beide stelsels wordt veroorzaakt door een theoretisch onderbouwde analyse of dat het veroorzaakt wordt door een eenvoudige heuristiek (in dat geval zouden er onafhankelijk van de kosten meer kandidaten moeten zijn in een stelsel met evenredige vertegenwoordiging).

De resultaten van het experiment komen redelijk overeen met de theoretische analyse. Naast de genoemde effecten van het electorale stelsel en de kosten van deelname, vind ik ook dat er veel meer kandidaten deelnemen dan de theorie voorspelt. Dit is niet ongevoel in dit soort experimenteel onderzoek. Het effect kan mede verklaard worden door het feit dat mensen naast financiële motieven ook gedreven kunnen worden door een drang naar competitie.

Als we de bevindingen van de hoofdstukken 3 en 4 combineren dan kunnen we 2 conclusies trekken: Ten eerste wordt het *citizen-candidate* model ondersteund door de experimenten. Ten tweede lijkt het in de toekomst noodzakelijk om rekening te houden met de effecten van coalitievorming als men een stelsel met evenredige vertegenwoordiging onderzoekt. Een logisch vervolgonderzoek zou dan ook zijn om de coalitievorming zoals onderzocht in hoofdstuk 3 toe te passen in de experimentele setting van hoofdstuk 4.

Bargaining in the Presence of Condorcet Cycles: The Role of Asymmetries, hoofdstuk 5, is het resultaat van een samenwerking met Harold Houba. Hierin onderzoeken we asymmetrische onderhandelingen. We concentreren ons op situaties waar er geen zogenoemde Condorcet winnaar is, dat wil zeggen dat geen van de alternatieven elk ander alternatief verslaat in paarsgewijze stemmingen. We maken deze keuze omdat dergelijke Condorcet winnaars in het algemeen na bijna elke onderhandeling geïmplementeerd worden. We gebruiken voor de analyse het strategische onderhandelingsmodel van Baron & Ferejohn (1989), waarbij in elke onderhandelingsronde een door het lot bepaalde speler een voorstel mag doen.

Voortbordurend op het werk van Herings en Houba (2010), die een soortgelijke situatie theoretisch benaderen, testen wij de theorie in een laboratorium experiment waarbij drie spelers moeten bepalen welke van drie alternatieven er uitgevoerd gaat worden. We variëren tussen sessies of de alternatieven symmetrisch zijn of dat een van de spelers meer verdient aan zijn beste uitkomst. De tweede parameter die we veranderen is de kans dat een speler de kans krijgt een voorstel te doen. We vergelijken daarbij de situatie dat iedereen dezelfde kans heeft een voorstel te doen met een situatie waarbij een van de drie spelers een kleinere kans heeft dit te doen dan de andere twee.

Uit het experiment komen twee belangrijke resultaten naar voren: deelnemers maken te weinig gebruik van hun onderhandelingspositie en accepteren voorstellen te snel, mogelijk veroorzaakt door risicomijdend gedrag. Het tweede resultaat is dat er bij asymmetrische kansen om een voorstel te mogen doen een systematische afwijking van de theoretische voorspellingen waarneembaar is. Deze afwijking treedt niet alleen op ten opzichte van een risico-neutraal Nash evenwicht, maar ook ten opzichte van een *quantal response*

evenwicht, waarbij de risico- en ruisparameters zijn geschat op basis van de experimentele data. De verandering van gedrag als men symmetrische verdiensten vergelijkt met asymmetrische wordt beter door de theorie verklaard. Daarom concluderen wij dat deelnemers meer moeite hebben asymmetrische kansen te doorgronden dan dat ze moeite hebben met asymmetrische uitkomsten en dat zij in het eerste geval terugvallen op eenvoudige vuistregels. Een vuistregel die deze uitkomsten goed zou kunnen verklaren is bijvoorbeeld de veronderstelling dat de kans die iemand heeft om een voorstel te doen gelijk is aan iemands onderhandelingspositie.

Zusammenfassung (Summary in German)

Politische Akteure haben einen enormen Einfluss auf unseren Alltag, und insbesondere ihr Einfluss auf ökonomische Aktivitäten ist nicht zu unterschätzen. Um ökonomische Aktivitäten erklären zu können ist es daher essentiell das Verhalten politischer Akteure zu verstehen. In der Tradition der politökonomischen Literatur untersucht diese Dissertation den Einfluss institutioneller Regeln auf das Verhalten dreier Gruppen von politischen Akteuren: Wählern, Kandidaten und Verhandlungspartnern. Zu diesem Zwecke kombiniere ich Erkenntnisse aus spieltheoretischen Modellen mit kontrollierten Laborexperimenten.

Zusammen mit Arthur Schram beschäftige ich mich in Kapitel 2, *A Simultaneous Analysis of Turnout and Voting under Proportional Representation – Theory and Experiments*, mit der Frage ob die Entscheidung zur Wahl zu gehen und für welche Partei (oder welchen Kandidaten) zu stimmen sich gegenseitig beeinflussen. Im Besonderen untersuchen wir ob extreme Parteien mehr Stimmen bekommen wenn es keine Wahlpflicht gibt, und wie eine Wahlpflicht strategisches Wählen¹ beeinflusst.

Obwohl Wählerverhalten schon seit langem erforscht wird sind solche Fragen bisher hauptsächlich ignoriert worden und stattdessen lag der Fokus der Literatur entweder auf der Analyse der Wahlbeteiligung oder der Erklärung für welche Partei ein Wähler stimmt. Wir legen dar, dass dadurch, insbesondere im Verhältniswahlrecht mit seinen Anreizen für strategisches Wählen, wichtige und relevante Aspekte der Situation verloren gehen können. Um die potentielle Wechselwirkung zwischen der Entscheidung zur Wahl zugehen und der Stimmabgabe zu berücksichtigen, präsentieren wir ein theoretisches Model für Wählerverhalten im Verhältniswahlrecht und ergänzen diese Analyse mit Daten aus Laborexperimenten.

Die theoretische Analyse prognostiziert drei Effekte: Erstens, einen *Polarisierungseffekt*: Wer Wählen geht stimmt häufiger für eine extreme Partei wenn es die Möglichkeit gibt der Wahl fern zu bleiben. Der Mechanismus, welcher diesem Effekt zu Grunde liegt ist, dass, wenn es eine Möglichkeit gibt der Wahl fern zu bleiben, die Unterstützer extremer Parteien seltener aus strategischen Gründen für eine moderate Partei stimmen, sondern häufiger eine extreme Partei wählen. Diese Verhaltensänderung ist eine Folge davon, dass Unterstützer extremer Parteien sich stärker an Wahlen beteiligen (der zweite Effekt). Daher wird die Wahl eher zu einem Kopf-an-Kopf-Rennen zwischen den extremeren Parteien, im

¹ Strategisches Wählen bedeutet, dass man nicht für die Partei stimmt die einem am nächsten steht sondern für eine andere Partei um dadurch das Wahlergebnis im eigenen Sinne zu beeinflussen.

Vergleich zu der Situation bei Wahlpflicht. Dies führt dazu, dass es weniger attraktiv ist aus strategischen Gründen für eine moderate Partei zu stimmen. Den zweiten Effekt, dass Unterstützer extremer Parteien eine höhere Wahlbeteiligung haben, nennen wir den *Extremisten Effekt*. Auslöser für diesen Effekt ist, dass für Unterstützer extremer Parteien mehr auf dem Spiel steht, da das worst-case Szenario (in dem die andere extreme Partei die Wahl gewinnt) für sie schlimmer ist als für Wähler in der Mitte. Der dritte Effekt ist der *Wahlbeteiligung Effekt*: Wenn die Parteien polarisierter sind steigt die Wahlbeteiligung. Begründet ist dies darin, dass größere Differenzen zwischen den Parteien dazu führen, dass für alle Wähler mehr auf dem Spiel steht.

Wir testen diese theoretischen Vorhersagen durch ein Laborexperiment in dem wir die Polarisierung der Parteien und die Existenz einer Wahlpflicht variieren. Unsere experimentellen Resultate entsprechen den theoretischen Vorhersagen, allerdings ist der *Polarisierungs Effekt* weniger stark ausgeprägt, wenn die Parteien nahe beieinander positioniert sind. Wie vorhergesagt führt höhere Polarisierung zu einem Anstieg der beobachtete Wahlbeteiligung und Unterstützer extremer Parteien geben häufiger ihre Stimme ab. Der zweite Effekt ist weniger ausgeprägt als vorhergesagt, da die gemäßigten Wähler deutlich häufiger als vorhergesagt an der Wahl teilnehmen.

Natürlich können die Resultate des Laborexperimentes keine definitive Antwort auf die Frage liefern, ob diese Effekte auch außerhalb des Labors relevant sind. Daher ergänzen wir die experimentelle Analyse um drei empirischen Studien, die sich mit jeweils einem der drei Effekte beschäftigen. Um den *Polarisierungs Effekt* zu untersuchen nutzen wir die Tatsache, dass sowohl die Niederlande, als auch Belgien in der Vergangenheit eine Wahlpflicht hatten und diese abgeschafft haben (Niederlande, 1970) oder das Nichtwählen nicht mehr sanktionieren (Belgien seit 2003). Angesichts der Ähnlichkeiten der politischen Systeme und der politischen Ansichten in den beiden Ländern können wir den Umfang des Wählens von extremen Parteien bei Wahlen bevor und nach dem Wechsel des Wahlsystems in beiden Ländern vergleichen. Wie durch unser Modell vorhergesagt zeigt sich, dass die Polarisierung des Wahlergebnisses in dem Land welches die Wahlpflicht abschafft (Niederlande) dramatisch ansteigt, während in Belgien keine substantielle Änderung der Wahlergebnisse sichtbar ist. Eine Analyse, welche die Daten aus der Comparative Study of Election Systems, dem Eurobarometer und der Dutch Election Study kombiniert, zeigt, dass wie vorhergesagt Wähler welche extreme Parteien unterstützen eine höhere Wahlbeteiligung haben. Zudem zeigt sich, dass in den Niederlanden eine starke Polarisierung des Parteiensystems mit einer höheren Wahlbeteiligung einhergeht.

Vor dem Hintergrund, dass Theorie, Experiment und empirische Analyse alle im Einklang mit einer Wechselwirkung zwischen der Entscheidung an der Wahl teilzunehmen und für welche Partei man stimmt stehen, schließen wir, dass dieser Interaktionseffekt in der Analyse des Wählerverhaltens berücksichtigt werden muss.

In Kapitel 3 und 4 wende ich mich dem Verhalten der Kandidaten zu. Da, ähnlich wie im Fall des Wählerverhaltens in Kapitel 2, möglicherweise eine Wechselwirkung zwischen der Entscheidung zur Wahl anzutreten und der Entwicklung des Wahlprogrammes

existiert, verwende ich das Citizen-Candidate Paradigma (Osborne und Slivinsky, 1996, Besley und Coate, 1997) um das Verhalten der Kandidaten zu analysieren. Mit diesem Paradigma ist es möglich beide Entscheidungen gleichzeitig zu analysieren, indem man annimmt, dass alle Bürger stabile und allgemein bekannte Politikpräferenzen haben und dass jeder dieser Bürger die Möglichkeit hat als Kandidat an der Wahl teilzunehmen. Dieses Modell kann offensichtlich dazu genutzt werden die Entscheidung zur Wahl anzutreten zu analysieren und darüber hinaus kann eine Analyse an welcher Stelle im politischen Raum die Kandidaten lokalisiert sind dazu genutzt werden etwas über die Wahlprogramme zu lernen, zum Beispiel wie polarisiert die Positionen der Kandidaten sind.

In Kapitel 3, *Plurality Voting versus Proportional Representation in the Citizen-Candidate Model: The Role of Coalitions*, beschäftige ich mich mit der Frage wie sich die Anzahl der Kandidaten und die Polarisierung ihrer Positionen in Mehrheits- und Verhältniswahlrecht unterscheiden. Der größte Beitrag dieses Kapitels zur Literatur liegt in der Untersuchung in welchem Umfang bzw. in welcher Art und Weise die Unterschiede zwischen den Wahlsystemen von den Details der Modellierung des Verhältniswahlrechtes abhängen. Bisher war der Standardansatz der Literatur die Regierungspolitik im Verhältniswahlrecht als den gewichteten Durchschnitt der Positionen aller Kandidaten zu modellieren. Ich argumentiere, dass dieser Ansatz eines der charakteristischen Merkmale des Verhältniswahlrechtes, die Möglichkeit von Koalitionsregierungen, ignoriert. Ich entwickle daher eine Modell des Verhältniswahlrechtes mit Koalitionsbildung in welchem nur die Mitglieder der Koalitionsregierung einen Einfluss auf die Regierungspolitik haben.

Im nächsten Schritt bestimme ich das Nash-Gleichgewicht für den Fall dass Kandidaten rein machtorientiert sind, und den Fall, dass sie ausschließlich politisch motiviert sind. Die theoretische Analyse liefert drei Ergebnisse: Erstens, wenn die Bildung von Koalitionen im Verhältniswahlrecht berücksichtigt werden führt dies dazu dass die Kandidaten weniger polarisiert sind als wenn diese Koalitionen ignoriert werden. Das bedeutet, dass einer der Hauptkritikpunkte am Verhältniswahlrecht, dass es zu polarisierten Kandidaten führt, weniger Schlagkraft hat wenn die Anreize, die mit der Koalitionsbildung verbunden sind, berücksichtigt werden. Zweitens, wenn Koalitionen nicht berücksichtigt werden führt das zu dem Ergebnis, dass das Mehrheitswahlrecht im Vergleich mit dem Verhältniswahlrecht zu weniger Polarisierung führt. Dies steht im Einklang mit Cox (1990), der darlegt, dass das Verhältniswahlrecht zu einer höheren Polarisierung führt. Drittens, für den klassischen Fall rein machtorientierter Kandidaten zeigt sich, dass das Verhältniswahlrecht mit Koalitionen im Vergleich mit dem Mehrheitswahlrecht und dem Verhältniswahlrecht ohne Koalitionen häufiger zu Wahlen mit vielen Kandidaten führt.

In Kapitel 4, *Plurality Voting versus Proportional Representation in the Citizen-Candidate Model: An Experiment*, nutze ich ein Laborexperiment um mich mit der Frage wie sich das Verhalten von Kandidaten im Mehrheits- und Verhältniswahlrecht unterscheidet zu beschäftigen. Im Labor implementiere ich das Citizen-Candidate Modell für fünf potentielle Kandidaten, welche gleichmäßig im politischen Raum verteilt sind, und variiere das Wahlsystem und die ihnen entstehenden Kosten zur Wahl anzutreten.

Die Theorie sagt einen intuitiven Kosten-Effekt voraus, d.h. mit steigenden Kosten zur Wahl anzutreten werden sich weniger Kandidaten zur Wahl stellen. Es zudem der Fall, dass das Verhältniswahlrecht zu mehr Kandidaten führen sollte, aber dieser Effekt tritt nur auf wenn die Kosten niedrig sind. Diese Tatsache macht es möglich zu untersuchen, ob die größere Zahl von Kandidaten im Verhältniswahlrecht ein Gleichgewichts-Phänomen ist oder auf eine Heuristik zurück zu führen ist. Sollte es auf einer Heuristik basieren (z.B. zur Wahl anzutreten um die Politik zu ändern obwohl dies nicht den Verdienst erhöht) würde man erwarten, dass dieser Effekt sowohl für hohe, wie für niedrige Kosten auftritt.

Die Ergebnisse des Experiments stehen im Großen und Ganzen im Einklang mit der Theorie, und ich beobachte die vorhergesagten Effekte im Hinblick auf das Wahlsystem und die Kosten Kandidat zu werden. Gleichzeitig beobachte ich aber auch die Teilnehmer des Experiments deutlich häufiger als vorhergesagt zur Wahl antreten. Diese Beobachtung wurde auch in vielen anderen Experimenten zu Markteintritt und Wettkämpfen gemacht. Diese Beobachtung könnte durch einen „Freude am Sieg“-Effekt erklärt werden bei dem Spieler einen nicht-monetären Nutzen aus dem Gewinnen der Wahl ziehen.

Die Ergebnisse aus Kapitel 3 und 4 führen zu zwei Schlussfolgerungen: Erstens, das Citizen-Candidate Paradigma findet Bestätigung in den experimentellen Resultaten. Dies erhöht unser Vertrauen in die Nützlichkeit dieses Ansatzes. Zweitens, die Analyse des Verhältniswahlrechts erfordert Koalitionen und die damit verbunden Anreizstruktur in unsere Modelle zu integrieren. Ausgehend von diesen beiden Schlussfolgerungen, ist es sinnvoll und bietet sich an als nächsten Schritt das Modell des Verhältniswahlrechts mit Koalitionen aus Kapitel 3 mit dem experimentellen Rahmen aus Kapitel 4 zu kombinieren.

In Zusammenarbeit mit Harold Houba untersucht Kapitel 5, *Bargaining in the Presence of Condorcet Cycles: The Role of Asymmetries*, die Rolle von Asymmetrien in Verhandlungen. Wir konzentrieren uns auf Situationen ohne Condorcet-Sieger (dies ist eine Alternative, die alle anderen in einer Kampfabstimmung schlägt), da ansonsten unabhängig von den Details des Verhandlungsprozesses diese Alternative sehr wahrscheinlich das Verhandlungsergebnis sein wird. Um die Situation zu analysieren nutzen wir das strategische Verhandlungsmodell von Baron & Ferejohn (1989), in dem in jeder Verhandlungsrunde ein Verhandlungspartner zufällig ausgewählt wird einen Vorschlag zu machen über den die anderen Partner dann abstimmen.

Aufbauend auf Herings und Houba (2010), die theoretisch eine sehr ähnliche Situation analysieren, entwickeln wir ein Laborexperiment mit drei Spielern, die aus drei verfügbaren Alternativen eine auswählen müssen. Wir variieren dann ob die Alternativen symmetrisch sind oder ob einer der Spieler mehr an seiner Lieblingsalternative verdient als die anderen beiden. Der zweite Parameter den wir variieren ist die Wahrscheinlichkeit, dass ein Spieler einen Vorschlag machen kann. Wir vergleichen die symmetrische Situation in der alle Spieler die gleiche Wahrscheinlichkeit haben einen Vorschlag machen zu können mit der Situation in der einer der Spieler seltener einen Vorschlag machen kann als die anderen beiden.

Das Experiment liefert zwei wesentliche Ergebnisse: Erstens, die Spieler nutzen ihre Verhandlungsmacht nicht in vollem Umfang aus und akzeptieren Vorschläge zu häufig, ein Verhalten welches durch Risikoaversion erklärt werden könnte. Zweitens, im Falle von asymmetrischen Wahrscheinlichkeiten beobachten wir substantielle und systematische Abweichungen von den theoriebasierten Vorhersagen. Die Abweichungen treten nicht nur relative zum risikoneutralen Nash-Gleichgewicht auf, sondern auch wenn das Quantal Response Gleichgewicht – mit Risikoaversion und Fehleranfälligkeit bestimmt anhand der experimentellen Daten – als theoretischer Vergleichsmaßstab herangezogen wird. Im Gegensatz dazu ist die Veränderung des Verhaltens bei asymmetrischen Alternativen deutlich näher an den theoretischen Vorhersagen. Dies führt uns zur Schlussfolgerung, dass die Spieler es schwieriger finden die strategischen Effekte von asymmetrischen Wahrscheinlichkeiten als von asymmetrischen Alternativen zu verstehen, und daher zu Heuristiken greifen, um mit asymmetrischen Wahrscheinlichkeiten umzugehen. Eine Heuristik, die mit dem beobachteten Verhalten im Einklang steht, ist, dass die Spieler die Wahrscheinlichkeit einen Vorschlag machen zu können mit ihrer Verhandlungsmacht gleich setzen.

The Tinbergen Institute is the Institute for Economic Research, which was founded in 1987 by the Faculties of Economics and Econometrics of the Erasmus University Rotterdam, University of Amsterdam and VU University Amsterdam. The Institute is named after the late Professor Jan Tinbergen, Dutch Nobel Prize laureate in economics in 1969. The Tinbergen Institute is located in Amsterdam and Rotterdam. The following books recently appeared in the Tinbergen Institute Research Series:

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