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# Voting in Legislative Elections Under Plurality Rule

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# VOTING IN LEGISLATIVE ELECTIONS UNDER PLURALITY RULE\*

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## **Abstract**

Models of single district plurality elections show that with three parties anything can happen - extreme policies can win regardless of voter preferences. I show that when single district elections are used to fill a legislature we get back to a world where the median voter matters. An extreme policy will generally only come about if it is preferred to a more moderate policy by the median voter in a majority of districts. The mere existence of a centrist party can lead to moderate outcomes even if the party itself wins few seats. Furthermore, I show that while standard single district elections always have *misaligned voting* i.e. some voters do not vote for their preferred choice, equilibria of the legislative election exist with no misaligned voting in any district. Finally, I show that when parties are impatient, a fixed rule on how legislative bargaining occurs will lead to more coalition governments, while uncertainty will favour single party governments.

**Keywords:** Strategic Voting, Legislative Elections, Duverger's Law, Plurality Rule, Polarization, Poisson Games.

**JEL Classification Number:** C71, C72, D71, D72, D78.

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# 1 Introduction

Plurality rule (a.k.a. first-past-the-post) is used to elect legislatures in the U.S., U.K., Canada, India, Pakistan, Malaysia as well as a host of other former British colonies - yet we know very little about how it performs in such settings. The literature on single district elections shows that plurality rule performs well when there are only two candidates but poorly when there are more.<sup>1</sup> Indeed, plurality has recently been deemed the worst voting rule by a panel of voting theorists.<sup>2</sup> However, the objectives of voters differ in single district and legislative elections. In a legislative election, many districts hold simultaneous plurality elections and the winner of each district takes a seat in a legislature. Once all seats are filled, the elected politicians bargain over the formation of government and implement policy. If voters only care about which policy is implemented in the legislature, they will cast their ballots to influence the outcome of the legislative bargaining stage. A voter's preferred candidate will therefore depend on the results in other districts. In contrast, in a single district election - such as a mayoral election - a voter's preference ordering over candidates is fixed, as only the local result matters. These different objectives are at the heart of this paper. I show that when three parties compete for legislative seats and voters care about national policy, several undesirable properties of plurality rule are mitigated.

While there has been some key work on voting strategies in legislative elections under proportional representation (PR), notably Austen-Smith and Banks (1988) and Baron and Diermeier (2001), there has been scant attention paid to the question of how voters should act when three parties compete in a legislative election under plurality rule. Studies of plurality rule have either focused on two-party legislative competition or else on three-party single district elections, in which voters only care about the result in that district. In the former case, as voters face a choice of two parties, they have no strategic decision to make - they simply vote for their favourite. However, for almost all countries using plurality rule, with the notable exception of the U.S., politics is not a two-party game: the U.K. has the Conservatives, Labour and the Liberal Democrats; Canada has the Conservatives, Liberals, and New Democrats; India has Congress, BJP and many smaller parties.<sup>3</sup> With a choice of three candidates, voters must consider how others will vote when deciding on their own ballot choice.

In a single plurality election, only one candidate can win. Therefore, when faced with

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<sup>1</sup>See for example Myerson (2000) and Myerson (2002).

<sup>2</sup>See Laslier (2012)

<sup>3</sup>The recent 2015 UK election witnessed a further fragmentation of the political landscape with the Scottish National Party gaining a large number of seats. Other countries with plurality rule and multiple parties represented in the legislature include: Bangladesh, Botswana, Kenya, Liberia, Malawi, Malaysia, Mongolia, Pakistan, Trinidad & Tobago, Tanzania, Uganda, and Zambia.

a choice of three options, voters who prefer the candidate expected to come third have an incentive to abandon him and instead vote for their second favourite, so that in equilibrium only two candidates receive votes. These are the only serious candidates. This effect, known as Duverger’s law<sup>4</sup>, was first stated by Henry Droop in 1869:

“Each elector has practically only a choice between two candidates or sets of candidates. As success depends upon obtaining a majority of the aggregate votes of all the electors, an election is usually reduced to a contest between the two most popular candidates or sets of candidates. Even if other candidates go to the poll, the electors usually find out that their votes will be thrown away, unless given in favour of one or other of the parties between whom the election really lies.” (Droop cited in Riker (1982), p. 756)

A vast literature has pointed out two implications of Duverger’s law in single district elections.<sup>5</sup> First, “*anything goes*”: the equilibrium is completely driven by voters’ beliefs, so *any* of the three candidates could be abandoned, leaving the other two to share the vote. This means that, regardless of voter preferences, there can always be polarisation - where a race between the two extreme choices results in an implemented policy far away from the centre. Second, when each of the three choices is preferred by some voter, there will always be *misaligned voting*. That is, some people will vote for an option which is not their most preferred. Misaligned voting undermines the legitimacy of the elected candidate: one candidate may win a majority simply to “keep out” a more despised opponent, so the winner’s policies may actually be preferred by relatively few voters.

In this paper, I model a legislative election in which each voter casts a ballot in a local district but their utility depends on policy determined in the national parliament. I show that while polarisation and misaligned voting are always possible in stand-alone multi-candidate plurality elections, they can both be mitigated in a legislative election setting.

The intuition for the polarisation result is as follows. For any party to win a majority of seats in the legislature it must be that they are preferred to some alternative by a majority of voters in a majority of districts. I show that the alternative to a left majority will generally not be a right majority but rather a moderate coalition government. Therefore, for an extreme policy to come about, it must be that the median voter in the median district prefers this policy to the moderate coalition policy. This contrasts with single plurality elections where extreme policy outcomes are always possible, regardless of preferences.

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<sup>4</sup>The law takes its name from French sociologist Maurice Duverger who popularised the idea in his book *Political Parties*. While Riker (1982) argues that Duverger’s law should be interpreted as the tendency of plurality rule to bring about a two-party system, most scholars use the term to describe the local effect: in any one district only two candidates will receive votes. I also use the local interpretation.

<sup>5</sup>See Palfrey (1989), Myerson and Weber (1993), Cox (1997), Fey (1997), Myerson (2002), Myatt (2007).

The misaligned voting result stems from the fact that voters condition their ballots on a wider set of events in my setting. In a standard plurality election, voters condition their vote on the likelihood of being pivotal in their district. However, in a legislative election, voters will condition their ballot choice on their vote being pivotal and their district being decisive in determining the government policy. In many cases a district will be decisive between two policies, even though there are three candidates. For example, a district might be decisive in either granting a majority of seats to a non-centrist party, say the left party, or bringing about a coalition by electing one of the other parties. Under many bargaining rules this coalition policy will be the same regardless of which of the weaker parties is elected. So, voters only face a choice between two policies: that of the left party and that of the coalition. When voters have a choice over two policies there can be no misaligned voting - everyone must be voting for their preferred option of the two.

One technical contribution of the paper is to extend the Poisson games framework of Myerson (2000) to a multi-district setting. I show in Lemma 1 that the Magnitude Theorem and it's Corollary can be used to rank the likelihood of various pivotal events across districts. This greatly reduces the complexity of working with multi-district pivotal events and makes the problem much more tractable.

I examine the workings of my model under several legislative bargaining settings - varying the scope of bargaining, the patience of politicians, and the bargaining protocol. Government formation processes *do* vary across countries. In some countries potential coalition partners may bargain jointly over policy and perks, while in others perks may be insufficient to overcome ideological differences. The patience of politicians may also differ across countries depending on aspects such as how quickly successive rounds of bargaining occur, and how likely politicians are to be re-elected.<sup>6</sup> A further feature of government formation which has been studied extensively is the protocol for selecting a formateur (a.k.a. proposer). The two standard cases are *random recognition* - where a party's probability of being the formateur in each round of bargaining is equal to its seat share - and *fixed order* - where the largest party makes the first offer, then the second largest, and so on. Diermeier and Merlo (2004) analyse 313 government formations in Western European over the period 1945–1997 and find the data favours random recognition rule.<sup>7</sup> On the other hand, Bandyopadhyay, Chatterjee, and Sjöström (2011) note that a fixed order of bargaining is constitutionally enshrined in Greece and Bulgaria, and is a strong norm in the U.K. and India, where elections are held under plurality rule. Therefore, I examine these various combinations to see how robust the

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<sup>6</sup>See Austen-Smith and Banks (2005) and Banks and Duggan (2006) for a discussion of discount rates in legislative bargaining.

<sup>7</sup>For a critique of the empirical support for random recognition see Laver, Marchi, and Mutlu (2011).

polarisation and misaligned voting results are.

In my benchmark model, parties in the legislature bargain only over policy and do not discount the future. Here, if no party holds a majority of seats, the moderate party's policy will be implemented. While this enormous power of the moderate party may be debatable in reality, the simplicity of bargaining underlines the novelty of the model's voting stage. Two clear predictions emerge from this benchmark model. First, when the moderate party wins at least one seat, polarisation is mitigated: the policy of the left or right party can only be implemented if a majority of voters in a majority of districts prefer it to the policy of the moderate party. Second, if either the left or right party is a serious candidate in less than half of the districts, there can be no misaligned voting. These results change somewhat under different bargaining rules, but their flavour remains the same. When parties bargain over perks of office as well as policy, the polarisation result is generally strengthened - it is even more difficult to have extreme outcomes - while the misaligned voting result is weakened - it can only be ruled out if a non-centrist party is serious in less than a quarter of districts. When I add discounting to the benchmark model, the power of the moderate party is reduced. Nonetheless, an extreme policy can still only be implemented if it is preferred to a more moderate coalition policy. Here, misaligned voting cannot generally be eliminated in all districts but may be ruled out in a large subset of districts.

Finally, when politicians are impatient, I show that if a country uses a random recognition rule then coalition governments will be more difficult to construct than under a fixed order of recognition, all else equal. The reason is that a fixed order rule gives a significant advantage to the largest party and also makes it easier for voters to predict which government policy will be implemented after the election. As the difference in policy between, say, a left majority government and a coalition led by the left is quite small, voter preferences must be very much skewed in favour of the left party in order for it to win a majority. With a random recognition rule, however, risk averse voters will prefer the certainty of a non-centrist single-party government to the lottery over policies which coalition bargaining would induce.

This paper contributes primarily to the theoretical literature on strategic voting in legislative elections. The bulk of this work has been on PR. Austen-Smith and Banks (1988) find that, with a minimum share of votes required to enter the legislature, the moderate party will receive just enough votes to ensure representation, with the remainder of its supporters choosing to vote for either the left or right party. Baron and Diermeier (2001) show that, with two dimensions of policy, either minimal-winning, surplus, or consensus governments can form depending on the status quo. On plurality legislative elections Morelli (2004) and Bandyopadhyay, Chatterjee, and Sjöström (2011) show that if parties can make pre-electoral pacts, and candidate entry is endogenous, then voters will not need to act strategically. My

paper nonetheless focuses on strategic voting because in the main countries of interest, the U.K. and Canada, there are generally no pre-electoral pacts and the three main parties compete in almost every district, so strategic candidacy is not present.<sup>8</sup>

The paper proceeds as follows. In the next section I introduce the benchmark model and define an equilibrium. In Section 3, I solve the model and show conditions which must hold in equilibrium. Section 4 presents the main results on the level of polarisation and misaligned voting in the benchmark model. Section 5 adds perks of office to the bargaining stage of the model, while Section 6 shows how the benchmark results change when parties discount the future. Finally, Section 7 discusses the assumptions of the model and concludes.

## 2 Model

**Parties** There are three parties;  $l, m$ , and  $r$ , contesting simultaneous elections in  $D$  districts, where  $D$  is an odd number. The winner of each of the  $D$  elections is decided by plurality rule: whichever party receives the most votes in district  $d \in D$  is deemed elected and takes a seat in the legislature. The outcome from all districts gives a distribution of seats in the legislature,  $S \equiv (s_l, s_m, s_r)$ , with party  $c \in \{l, m, r\}$  having  $s_c$  seats and  $\sum_c s_c = D$ . Party  $c$  has a preferred platform  $a_c$  in the unidimensional policy space  $\mathbb{X} = [-1, 1]$  on which it must compete in every district. A party cannot announce a different platform to gain votes; voters know that a party will always implement its preferred platform if it gains a legislative majority. Once all the seats in the legislature have been filled, the parties bargain over the formation of government and implement a policy  $z$ . As such, a party cannot commit to implement its platform as the policy outcome  $z$  depends on bargaining. Party  $c$  has the payoff  $W_c = b_c - (z - a_c)^2$ , linear in its share of government benefits  $b_c$ , and negative quadratic in the distance between its platform  $a_c$  and the implemented policy  $z$ . A feasible allocation of benefits is  $b = (b_l, b_m, b_r)$  where each  $b_c$  is non-negative and  $\sum_c b_c \leq B$ .

The benchmark model I use is that of Baron (1991), where  $B = 0$  so that bargaining is over policy alone.<sup>9</sup> In Section 5, I consider a different bargaining game due to Austen-Smith and Banks (1988) with  $B > 0$ . If a party has a majority of the seats in the legislature it

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<sup>8</sup>In the 2010 U.K. General Election, the three main parties contested 631 out of 650 districts (None of them contest seats in Northern Ireland), while in the 2011 Canadian Federal Election the three major parties contested 307 of the 308 seats.

<sup>9</sup>A large literature has grown from legislative bargaining model of Baron and Ferejohn (1989), in which legislators bargain over the division of a dollar. See Baron (1991), Banks and Duggan (2000), Baron and Diermeier (2001), Jackson and Moselle (2002), Eraslan, Diermeier, and Merlo (2003), Kalandrakis (2004), Banks and Duggan (2006), and many others. Morelli (1999) introduces a different approach to legislative bargaining whereby potential coalition partners make demands to an endogenously chosen formateur. In contrast with the Baron and Ferejohn (1989) setup, the formateur does not capture a disproportionate share of the payoffs.



can form a unitary government and will implement its preferred policy. If no party wins an outright majority we enter a stage of legislative bargaining. I consider two bargaining protocols when  $B = 0$ : one in which the order of bargaining is random and one in which it is fixed. Under the former rule, one party is randomly selected as formateur, where the probability of each party being chosen is equal to its seat share in the legislature. The formateur proposes a policy in  $[-1, 1]$ , which is implemented if a majority of the legislature support it; if not, a new formateur is selected, under the same random recognition rule, and the process repeats itself until agreement is reached. Under the fixed order rule, the party with the largest number of seats proposes a policy in  $[-1, 1]$ , which is implemented if a majority of the legislature support it; if not, the second largest party proposes a policy. If this second policy does not gain majority support, the smallest party proposes a policy, and if still there is no agreement, a new round of bargaining begins with the largest party again first to move. I assume for now that parties are perfectly patient,  $\delta = 1$ , but this is relaxed in Section 6. A party's strategy specifies which policy to propose if formateur, and which policies to accept or reject otherwise.

**Voters** Individuals are purely policy-motivated with quadratic preferences on  $\mathbb{X}$ . As such, a voter does not care who wins his district *per se*, nor does he care which parties form government; all that matters is the final policy,  $z$ , decided in the legislature. A voter's type,  $t \in T \subset \mathbb{X}$ , is simply his position on the policy line; his utility is  $u_t(z) = -(z - t)^2$ . I assume  $T$  is sufficiently rich that for any tuple of distinct policies,  $(a_l, a_m, a_r)$ , there is at least one voter type who prefers one of the three over the other two. Furthermore, I assume for simplicity that there is no type which is exactly indifferent between two platforms. Let  $V \equiv \{v_l, v_m, v_r\}$  be the set of feasible actions an individual can take, with  $v_c$  indicating a vote for party  $c$ . Voting is costless; thus, there will be no abstention.

Following Myerson (2000, 2002), the number of voters in each district  $d$  is not fully known but rather is a random variable  $n_d$ , which follows a Poisson distribution and has mean  $n$ . The probability that there are exactly  $k$  voters in a district is  $Pr[n_d = k] = \frac{e^{-n} n^k}{k!}$ . Appendix A summarises several properties of the Poisson model. The use of Poisson games in large election models is now commonplace as it simplifies the calculation of probabilities while still producing the same predictions as models with fixed but large populations.<sup>10</sup>

Each district has a distribution of types from which its voters are drawn,  $f_d$ , which has

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<sup>10</sup>Krishna and Morgan (2011) use a Poisson model to show that in large elections, voluntary voting dominates compulsory voting when voting is costly and voters have preferences over ideology and candidate quality. Bouton and Castanheira (2012) use a Poisson model to show that when a divided majority need to aggregate information as well as coordinate their voting behaviour, approval voting serves to bring about the first-best outcome in a large election. Furthermore, Bouton (2013) uses a Poisson model to analyse the properties of runoff elections.

full support over  $[-1, 1]$ . The probability of drawing a type  $t$  is  $f_d(t)$ . The *actual* population of voters in  $d$  consists of  $n_d$  independent draws from  $f_d$ . A voter knows his own type, the distribution from which he was drawn, and the distribution functions of the other districts,  $\mathbf{f} \equiv (f_1, \dots, f_d, \dots, f_D)$ , but he does not know the actual distribution of voters that is drawn in any district.

A voter's strategy is a mapping  $\sigma : T \rightarrow \Delta(V)$  where  $\sigma_{t,d}(v_c)$  is the probability that a type  $t$  voter in district  $d$  casts ballot  $v_c$ . The usual constraints apply:  $\sigma_{t,d}(v_c) \geq 0, \forall c$  and  $\sum_c \sigma_{t,d}(v_c) = 1, \forall t$ . In a Poisson game, all voters of the same type in the same district will follow the same strategy (see Myerson (1998)). Given the various  $\sigma_{t,d}$ 's, the expected vote share of party  $c$  in the district is

$$\tau_d(c) = \sum_{t \in T} f_d(t) \sigma_{t,d}(v_c) \quad (1)$$

which can also be interpreted as the probability of a randomly selected voter playing  $v_c$ . The expected distribution of party vote shares in  $d$  is  $\tau_d \equiv (\tau_d(l), \tau_d(m), \tau_d(r))$ . The realised profile of votes is  $x_d \equiv (x_d(l), x_d(m), x_d(r))$ , but this is uncertain *ex ante*. As the population of voters is made up of  $n_d$  independent draws from  $f_d$ , where  $E(n_d) = n$ , the expected number of ballots for candidate  $c$  is  $E(x_d(c) | \sigma_d) = n \tau_d(c)$ . In the extremely unlikely event that nobody votes, I assume that party  $m$  wins the seat.<sup>11</sup> Let  $\boldsymbol{\sigma} \equiv (\sigma_1, \dots, \sigma_d, \dots, \sigma_D)$  denote the profile of voter strategies across districts and let  $\boldsymbol{\sigma}_{-d}$  be that profile with  $\sigma_d$  omitted. Let  $\boldsymbol{\tau} \equiv (\tau_1, \dots, \tau_d, \dots, \tau_D)$  denote the profile of expected party vote share distributions and let  $\boldsymbol{\tau}_{-d}$  be that profile with  $\tau_d$  omitted. Thus, we have  $\boldsymbol{\tau}(\boldsymbol{\sigma}, \mathbf{f})$ .

At this point, I could define an equilibrium of the game; however, it is more convenient to define equilibrium in terms of pivotality and decisiveness, so I first introduce these additional concepts below.

**Pivotality, Decisiveness and Payoffs** A single vote is *pivotal* if it makes or breaks a tie for first place in the district. A district is *decisive* if the policy outcome  $z$  depends on which candidate that district elects. When deciding on his strategy, a voter need only consider cases in which his vote affects the policy outcome. Therefore, he will condition his vote choice on being *pivotal* in his district and on the district being *decisive*. The ability to do so is key, as if a voter cannot condition on some event where his vote matters then he does not know how he should vote.

Let  $piv_d(c, c')$  denote when, in district  $d$ , a vote for party  $c'$  is pivotal against  $c$ . This occurs when  $x_d(c) = x_d(c') \geq x_d(c'')$  – so that an extra vote for  $c'$  means it wins the seat –

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<sup>11</sup>The probability of zero turnout in a district is  $e^{-n}$ .

or when  $x_d(c) = x_d(c') + 1 \geq x_d(c'')$  – so that an extra vote for  $c'$  forces a tie. In the event of a tie, a coin toss determines the winner.

Let  $\lambda_d$  denote an event in which district  $d$  is decisive in determining which policy  $z$  is implemented; and let  $\lambda_d^i$  denote the  $i$ -th most likely decisive event for district  $d$ . Here the decision of district  $d$  will lead to one of three final policy outcomes, thus, we can write each decisive event as  $\lambda_d^i(z^i)$  or  $\lambda_d^i(z_l^i, z_m^i, z_r^i)$  where each  $z_c^i$  is the policy outcome of the legislative bargaining stage when the decisive district elects party  $c$ . Note that these policies need not correspond to the announced platforms of the parties – typically coalition bargaining will lead to compromised policies. Two decisive events  $\lambda_d^i$  and  $\lambda_d^j$  are *distinct* if  $(z_l^i, z_m^i, z_r^i) \neq (z_l^j, z_m^j, z_r^j)$ . Let  $\Lambda$  be the set of distinct decisive events; this set consists of  $I$  elements. As we will see, the number and type of decisive events in the set  $\Lambda$  depends on the legislative bargaining rule used.

It is useful for the following sections to classify decisive events into three categories. Let  $\lambda(3)$  be a decisive event where all three policies  $z_l^i, z_m^i$ , and  $z_r^i$  are different points on the policy line; let  $\lambda(2)$  be a case where two of the three policies are identical.<sup>12</sup> Finally, let  $\lambda(2')$  be an event where there are three different policies but one of them is the preferred choice of no voter.<sup>13</sup> We can now turn to voter payoffs.

Let  $G_{t,d}(v_c | n\tau)$  denote the expected gain for a voter of type  $t$  in district  $d$  of voting for party  $c$ , given the strategies of all other players in the game – this includes players in his own district as well as those in the other  $D - 1$  districts. The expected gain of voting  $v_l$  is given by

$$G_{t,d}(v_l | n\tau) = \sum_{i=1}^I Pr[\lambda_d^i] \left( Pr[piv_d(m, l)] \left( u_t(z_l^i) - u_t(z_m^i) \right) + Pr[piv_d(r, l)] \left( u_t(z_l^i) - u_t(z_r^i) \right) \right) \quad (2)$$

with the gain of voting  $v_m$  and  $v_r$  similarly defined. The probability of being pivotal between two candidates,  $Pr[piv_d(c, c')]$ , depends on the strategies and distribution of player types in that district, summarised by  $\tau_d$ , while the probability of district  $d$  being decisive depends on the strategies and distributions of player types in the other  $D - 1$  districts,  $\tau_{-d}$ . The best response correspondence of a type  $t$  in district  $d$  to a strategy profile and distribution of types given by  $\tau$  is

$$BR_{t,d}(n\tau) \equiv \operatorname{argmax}_{\sigma_{t,d}} \sum_{v_c \in V} \sigma_{t,d}(v_c) G_{t,d}(v_c | n\tau) \quad (3)$$

<sup>12</sup>Obviously,  $\lambda(1)$  events cannot exist; if electing any of the three parties gives the same policy, it is not a decisive event.

<sup>13</sup>For this to be the case, the universally disliked policy must be a lottery over two or more policies.

**Timing** The sequence of play is as follows:

1. In each district, nature draws a population of  $n_d$  voters from  $f_d$ .
2. Voters observe platforms  $(a_l, a_m, a_r)$  and cast their vote for one of the three parties. Whichever party wins a plurality in a district takes that seat in the legislature.
3. A government is formed according to a specified bargaining process and a policy outcome,  $z$ , is chosen.

**Equilibrium Concept** The equilibrium of this game consists of a *voting equilibrium* at stage 2 and a *bargaining equilibrium* at stage 3. In a *bargaining equilibrium*, each party's strategy is a best response to the strategies of the other two parties. I restrict attention to stationary bargaining equilibria, as is standard in such games.<sup>14</sup>

The solution concept for the voting game at stage 2 is strictly perfect equilibrium (Okada (1981)).<sup>15</sup> A strategy profile  $\sigma^*$  is a strictly perfect equilibrium if and only if  $\exists \epsilon > 0$  such that  $\forall \tilde{\tau}_d \in \Delta V : |\tilde{\tau}_d - \tau_d(\sigma^*, \mathbf{f})| < \epsilon$  then  $\sigma_{t,d}^* \in BR_{t,d}(n\tilde{\tau})$  for all  $(t, d) \in T \times D$ . That is, the equilibrium must be robust to epsilon changes in the strategies of players. Bouton and Gratton (2015) argue that restricting attention to such equilibria in multi-candidate Poisson games is appropriate because it rules out unstable and undesirable equilibria identified by Fey (1997). If, instead, Bayesian Nash equilibrium is used there may be knife-edge equilibria in which voters expect two or more candidates to get exactly the same number of votes. Bouton and Gratton (2015) also note that requiring strict perfection is equivalent to robustness to heterogenous beliefs about the distribution of preferences,  $\mathbf{f}$ . As I am interested in the properties of large national elections, I analyse the limiting properties of such equilibria as  $n \rightarrow \infty$ .

### 3 Equilibrium

I solve for the equilibrium of the game by backward induction. The bargaining equilibrium at stage 3 follows from Baron (1991). Of greater interest to us is the voting equilibrium at stage 2. While there are multiple voting equilibria for any distribution of voter types, I show that every equilibrium has only two candidates receiving votes in each district and I present several properties which must hold in any equilibrium.

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<sup>14</sup>An equilibrium is stationary if it is a subgame perfect equilibrium and each party's strategy is the same at the beginning of each bargaining period, regardless of the history of play.

<sup>15</sup>The original formulation of strictly perfect equilibrium was for games with a finite number of players; Bouton and Gratton (2015) extend this to Poisson games.

**Stage 3: Bargaining Equilibrium** When no party has a majority of seats and  $\delta = 1$ , in any stationary bargaining equilibrium  $z = a_m$  is proposed and eventually passed with probability one.<sup>16</sup> This is regardless of whether the protocol is fixed order or random. To see this, note that if any other policy is proposed, a majority of legislators will find it worthwhile to wait until  $a_m$  is offered (which will occur when party  $m$  is eventually chosen as formateur). The equilibrium policy outcome of the legislative bargaining stage is then

$$z = \begin{cases} a_l & \text{if } s_l > \frac{D-1}{2} \\ a_r & \text{if } s_r > \frac{D-1}{2} \\ a_m & \text{otherwise} \end{cases} \quad (4)$$

Every feasible seat distribution is mapped into a policy outcome, so, at stage 2, voters can fully anticipate which policy will arise from a given seat distribution. The set of distinct decisive events is given by

$$\Lambda = \{\lambda(a_l, a_m, a_m), \lambda(a_m, a_m, a_r), \lambda(a_l, a_m, a_r)\} \quad (5)$$

**Stage 2: Voting Equilibrium** A slight detour on how voters optimally cast their vote is in order before describing the voting equilibrium. We know from the Magnitude Theorem (Myerson (2000), see appendix) that as  $n \rightarrow \infty$  voters in a single district election need only condition their choice on the most likely vote profile in which their vote is pivotal. The following lemma extends this result to the case of multi-district elections considered here.

**Lemma 1.** *As  $n \rightarrow \infty$  a voter need only condition his vote on the most likely event in which his vote is both pivotal and decisive over two distinct policy outcomes.*

*Proof.* See Appendix A. □

An intuitive way of thinking of a voter's decision process is the following. As in stand-alone plurality elections, a voter must consider the relative probabilities of his vote changing the outcome in his district. However, he must also consider what happens in other districts. Given  $\tau_{-d}$ , the voter will have an expectation about what the seat distribution will be before his district votes,  $E(S_{-d})$ . If such an expectation means that  $d$  is not decisive, then the voter will look to the most likely upset out of all the districts - where an expected winner in a district instead loses. If  $d$  is now decisive, he can condition on this event; if not, he must consider the next most likely upset. This processes of continues until the voter has worked out the most likely chain of upsets which must occur in order to make his district decisive.

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<sup>16</sup>For a proof see Jackson and Moselle (2002).

Combining the probability of various upsets in the other districts with the probability of being pivotal in district  $d$ , the voter can rank the probabilities of the various cases in which his vote choice will change his utility. Only the relative probabilities of these events matter for the voter. The lemma says that in a large election a voter need only condition his ballot on the most likely of these events.

Now that we have analysed the decision problem of a single voter, we can see what happens in an equilibrium. Voting games where players have three choices typically have multiple equilibria; this game is no exception. However, I show that every voting equilibrium involves only two candidates getting votes in each district.

**Proposition 1.** *For any majoritarian legislative bargaining rule and any distribution of voter preferences,  $\mathbf{f} \equiv (f_1, \dots, f_d, \dots, f_D)$ , there are multiple equilibria; in every equilibrium districts are duvergerian.*

*Proof.* See Appendix A. □

It is perhaps unsurprising that there are multiple equilibria and districts are always duvergerian, especially given the findings of the extensive literature on single district plurality elections. The logic as to why races are duvergerian is similar to the single district case; voters condition their ballot choice on the most likely case in which they are pivotal, decisive and not indifferent over outcomes. This greatly simplifies the decision process of voters and means they need only consider the two frontrunners in their district.<sup>17</sup> While we cannot pin down which equilibrium will be played, the following properties will always hold.

1. In each district only two candidates receive votes; call these *serious candidates*.
2. If  $\tau_d(c) > \tau_d(c') > 0$ , candidate  $c$  is the expected winner and his probability of winning goes to one as  $n \rightarrow \infty$ . Let  $d_c$  denote such a district.
3. The expected seat distribution is  $E(S) = E(s_l, s_m, s_r) = (\#d_l, \#d_m, \#d_r)$ .
4. A district with  $c$  and  $c'$  as serious candidates will condition on the most likely decisive event  $\lambda^i \in \Lambda$  such that  $z_c^i \neq z_{c'}^i$ .

The fourth property says: if a district's most likely decisive event,  $\lambda_d^1$ , is of the type  $\lambda(3)$  or  $\lambda(2')$ , then voters must be conditioning on this event; if  $\lambda_d^1$  is of type  $\lambda(2)$ , voters will be conditioning on it only if they are not indifferent between the two serious candidates.

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<sup>17</sup>By restricting attention to strictly perfect equilibria we rule out knife edge cases where candidates are expected to get exactly the same share of votes.

## 4 Analysis of Benchmark Model

This section presents the main results of the paper: the problems associated with standard plurality rule election - polarisation and misaligned voting - can be mitigated in legislative elections. Throughout the rest of the paper, several figures show the decision problem faced by voters. These should make the arguments made in proofs easier to follow, hence, a slight detour is needed to explain the graphical approach.

Recall, from Equation 5, that there are three distinct decisive events a district may condition on:

$$\Lambda = \{\lambda(a_l, a_m, a_m), \lambda(a_m, a_m, a_r), \lambda(a_l, a_m, a_r)\}$$

The first two are  $\lambda(2)$  events while the final one is a  $\lambda(3)$  event. A  $\lambda(a_l, a_m, a_m)$  event occurs when a district is decisive in determining whether  $l$  wins a majority of seats and implements  $z = a_l$ , or it falls just short, allowing a coalition to implement  $z = a_m$ . Here, voter types  $t < \frac{a_l + a_m}{2} \equiv a_{lm}$  will vote  $v_l$  while those of type  $t > a_{lm}$  will coordinate on either  $v_m$  or  $v_r$ , as they are indifferent between the two policies offered. Similarly, in a  $\lambda(a_m, a_m, a_r)$  event, a district can secure party  $r$  a majority of seats or not; those with  $t < a_{mr}$  will vote either  $v_l$  or  $v_m$ , while the rest will choose  $v_r$ . Finally, when a district finds itself at a point  $\lambda(a_l, a_m, a_r)$ , it is conditioning on  $l$  and  $r$  winning half the seats each before  $d$ 's result is included:  $S_{-d} = (\frac{D-1}{2}, 0, \frac{D-1}{2})$ . Electing either  $l$  or  $r$  would give them a majority, while electing  $m$  would bring about a coalition. Therefore, depending on the result in  $d$ , any of the three policies  $a_l, a_m$  or  $a_r$  could be implemented.

These three distinct decisive events are represented in Figure 1. The simplex represents the decision problem of voters in district  $d$ , holding fixed the strategies of those in the other  $D - 1$  districts.<sup>18</sup> Each point corresponds to an expected distribution of  $D - 1$  seats among the three parties: the bottom left point corresponds to  $E(S_{-d}) = (D - 1, 0, 0)$ ; the bottom right,  $E(S_{-d}) = (0, 0, D - 1)$ ; the apex is  $E(S_{-d}) = (0, D - 1, 0)$ . For any given point, the number of party  $m$  seats can be read directly off the y-axis, while the the number of party  $r$  seats can be read by moving down the 45 degree line in a southwesterly direction to the x-axis. The number of party  $l$  seats is simply the remainder.

Each district will condition on one of the distinct events  $\lambda \in \Lambda$  when voting, and this must be consistent with the equilibrium properties given in the previous section. All  $d_l$  have  $E(S_{-d_l}) = E(s_l - 1, s_m, s_r)$ , all  $d_m$  have  $E(S_{-d_m}) = E(s_l, s_m - 1, s_r)$ , and all  $d_r$  have  $E(S_{-d_r}) = E(s_l, s_m, s_r - 1)$ . In Figure 1 this corresponds to the various  $E(S_{-d})$  forming an inverted triangle. An example is shown for the case of  $E(S) = (16, 2, 7)$ .

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<sup>18</sup>While the simplex represents the case of  $D = 25$ , the same would hold for any odd  $D$ . To avoid the case where two parties could share the seats equally, I ignore the case where  $D$  is even.

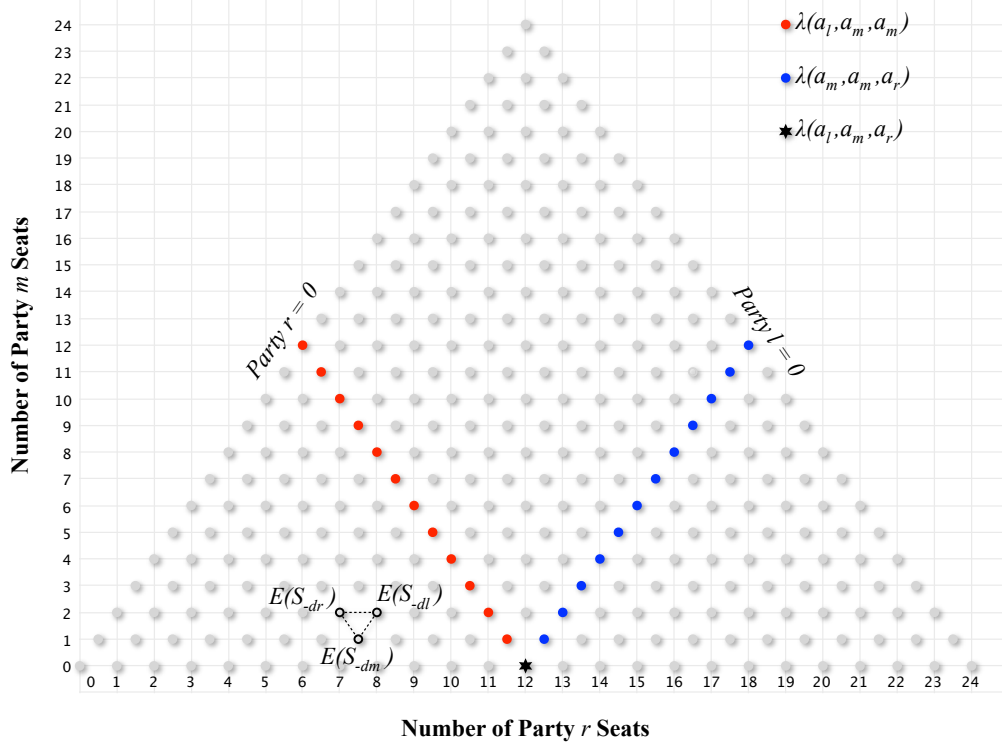


Figure 1: Cases in which  $d$  is decisive when  $D = 25$

## 4.1 Polarisation

Much attention in the U.S. has focused on how a system with two polarised parties has led to policies which are far away from the median voter's preferred point.<sup>19</sup> An open question is the degree to which policy outcomes reflect the preferences of voters in a legislative election with three parties. Let  $\tilde{t}_d$  be the expected position of the median voter in district  $d$ , and label the districts so that  $\tilde{t}_1 < \dots < \tilde{t}_{\frac{D+1}{2}} < \dots < \tilde{t}_D$ . Then,  $\tilde{t}_{\frac{D+1}{2}}$  is the expected median voter in the median district. While polarisation of outcomes can always occur in stand-alone multi-candidate plurality elections, the following proposition shows that an extreme policy can only be implemented in my setting if it is preferred to a moderate policy by the median voter in the median district.

**Proposition 2.** *For any distribution of voter preferences, where bargaining occurs over policy and  $\delta = 1$ , if  $E(s_m) > 0$  then the expected outcome can be  $a_l$  only if the median voter in the median district prefers policy  $a_l$  to policy  $a_m$ ; that is, if  $\tilde{t}_{\frac{D+1}{2}} < a_{lm}$ . Similarly, a necessary condition for  $E(z) = a_r$  is  $\tilde{t}_{\frac{D+1}{2}} > a_{mr}$ .*

*Proof.* See Appendix A. □

<sup>19</sup>See McCarty, Poole, and Rosenthal (2008) as well as Polborn and Krasa (2015).



The focus on expected policies in the proposition is because of the random nature of the model. It is always possible, though immensely unlikely, for the realised population of voters to differ from the expected population sufficiently that  $E(z) \neq z$ . However, as  $n \rightarrow \infty$  this probability goes to zero. The proposition stands in stark contrast to single district plurality elections. In a stand-alone plurality election it can always be that  $l$  and  $r$  are the serious candidates, so either  $a_l$  or  $a_r$  will be implemented. A median voter will elect  $l$  as long as he prefers  $a_l$  to  $a_r$ . In a legislative election it takes much more to get non-moderate policies. For  $a_l$  to come about it must be that (a) voters act as if their vote is pivotal in deciding between an  $l$  majority government and a coalition, and (b) a majority of voters in a majority of districts prefer that majority government policy,  $a_l$ , to the coalition policy.

This result gives a novel insight into multiparty legislative elections under plurality. In the U.K., until recently, a vote for the Liberal Democrats (Lib Dems) has typically been considered a “wasted vote”.<sup>20</sup> The popular belief was that the Lib Dems were not a legitimate contender for government and so, even if they took a number of seats in parliament, they would not influence policy. As a result, centrist voters instead voted for either the Conservatives or Labour. My model shows that electing a Lib Dem candidate is far from a waste. Electing just one member of the Lib Dems to the legislature will be enough to moderate extreme policies unless voter preferences favour one of the non-centrist parties very much. In this benchmark case moderation leads to any coalition implementing Lib Dem policies in full. In Section 5 and Section 6 we’ll see that a coalition doesn’t implement the exact policy of the moderate party - nonetheless, coalition policies remain quite centrist and extreme outcomes are still mitigated. This result suggests that concerns about the average voter not being adequately represented in the U.K. or Canada are misplaced. If the Conservatives win a majority in parliament it must be that a majority of voters in a majority of districts prefer their policy to that of a moderate coalition. On the other hand, a moderate coalition can come about for any distribution of voter preferences.<sup>21</sup> Supporters of the Lib Dems in the U.K. and the Liberals in Canada are therefore hugely advantaged by the current electoral system; it is the supporters of the non-centrist parties who are disadvantaged.

## 4.2 Misaligned Voting

All voters are strategic: a voter chooses his ballot to maximise his expected utility; which ballot this is depends on how the others vote. In any given situation, an individual may cast

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<sup>20</sup>See “What Future for the Liberal Democrats” by Lord Ashcroft, 2010.

<sup>21</sup>For any  $\mathbf{f}$ , there are always equilibria where  $z = a_m$  is the expected outcome. If support is strong for party  $r$  then an equilibrium in which districts focus on a  $\lambda(a_l, a_m, a_m)$  decisive event will give  $z = a_m$ . Likewise, if  $l$  is popular then a focus on  $\lambda(a_m, a_m, a_r)$  will give  $z = a_m$ .

the same ballot he would if his vote unilaterally decided the district, or the strategies played by the others in the district may mean his best response is to vote for a less desirable option. Following Kawai and Watanabe (2013), I call the latter misaligned voting.

**Definition.** *A voter casts a **misaligned vote** if, conditioning on the strategies of voters in other districts, he would prefer a different candidate to win his district than the one he votes for.*

If a voter casts a misaligned vote, he is essentially giving up on his preferred candidate due to the electoral mechanism. In a single plurality election there is only one district - so there is no conditioning on other districts. With candidates  $l, m$  and  $r$ , whichever candidate is least likely to be pivotal will be abandoned by his supporters, leading to a two-party race. Therefore, either all types with  $t < a_{lm}$ , all types with  $t > a_{mr}$ , or those in the interval in between will cast a misaligned vote. In contrast, Proposition 3 below shows that when  $\delta = 1$  there are many equilibria of the legislative election in which there is no misaligned voting in any district.

**Proposition 3.** *For any distribution of voter preferences, with bargaining over policy and  $\delta = 1$ , there always exist equilibria with no misaligned voting in any district. These occur when  $l$  or  $r$  are serious candidates in fewer than  $\frac{D-1}{2}$  districts.*

*Proof.* See Appendix A. □

The crux of the proposition is that when one of the non-centrist parties is a serious candidate in less than half the districts, only one distinct decisive event exists. This event is a choice over two policies; with only two policies on the table there is no strategic choice to make - voters simply vote for their preferred option of the two. So, there can be no misaligned voting. A voter with  $t > a_{lm}$  facing a  $\lambda(a_l, a_m, a_r)$  decisive event is indifferent between electing  $m$  or  $r$ ; he will vote for whichever of the two the other voters are coordinating on.

The proposition gives us a clear prediction on when there will and will not be misaligned voting with three parties competing in a legislative election. It shows that the conventional wisdom - no misaligned with two candidates, always misaligned with three - is wide of the mark; whether there is misaligned voting or not depends on the strength of the non-centrist parties. The proposition also has implications for the study of third-party entry into a two-party system. Suppose, as is plausible, that a newly formed party cannot become focal in many districts - maybe because they have limited resources, or because voters do not yet consider them a serious alternative. Either way, an entering third-party is likely to be weaker than the two established parties. Proposition 3 tells us that if a third party enters on the

flanks of the two established parties, then there will be no misaligned voting and no effect on the policy outcome as long as this party is serious in less than half the districts. On the other hand, if a third party enters at a policy point in between the two established parties, this can shake up the political landscape. First of all, there will necessarily be misaligned voting. Second of all, the policy outcome will now depend on which equilibrium voters focus on - either  $a_l$  or  $a_m$  if  $\tilde{t}_{\frac{D+1}{2}} < a_{lr}$  and  $a_m$  or  $a_r$  if  $\tilde{t}_{\frac{D+1}{2}} > a_{lr}$ . Success for the new party in just one district can radically change the policy outcome. The implication is that parties in a two-party system should be less concerned about the entry of fringe parties and more concerned about potential centrist parties stealing the middle ground.

## 5 Legislative Bargaining over Policy and Perks

While the model of bargaining over policy in the previous section is tractable, it lacks one of the key features of the government formation process: parties often bargain over perks of office such as ministerial positions as well as over policy. Here, as parties can trade off losses in the policy dimension for gains in the perks dimension, and vice versa, a larger set of policy outcomes are possible. This section will show that, nonetheless, the results of the benchmark model extend broadly to the case of bargaining over policy and perks.

The following legislative bargain model with  $B > 0$  is due to Austen-Smith and Banks (1988) (henceforth ASB).<sup>22</sup> As usual, if a party wins an overall majority it will implement its preferred policy and keep all of  $B$ . Otherwise, the parties enter into a stage of bargaining over government formation. The party winning the most seats of the three begins the process by offering a policy outcome  $y^1 \in \mathbb{X}$  and a distribution of a fixed amount of transferable private benefits across the parties,  $b^1 = (b_l^1, b_m^1, b_r^1) \in [0, B]^3$ . It is assumed that  $B$  is large enough so that any possible governments can form, i.e.  $l$  can offer enough benefits to party  $r$  so as to overcome their ideological differences. If the first proposal is rejected, the party with the second largest number of seats gets to propose  $(y^2, b^2)$ . If this is rejected, the smallest party proposes  $(y^3, b^3)$ . If no agreement has been reached after the third period, a caretaker government implements  $(y^0, b^0)$ , which gives zero utility to all parties.<sup>23</sup>

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<sup>22</sup>Other papers with bargaining over policy and perks include Diermeier and Merlo (2000) and Bandyopadhyay and Oak (2008).

<sup>23</sup>This three-period protocol is a departure from the infinite horizon of the other bargaining rules I use. Nonetheless, it is the standard ASB model and so is used for easy comparisons to the literature.

Seat Share	$3\Delta_r < \Delta_l$	$2\Delta_r < \Delta_l \leq 3\Delta_r$	$\Delta_r < \Delta_l \leq 2\Delta_r$	$\Delta_l = \Delta_r$	$\Delta_l < \Delta_r \leq 2\Delta_l$	$2\Delta_l < \Delta_r \leq 3\Delta_l$	$3\Delta_l < \Delta_r$
$s_l > (D-1)/2$	$a_l$	$a_l$	$a_l$	$a_l$	$a_l$	$a_l$	$a_l$
$(D+1)/2 > s_l > s_r > s_m$	$a_{lm}$	$a_{lm}$	$a_{lm}$	$a_{lm}$	$a_{lm}$	$2a_m - a_{lr}$	$a_l$
$(D+1)/2 > s_l > s_m > s_r$	$a_{lr}$	$a_{lr}$	$a_{lr}$	$a_m$	$a_m$	$a_m$	$a_m$
$s_m > s_l, s_r$	$a_m$	$a_m$	$a_m$	$a_m$	$a_m$	$a_m$	$a_m$
$(D+1)/2 > s_r > s_m > s_l$	$a_m$	$a_m$	$a_m$	$a_m$	$a_{lr}$	$a_{lr}$	$a_{lr}$
$(D+1)/2 > s_r > s_l > s_m$	$a_r$	$2a_m - a_{lr}$	$a_{mr}$	$a_{mr}$	$a_{mr}$	$a_{mr}$	$a_{mr}$
$s_r > (D-1)/2$	$a_r$	$a_r$	$a_r$	$a_r$	$a_r$	$a_r$	$a_r$

Table 1: Policy outcomes under ASB bargaining for any seat distribution and distance between parties.

At its turn to make a proposal, party  $c$  solves

$$\begin{aligned} & \max_{b_{c'}, y} B - b_{c'} - (y - a_c)^2 \\ & \text{subject to } b_{c'} - (y - a_{c'})^2 \geq W_{c'} \end{aligned} \quad (6)$$

where  $W_{c'}$  is the continuation value of party  $c'$  and  $W_{c''} + (y - a_{c''})^2 > W_{c'} + (y - a_{c'})^2$ , so that the formateur makes the offer to whichever party is cheaper. Solving the game by backward induction, Austen-Smith and Banks (1988) show that a coalition government will always be made up of the largest party and the smallest party. They solve for the equilibrium policy outcome, for any possible distance between  $a_l$ ,  $a_m$  and  $a_r$ .

Table 1 shows the policy outcome for each seat distribution and distance between parties, where  $\Delta_l \equiv a_m - a_l$  and  $\Delta_r \equiv a_r - a_m$ . I assume if two parties have exactly the same number of seats, a coin is tossed before the bargaining game begins to decide the order of play. So, if  $s_l = s_r > s_m$ , then with probability one-half, the game will play out as when  $s_l > s_r > s_m$  and otherwise as  $s_r > s_l > s_m$ .

The set of possible policy outcomes depends on the number of seats in the legislature, and on the distance between party policies. The simplex in Figure 2 shows what the policy will be, for any seat distribution, when there are 25 districts and  $\Delta_l < \Delta_r \leq 2\Delta_l$ . Notice that there are far more policy possibilities than in the case of  $B = 0$ . Figure 3 shows the various decisive cases from the perspective of a single district; it is the analogue of Figure 1. While there are many more decisive cases than when  $B = 0$ , they can be grouped into the three categories defined previously:  $\lambda(2)$ ,  $\lambda(2')$  and  $\lambda(3)$  events.

The following proposition shows that, even when parties can bargain over perks as well as policy, a non-centrist party will only win a majority if the median voter in the median district prefers its policy to that of the centrist party.

**Proposition 4.** *For any distribution of voter preferences,  $3\Delta_l > \Delta_r$  and  $E(s_m) > 1$ , the expected outcome under ASB bargaining can be  $a_l$  only if  $\tilde{t}_{\frac{D+1}{2}} < a_{lm}$ . Similarly, when  $3\Delta_r > \Delta_l$  and  $E(s_m) > 1$ , a necessary condition for  $E(z) = a_r$  is  $\tilde{t}_{\frac{D+1}{2}} > a_{mr}$ .*

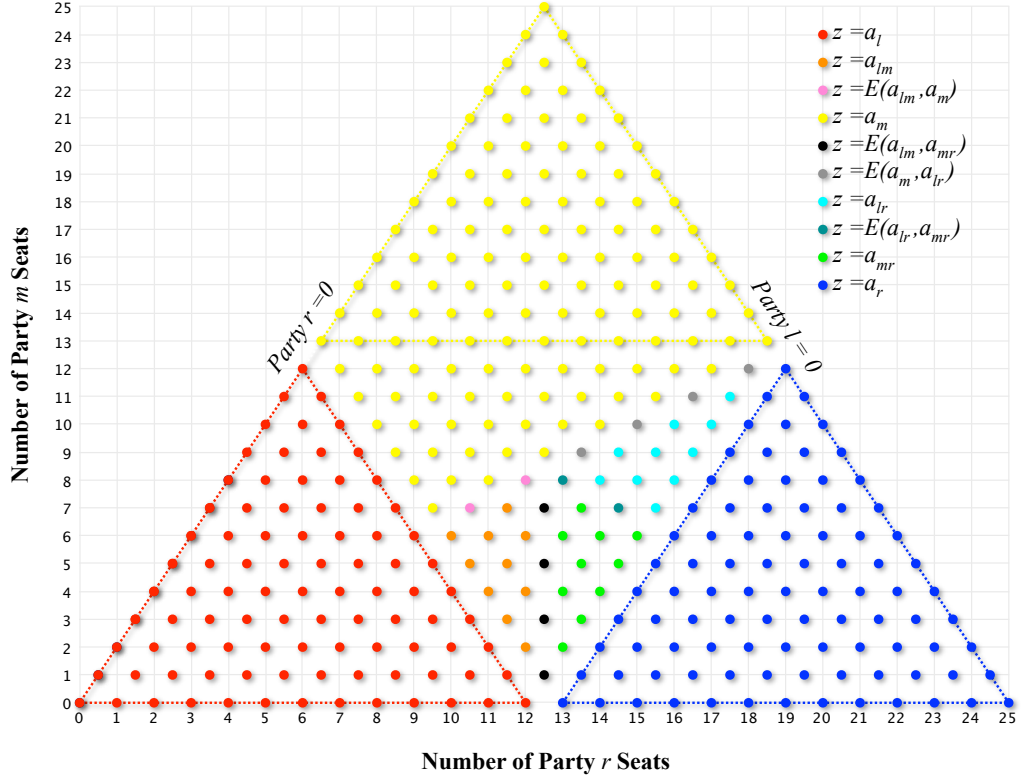


Figure 2: Policy outcomes under ASB bargaining, with  $D = 25$  and  $\Delta_l < \Delta_r \leq 2\Delta_l$

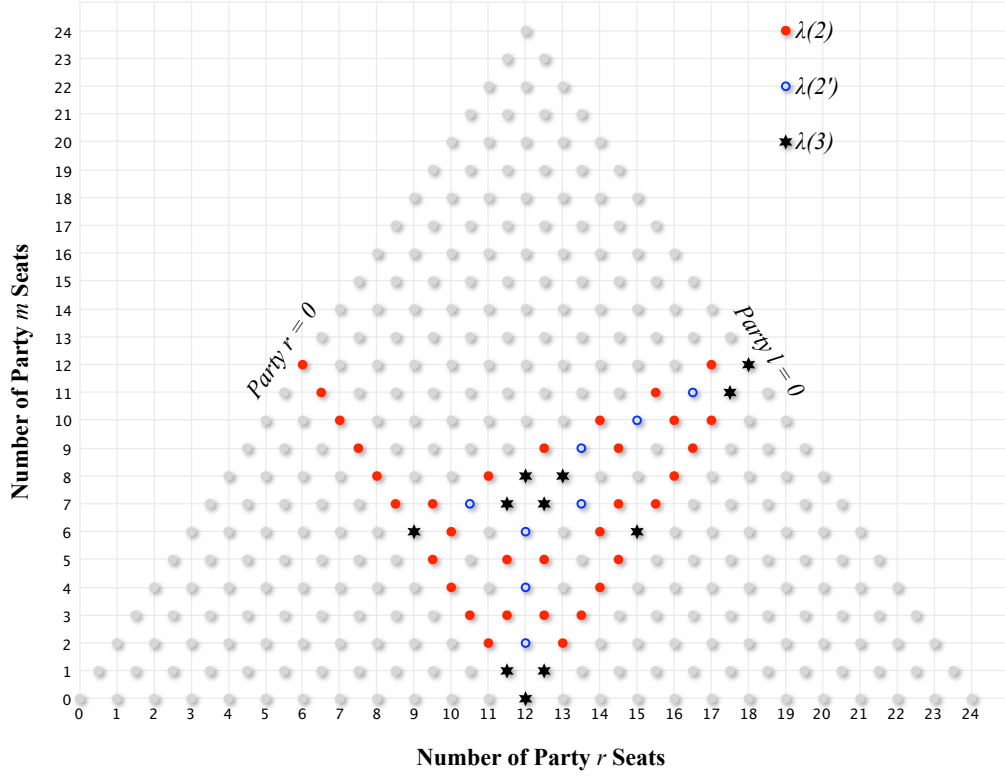


Figure 3: Decisive events under ASB bargaining, with  $D = 25$  and  $\Delta_l < \Delta_r \leq 2\Delta_l$

*Proof.* See Appendix A. □

Ruling out extreme outcomes here also requires that the non-centrist parties are not exceptionally asymmetrically positioned. Given that restriction, we reaffirm the result of Proposition 2, that moderate coalitions will be the norm in legislative elections unless the population is heavily biased in favour of one of the non-centrist parties. Moreover, bargaining over perks and policy can make it even more difficult for a non-centrist party to gain a majority than in the benchmark case. This can be seen from Figure 2: starting from a point  $E(S)$  where  $E(s_l) > \frac{D-1}{2}$ ,  $E(s_m) > 1$  and  $\frac{D-1}{4} < E(s_r) < \frac{D-1}{2}$ , the most likely decisive event for each district must be  $\lambda(a_l, a_{lm}, a_{lm})$ . Therefore, a party  $l$  majority could only come about if  $\tilde{t}_{\frac{D+1}{2}} < \frac{a_l + a_{lm}}{2}$  - an even stricter requirement than that of the benchmark case. This result is noteworthy as in U.K. and Canadian elections party seat shares have tended to be in line with this case: one of the non-centrist parties wins a majority, the other wins more than a quarter of the seats, while the centrist party wins much less than a quarter.

On the other dimension of interest bargaining over policy and perks does not perform as well; the restrictions needed to completely rule out misaligned voting are more severe than in the benchmark model. However, as Proposition 6 will show, there are many equilibria in which a large subset of districts have no misaligned voting.

**Proposition 5.** *In a legislative election with ASB bargaining, there always exist equilibria with no misaligned voting in any district.*

1. When  $\Delta_l = \Delta_r$ , there is no misaligned voting if either party  $l$  or party  $r$  are serious in fewer than  $\frac{D-1}{4}$  districts.
2. When  $\Delta_l < \Delta_r$ , there is no misaligned voting if party  $r$  is serious in fewer than  $\frac{D-1}{4}$  districts.
3. When  $\Delta_l > \Delta_r$ , there is no misaligned voting if party  $l$  is serious in fewer than  $\frac{D-1}{4}$  districts.

*Proof.* See Appendix A. □

The intuition is the same as in Proposition 3: when a non-centrist party is not serious in enough districts, there is no hope of it influencing the outcome of legislative bargaining. The threshold for relevance is lower than in the benchmark case. This is because the order of parties matters for the policy outcome under ASB bargaining. From Figure 3 we see that once it is possible for party  $r$  to win  $\frac{D-1}{4}$  districts, two distinct decisive events exist:  $\lambda(a_l, a_m, a_m)$  and  $\lambda(a_l, a_m, a_{lm})$ . No matter which of these two events a district focuses on,

and which two candidates are serious, some voters in the district will be casting misaligned votes.

When party  $l$  or  $r$  have serious candidates in more than  $\frac{D-1}{4}$  districts we cannot rule out misaligned voting. This should not be surprising in a model with three differentiated parties and multiple voter types on a policy line. We know that in single plurality elections there will always be misaligned voting. What *is* surprising is that misaligned voting can ever be ruled out in a district. The following proposition holds for all bargaining rules and gives conditions for equilibria with no misaligned voting in a subset of districts.

**Proposition 6.** *There will be no misaligned voting in a district if either*

1. *The most likely decisive event  $\lambda_d^1$  is a  $\lambda(2')$  event where candidates  $c$  and  $c'$  are serious and  $z_{c'}^1$  is preferred by no voter.*
2. *The most likely decisive event  $\lambda_d^1$  is a  $\lambda(2)$  event where candidates  $c$  and  $c'$  are serious,  $z_c^1 = z_{c'}^1$ , and all those voting  $v_c$  must have  $u_t(z_c^i) > u_t(z_{c'}^i)$  in the next most likely decisive event  $\lambda^i \in \Lambda$  in which  $z_c^i \neq z_{c'}^i$ .*

*Proof.* See Appendix A. □

The proposition is best understood by way of example. To see the first part, take a  $\lambda(2')$  event, for example,  $S_{-d} = (\frac{D-3}{2}, 2, \frac{D-3}{2})$  in Figure 3. Electing  $l$  will give  $s_l > s_r > s_m$  resulting in  $z = a_{lm}$ , electing  $r$  instead will give  $s_r > s_l > s_m$  and bring about  $z = a_{mr}$ , while electing  $m$  will lead to a tie for first place between  $l$  and  $r$ . A coin toss will decide which of the two policies comes about, but *ex ante* voters' expectation is  $E(a_{lm}, a_{mr})$ . As voters have concave utility functions, every voter strictly prefers either  $a_{lm}$  or  $a_{mr}$  to the lottery over the pair. If this decisive event is the most likely (i.e. infinitely more likely than all others) and the district focuses on a race between  $l$  and  $r$ , nobody in the district is casting a misaligned vote.

To see the second part of the proposition, suppose the most likely decisive event is  $S_{-d} = (\frac{D-3}{2}, 3, \frac{D-5}{2})$ . Here, electing  $l$  or  $m$  gives  $a_{lm}$  while electing  $r$  brings about a coin toss and an expected policy  $E(a_{lm}, a_{mr})$ . Suppose further that the second most likely decisive event is  $S_{-d} = (\frac{D-5}{2}, 3, \frac{D-3}{2})$ , where electing  $m$  or  $r$  gives policy  $a_{mr}$  while electing  $l$  gives  $E(a_{lm}, a_{mr})$ . In the most likely event, all voters below a certain threshold will be indifferent between electing  $l$  and electing  $m$ . However, in the second most likely decisive event, all of these voters would prefer to elect  $l$  than  $m$ . Given that each decisive event is infinitely more likely to occur than a less likely decisive event, these voters need only consider the top two decisive events. Any voter who is indifferent between  $l$  and  $m$  in the most likely decisive event strictly prefers  $l$  in the second most likely. So, if the district focuses on a race

between  $l$  and  $r$  there will be no misaligned voting. A special case of this second condition is when  $\lambda^1$  is a  $\lambda(2)$  event and no  $\lambda^2$  event exists. This is what rules out misaligned voting in Proposition 3 and Proposition 5.

Proposition 6 is quite useful, as it holds for any bargaining rule. It will allow me to say that in the next section, even though we cannot get results such as Proposition 3 and Proposition 5, we do not return to the single plurality election case of “always misaligned voting”. Instead, there are again many equilibria in which a subset of districts have no misaligned voting.

## 6 Impatient Parties

In this section, I examine how the results of the benchmark model change when  $\delta < 1$ , so that parties are no longer perfectly patient. It is likely that the discount rates of politicians vary across countries depending on things such as constitutional constraints of bargaining, the status quo, and the propensity of politicians to be reelected.<sup>24</sup>

In the benchmark model it didn’t matter whether the bargaining protocol was random or had a fixed order; a coalition would always implement  $z = a_m$ . Once parties discount the future, we get different policy outcomes depending on which of the two is used. Also, once discounting is introduced into a bargaining model, one needs to decide whether players receive payoffs at each stage of bargaining or only once an agreement is reached. In the former case, the location of a status quo policy,  $Q$ , will be important for final policy outcomes. The literature is far from united in the treatment of stage utilities in government formation. With no stage payoffs, Jackson and Moselle (2002) show that there exists  $\delta^* < 1$  such that if  $\delta \geq \delta^*$  then the coalition policy will be within  $\epsilon$  of  $a_m$ . However, their model doesn’t lend itself easily to the current setup as mixing over proposals means precise policy outcomes are not pinned down. Therefore, I follow Austen-Smith and Banks (2005) and Banks and Duggan (2006) in having players receive stage payoffs. I assume the status quo is neither too extreme,  $Q \in (-\Delta_c, \Delta_c)$  where  $\Delta_c = \min\{\Delta_l, \Delta_r\}$ , nor too central  $Q \neq a_m$ .<sup>25</sup>

In each period where no agreement is reached, the status quo policy remains and enters party’s payoff functions. All parties discount the future at the same rate of  $\delta \in (0, 1)$ . Therefore, if a proposal  $y$  is passed in period  $t$ , the payoff of party  $c$  is

$$W_c = -(1 - \delta^{t-1})(Q - a_c)^2 - \delta^{t-1}(y - a_c)^2 \quad (7)$$

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<sup>24</sup>After the 2010 Belgian elections, legislative bargaining lasted for a record-breaking 541 days, suggesting high values of  $\delta$ . Conversely, after the 2010 U.K. elections, a coalition government was formed within five days.

<sup>25</sup>If  $Q = a_m$  the result is the same as the benchmark case of  $\delta = 1$ .



For ease of analysis I assume, without loss of generality, that  $a_m = 0$ .<sup>26</sup> Banks and Duggan (2000) show that all stationary equilibria are no-delay equilibria and are in pure strategies when the policy space is one-dimensional and  $\delta < 1$ .

## 6.1 Fixed Order Bargaining

The order of recognition is fixed and follows the ranking of parties' seat shares. In Appendix A, I derive the policy outcomes for any ordering of parties; these are presented in Table 2 below along with policies for specific values of  $\delta$  and  $Q$ . From the table we see that the further party  $m$  moves down the ranking of seat shares, the further the coalition policy moves away from  $a_m$ . Figure 4 shows the various policy outcomes for any seat distribution in the legislature. Figure 5 shows the frequency of the three categories of decisive events.

Seat Share	Policy	$\delta = 0.95$ $ Q  = 0.5$	$\delta = 0.95$ $ Q  = 0.25$	$\delta = 0.9$ $ Q  = 0.5$
$s_l > (D-1)/2$	$a_l$	$< -0.5$	$< -0.25$	$< -0.5$
$(D+1)/2 > s_l > s_r > s_m$	$-\sqrt{(1-\delta^2)Q^2}$	-0.156	-0.078	-0.218
$(D+1)/2 > s_l > s_m > s_r$	$-\sqrt{(1-\delta)Q^2}$	-0.112	-0.056	-0.158
$s_m > s_l, s_r$	$a_m = 0$	0	0	0
$(D+1)/2 > s_r > s_m > s_l$	$\sqrt{(1-\delta)Q^2}$	0.112	0.056	0.158
$(D+1)/2 > s_r > s_l > s_m$	$\sqrt{(1-\delta^2)Q^2}$	0.156	0.078	0.218
$s_r > (D-1)/2$	$a_r$	$> 0.5$	$> 0.25$	$> 0.5$

Table 2: Policy outcomes with fixed order bargaining over policy and  $\delta < 1$ .

The proposition below shows that when the bargaining protocol is fixed, parties discount the future, and the status quo is not exactly  $a_m$ , it is even more difficult to have polarised outcomes than is the case in the benchmark model.

**Proposition 7.** *For any distribution of voter preferences, with a fixed order of bargaining over policy,  $\delta < 1$  and  $E(s_m), E(s_r) > 1$ ; the expected outcome can be  $a_l$  only if  $\tilde{t}_{\frac{D+1}{2}} < \frac{a_l - \sqrt{(1-\delta)Q^2}}{2} < a_{lm}$ . Similarly, when  $E(s_l), E(s_m) > 1$ ; then a necessary condition for  $E(z) = a_r$  is  $\tilde{t}_{\frac{D+1}{2}} > \frac{a_r + \sqrt{(1-\delta)Q^2}}{2} > a_{mr}$ .*

*Proof.* See Appendix A. □

Here, a majority government will only come about if the electorate is even more biased in

<sup>26</sup>Taking any original positions  $(a_l, a_m \neq 0, a_r)$ , we can always alter  $\mathbf{f}$  so that the preferences of all voter types are the same when  $(a'_l, a'_m = 0, a'_r)$ .

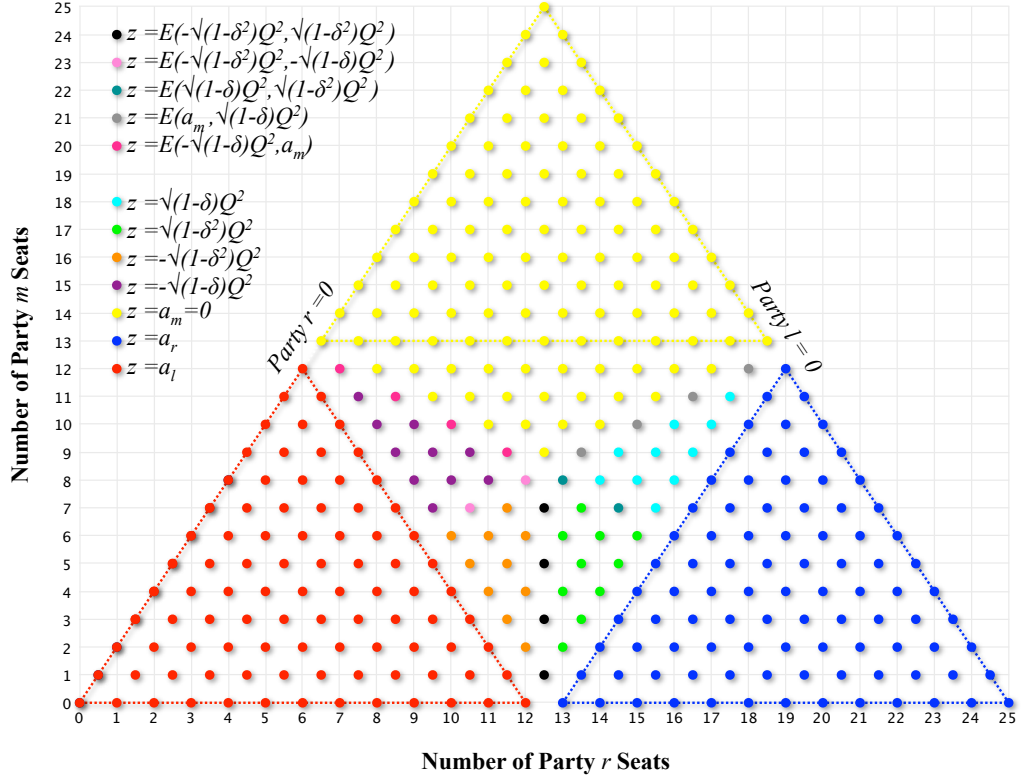


Figure 4: Policy outcomes under fixed order bargaining, with  $D = 25$  and  $\delta < 1$

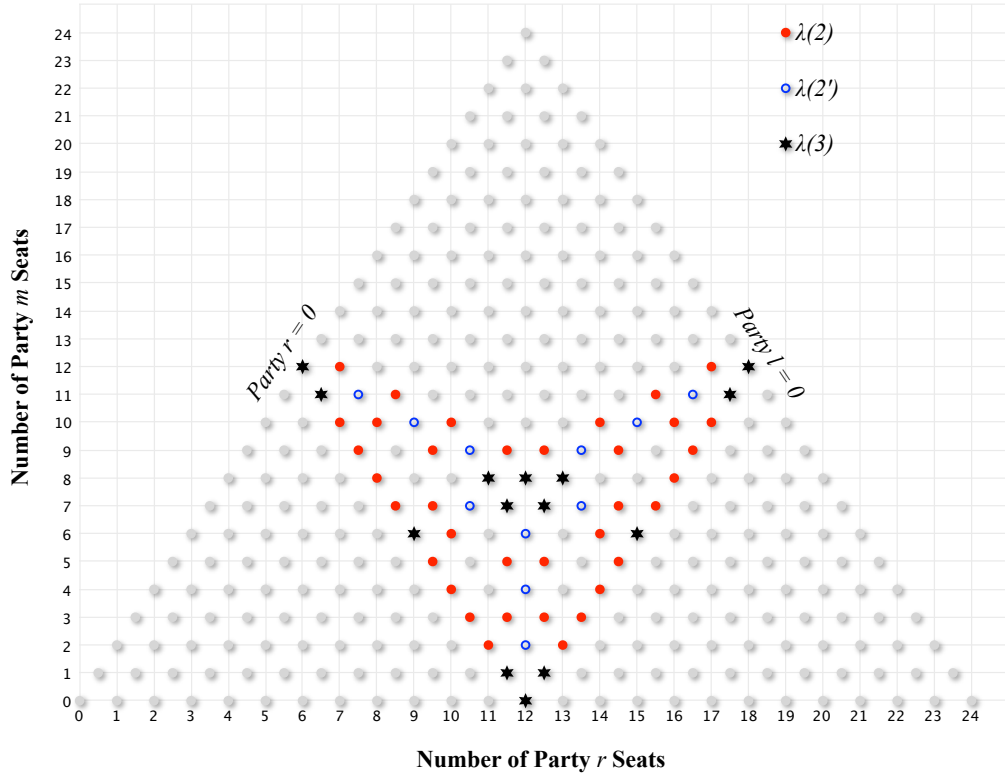


Figure 5: Decisive events under fixed order bargaining, with  $D = 25$  and  $\delta < 1$

favour of policy  $a_l$  than in the benchmark case.<sup>27</sup> The reason is that in the benchmark case every coalition implements  $z = a_m$ , while with discounting and a fixed order protocol, the largest party has an advantage in coalition negotiations and can use this to get an alternative policy passed. Voters anticipate this power in coalition formation, so will only vote to bring about an  $l$  majority if they prefer it to an  $l$ -led coalition.

For example, if  $a_l = -1$ ,  $\delta = 0.95$  and  $|Q| = 0.25$  then an  $l$  coalition would implement a policy  $-0.078$  or  $-0.056$ . Realising the advantage of party  $l$  in bargaining, voters will only approve  $a_l$  if  $\tilde{t}_{\frac{D+1}{2}} < -0.528$ , which is slightly to the left of the indifferent type  $a_{lm}$  in the benchmark case. What the proposition also shows is that the further the status quo is from  $a_m$ , the more likely we are to have coalition governments, all else equal. This is because a more distant status quo gives the formateur even more bargaining power over the moderate party. For example, if  $a_l = -1$ ,  $\delta = 0.95$  and  $|Q| = 0.5$  then an  $l$  majority implementing  $a_l$  can only come about if  $\tilde{t}_{\frac{D+1}{2}} < -0.556$ . Similarly, reducing the discount factor will strengthen the bargaining hand of the formateur: setting  $\delta = 0.9$  means  $z = a_l$  requires  $\tilde{t}_{\frac{D+1}{2}} < -0.579$ .

Figure 5 shows the frequency of the three types of decisive event for this bargaining rule. While it is quite similar to Figure 3, the difference is that now there is no condition we can impose to rule out misaligned voting. The decisive events of Figure 5 where one party has no seats are  $\lambda(3)$  events. For any  $E(S)$  at least one of these  $\lambda(3)$  events can always be conditioned on. If a district is conditioning on a  $\lambda(3)$  event there must be misaligned voting in that district. Nonetheless, Proposition 6 still holds here: there are equilibria with no misaligned voting in a subset of districts - an improvement on a single plurality election. The following proposition summarises the state of misaligned voting under this bargaining rule.

**Proposition 8.** *In a legislative election with a fixed order of bargaining over policy and  $\delta < 1$ , there is always misaligned voting in some district. However, equilibria exist with no misaligned voting in a subset of districts.*

## 6.2 Random Recognition Bargaining

In each period one party is randomly selected as formateur, where the probability of each party being chosen is equal to its seat share in the legislature,  $\frac{s_i}{D}$ . Party payoffs are again given by Equation 7. As usual if a party has a majority of seats it will implement its preferred policy. Following Banks and Duggan (2006), when no party has a majority I

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<sup>27</sup>It is worth mentioning that without the restriction to  $E(s_r) > 1$  in the proposition, the threshold becomes  $\tilde{t}_{\frac{D+1}{2}} < a_{lm}$  as in the benchmark case. This is because some districts may then condition on  $(\frac{D-1}{2}, \frac{D-1}{2}, 0)$ , and have  $l$  and  $m$  as serious candidates. In such a case  $l$  will win the district only if  $\tilde{t} < a_{lm}$ .

look for an equilibrium of the form  $y_l = a_m - \Omega$ ,  $y_m = a_m$ ,  $y_r = a_m + \Omega$ . Cho and Duggan (2003) show that this stationary equilibrium is unique. As bargaining is only over policy, any minimum winning coalition will include party  $m$ . When there was no discounting this meant party  $m$  could always achieve  $z = a_m$ . Now, however, the presence of discounting and  $Q \neq 0$  allows parties  $l$  and  $r$  to offer policies further away from  $a_m$ , which party  $m$  will nonetheless support. The moderate party will be indifferent between accepting and rejecting an offer  $y$  when

$$W_m(y) = -(\Omega)^2 = -(1 - \delta)(Q)^2 - \frac{\delta(D - s_m)}{D}(\Omega)^2 \quad (8)$$

which, when rearranged gives

$$\Omega = \sqrt{\frac{(1 - \delta)Q^2}{1 - \delta \frac{D - s_m}{D}}} \quad (9)$$

Table 3 shows the equilibrium offer each party will make when chosen as formateur. Notice that the policies offered by  $l$  and  $r$  depend on the seat share of party  $m$ . The more seats party  $m$  has, the closer these offers get to zero. The other thing to notice is that the policies lie inside  $(-Q, Q)$ .

Formateur	Policy
$y_l$	$-\sqrt{\frac{1 - \delta}{1 - \delta \frac{D - s_m}{D}}} Q^2 > - Q $
$y_m$	$a_m = 0$
$y_r$	$\sqrt{\frac{1 - \delta}{1 - \delta \frac{D - s_m}{D}}} Q^2 <  Q $

Table 3: Policy proposals with random order bargaining over policy,  $\delta < 1$ .

For a seat distribution such that no party has a majority, the expected policy outcome from bargaining is

$$E(z) = -\frac{s_l}{D} \left( \sqrt{\frac{1 - \delta}{1 - \delta \frac{D - s_m}{D}}} Q^2 \right) + \frac{s_m}{D} (0) + \frac{s_r}{D} \left( \sqrt{\frac{1 - \delta}{1 - \delta \frac{D - s_m}{D}}} Q^2 \right) \quad (10)$$

An extra seat for any of the three parties will increase their respective probabilities of being the formateur and so affect the expected policy outcome. Thus, every district always conditions on a choice between three distinct (expected) policies. We also see that as  $s_m$  increases, the expected policy moves closer and closer to zero. This occurs for two reasons; firstly because there is a higher probability of party  $m$  being the formateur, and secondly because  $s_m$  enters the policy offers of  $l$  and  $r$ ; as  $s_m$  increases the absolute value of these policies shrink.

The proposition below shows that when the bargaining protocol is random, parties dis-

count the future, and the status quo is not exactly  $a_m$ , it is easier for a non-centrist party to win a majority of seats and implement its preferred policy than is the case in the benchmark model (though still more difficult than in a single district election).

**Proposition 9.** *For any distribution of voter preferences, with a random order of bargaining over policy,  $\delta < 1$  and  $E(s_m) > 0$ ; the expected outcome can be  $a_l$  only if  $\tilde{t}_{\frac{D+1}{2}} < z_l^*$ , where  $a_{lm} < z_l^* < a_m, a_{lr}$ . Similarly, a necessary condition for  $E(z) = a_r$  is  $\tilde{t}_{\frac{D+1}{2}} > z_r^*$ , where  $a_m, a_{lr} < z_r^* < a_{mr}$ .*

*Proof.* See Appendix A. □

The proposition implies that we should witness more majority governments than coalition governments when the bargaining protocol is random. The reason is that with a random recognition rule voters face uncertainty if they choose to elect a coalition. The implemented policy will vary greatly depending on which party is randomly chosen as formateur. As voters are risk averse, they find the certainty of policy provided by a majority government appealing. The median voter in the median district need not prefer the policy of a non-centrist party to that of party  $m$  in order for the former to win a majority of seats.

For example, if  $a_l = -1$ ,  $D = 101$ ,  $\delta = 0.95$  and  $|Q| = 0.25$  then  $S = (50, 1, 50)$  would bring about a lottery over policies  $(-0.229, 0, 0.229)$ . The uncertainty generated means a voter with  $t < -0.474$  would prefer to elect an  $l$  majority government, a type slightly to the right of  $a_{lm}$ , the indifferent type in the benchmark case. If instead we had  $|Q| = 0.5$  and kept the other parameters unchanged voters would face a lottery over policies  $(-0.459, 0, 0.459)$ ; a type  $t < -0.396$  would now prefer an  $l$  majority to a coalition government.

The proposition stacks the deck against a coalition government. It gives us the right-most type who might ever want an  $l$  majority, that is when  $S_{-d} = (\frac{D-1}{2}, 0, \frac{D-3}{2})$ . This almost-equal split of seats between the  $l$  and  $r$  party ensures huge variance in the coalition policy, making a single party government very appealing. It is worth considering when an  $l$  majority would be preferred to a more balanced coalition. Keep the parameters as in the example above and let a district condition on  $S_{-d} = (50, 25, 25)$  with  $l$  and  $r$  being serious in the district. If  $|Q| = 0.25$  then a victory for  $r$  will bring about a lottery  $(-0.105, 0, 0.105)$ . A voter in this district will prefer  $a_l$  to this lottery if  $t < -0.508$ . If instead  $|Q| = 0.5$ , a victory for  $r$  will bring about a lottery  $(-0.209, 0, 0.209)$ . A voter in this district will prefer  $a_l$  to this lottery if  $t < -0.509$ . In contrast to the proposition, these less extreme cases have  $\tilde{t}_{\frac{D+1}{2}} < z_l^* < a_{lm}$  meaning it is more difficult for  $a_l$  to come about than in the benchmark model.

Along with the previous propositions on polarisation, Proposition 9 shows that no matter which of the bargaining rules is used, there is less scope for polarisation in legislative elections using plurality rule than there is in stand-alone plurality elections such as mayoral

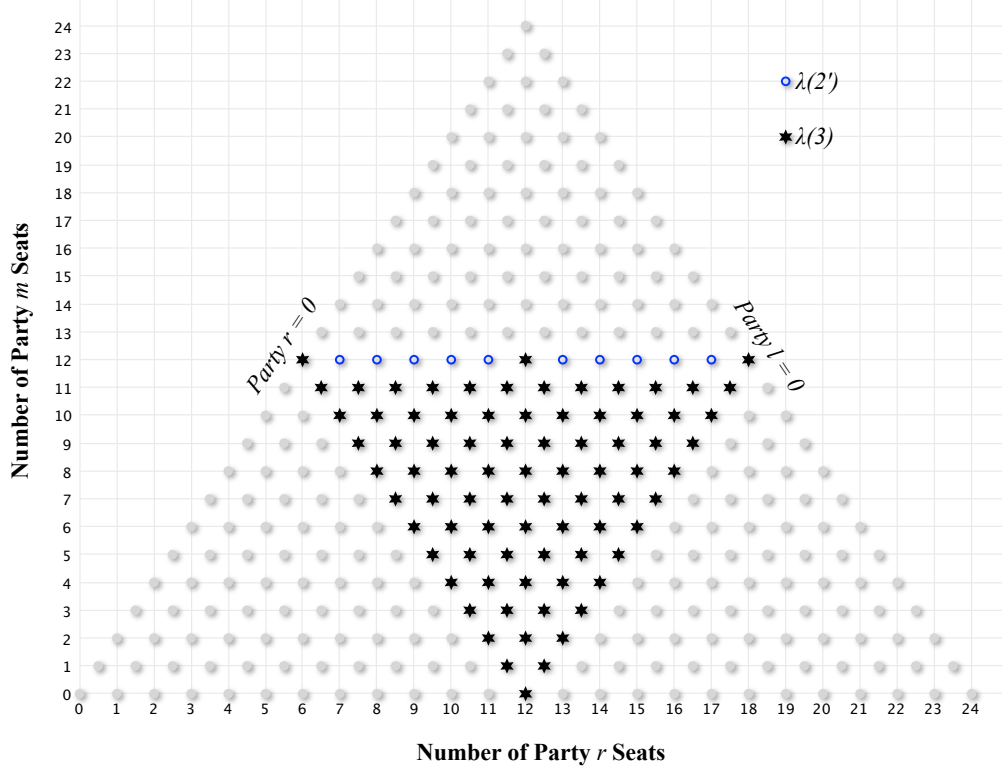


Figure 6: Decisive events under random recognition bargaining, with  $D = 25$  and  $\delta < 1$

or presidential elections. This remains true even when the coalition formation process leads to large uncertainty over policy outcomes.

Figure 6 shows the various decisive cases when the random recognition rule is used. Almost all points are  $\lambda(3)$  events and, as we know, if a district is conditioning on such an event it must have misaligned voting.<sup>28</sup> There are, however, a selection of  $\lambda(2')$  events where electing one of the three candidates is preferred by no voter. From Proposition 6, if a district is conditioning on such an event and the dominated candidate is not serious, there will be no misaligned voting.

**Proposition 10.** *For any distribution of voter preferences, in a legislative election with a random order of bargaining over policy,  $\delta < 1$ , and where  $\zeta \equiv \frac{D+1}{D-3} \sqrt{\frac{1-\delta}{1-\delta \frac{D+1}{2D}}}$ :*

1. *If  $|Q| > |\frac{a_l}{\zeta}|$  or  $|Q| > |\frac{a_r}{\zeta}|$  there exist equilibria with no misaligned voting in any district.*
2. *If  $|Q| < |\frac{a_l}{\zeta}|, |\frac{a_r}{\zeta}|$  there will be misaligned voting in at least one district.*

*Proof.* See Appendix A. □

<sup>28</sup>The picture changes somewhat depending on the values of  $Q$ ,  $D$  and  $\delta$ : for certain values, decisive events where  $s_m$  is small may be  $\lambda(2')$  events or may even be events where all voters would like to elect  $m$ . However this does not alter Proposition 10. Figure 6 shows the case of  $D = 25$ ,  $\delta = 0.99$  and  $|Q| < 0.33$ .

If  $|Q| > |\frac{a_l}{\zeta}|$  and each district has  $l$  and  $m$  as serious candidates then no voter type would like to see party  $r$  win a seat. Electing  $r$  in a district would give  $S = (\frac{D-1}{2}, \frac{D-1}{2}, 1)$ . Coalition bargaining would lead to a lottery over policies very close to policies  $a_l$  and  $a_m$ , so voters would prefer the certainty of either a  $l$  or  $m$  majority government. This result contrasts with the case of fixed order bargaining in Proposition 8. There the cases where a party is expected to win no seats are what drives misalignment; Here, it is exactly these cases where misaligned voting can be excluded.

For large  $D$  and  $\delta$  we will have  $|Q| < |\frac{a_l}{\zeta}|, |\frac{a_r}{\zeta}|$ . However, we can still find equilibria with no misaligned voting in as many as  $D - 1$  districts. As I show in the proof, and as can be seen from Figure 6, when  $s_m = \frac{D-1}{2}$  the expected policy which comes about by electing the smallest party in the legislature is actually not preferred by any voter type. In this case, if a district focuses on the two national frontrunners, there will be no misaligned voting. We can even find cases where there will be misalignment in only a single district. If party  $m$  has a majority of seats, party  $r$  has one seat, and  $l$  has the rest, then as long as all  $d_m$  and  $d_l$  districts have  $m$  and  $l$  as serious candidates, only that single  $d_r$  district will have misaligned voting. This gives a fresh insight into the idea of “wasted votes”: if party  $l$  or  $r$  is expected to be the smallest of the parties in the legislature, and party  $m$  is expected to have a majority, then the least popular non-centrist party should optimally be abandoned by voters. Any district which actually elects the weakest national party does so due to a coordination failure; a majority there would instead prefer to elect one of the other two parties. Notice, however, that for this to be the case, the moderate party must be expected to win an overall majority. So, while the idea of a wasted vote does carry some weight, it clearly does not apply to the case of the Liberal Democrats.

## 7 Discussion

In this paper, I introduced and analysed a model of three-party competition in legislative elections under plurality rule. I showed that two properties of plurality rule - polarisation and misaligned voting - are significantly reduced when the rule is used to elect a legislature. The degree to which these phenomena are reduced depends on the institutional setup - specifically, on how legislative bargaining occurs - but overall the results show that a plurality rule electoral system reflects voter preferences much more than a single district model would suggest.

In the benchmark model, parties are perfectly patient and bargain only over policy. Two clear results emerged from this model. First, while an extreme policy can always come about in standard plurality elections, in my setting a non-centrist policy needs broad

support in the electorate in order to be implemented; specifically, the median voter in the median district must prefer the extreme policy to the moderate party's policy. Second, while standard plurality elections with three distinct choices always have misaligned voting, in my benchmark model this is the case only if the non-centrist parties are serious candidates in more than half the districts - otherwise there is no misaligned voting in any district.

The results of the benchmark model largely hold up under the other bargaining rules considered: the non-centrist parties cannot win for any voter preferences (unlike in standard plurality elections), and there are always equilibria in which there is no misaligned voting (at least in a subset of districts). Moreover, if parties are impatient we gain an additional insight: with a fixed order of formateur recognition we should see more coalitions while when the order is random we should see more single-party governments, all else equal.

In a 2011 referendum UK voters were asked to choose between plurality rule and Instant Run-off Voting (IRV) as a means of electing parliament.<sup>29,30</sup> Supporters of IRV campaigned by appealing to the undesirable properties of plurality rule; claiming plurality protected a two party system of the non-centrist Conservative and Labour parties while the votes of millions of centrist voters were wasted. This paper shows that applying what we know about single district elections to legislative elections can lead to wrong conclusions. If we really want to know whether plurality is outperformed by IRV (or PR for that matter) as an electoral system then we need to analyse the full legislative election game. Such a comparison between systems is beyond the scope of this paper and is left for future work.

In the remainder of this section I discuss the robustness of my modelling assumptions. First, if utility functions are concave rather than specifically quadratic, the benchmark model is unchanged. When bargaining also involves perks, the same is true as long as there are enough perks to allow a coalition between the left and right parties to form.<sup>31</sup> Second, if parties bargain by making demands rather than offers, as in Morelli (1999), the results will be the same as in the benchmark model.<sup>32</sup> Third, if instead of a Poisson model I assumed a fixed population size drawn from a multinomial distribution, the results of my model would still go through.<sup>33</sup>

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<sup>29</sup>In the referendum, UK Voters decided to retain plurality rule.

<sup>30</sup>IRV is used to elect the Australian Parliament. Under IRV voters rank the candidates in their district on the ballot paper. If no candidate receives more than 50% of first preferences, those with the least first preference votes are eliminated and their second preferences are distributed to the remaining candidates. This continues until one candidate passes the 50% threshold and is elected.

<sup>31</sup>If the perks are not large enough or parties don't value perks enough, a coalition will always involve the moderate party and we return to the simpler bargaining over policy case.

<sup>32</sup>Whenever there is no clear majority, the head of state selects party  $m$  as the first mover, so the coalition policy will be  $z = a_m$ .

<sup>33</sup>Myerson (2000) shows that the magnitude of an event with a multinomial distribution is a simple transformation of its magnitude with a Poisson distribution. This transformation preserves the ordering of



A key assumption is that voters only care about the policy implemented in the legislature. If they also have preferences over who wins their local district, the results of the model no longer hold: the probability of being pivotal locally would outweigh any possible utility gain at the national level so that voters will only consider the local dimension. However, in Westminster systems, a Member of Parliament has no power to implement policy at a local level; he merely serves as an agent of his constituents: bringing up local issues in parliament, helping constituents with housing authority claims, etc. So, if voters *do* have preferences over their local winner, it should only be on a common-value, valence dimension. If this were indeed the case, party policies would be irrelevant for how voters cast their ballots.

Finally, the assumption of perfect information is unrealistic in a real world election. The asymptotic elements of the model mean voters can perfectly rank the probabilities of certain events. In real life we are never that confident: polls may not be accurate, or more often, polls may not exist at the district level. Myatt (2007) and Fisher and Myatt (2014) have analysed single plurality elections with aggregate uncertainty over voters' intentions. While this paper abstracts from aggregate uncertainty for the sake of comparison with standard models, including greater uncertainty in a multi-district model is an important path for future research.

## A Appendix

### A.1 Poisson Properties

The number of voters in a district is a Poisson random variable  $n_d$  with mean  $n$ . The probability of having exactly  $k$  voters is  $Pr[n_d = k] = \frac{e^{-n} n^k}{k!}$ . Poisson Voting games exhibit some useful properties. By *environmental equivalence*, from the perspective of a player in the game, the number of other players is also a Poisson random variable  $n_d$  with mean  $n$ . By the *decomposition property*, the number of voters of type  $t$  is Poisson distributed with mean  $n f_d(t)$ , and is independent of the number of other player types. The probability of a vote profile  $x_d = (x_d(l), x_d(m), x_d(r))$  given voter strategies is

$$Pr[x_d | n\tau_d] = \prod_{c \in \{l, m, r\}} \frac{e^{-n\tau_d(c)} (n\tau_d(c))^{x_d(c)}}{x_d(c)!} \quad (11)$$

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events and so this means that the ordering of sets of pivotal and decisive events in my model would remain unchanged, and therefore so would the equilibria.

Its associated magnitude is

$$\mu(x_d) \equiv \lim_{n \rightarrow \infty} \frac{\log(\Pr[x_d | n\tau_d])}{n} = \lim_{n \rightarrow \infty} \sum_{c \in \{l, m, r\}} \tau_d(c) \psi \left( \frac{x_d(c)}{n\tau_d(c)} \right) \quad (12)$$

where  $\psi(\theta) = \theta(1 - \log(\theta)) - 1$ .

**Magnitude Theorem** Let an event  $A_d$  be a subset of all possible vote profiles in district  $d$ . The magnitude theorem (Myerson (2000)) states that for a large population of size  $n$ , the magnitude of an event,  $\mu(A_d)$ , is:

$$\mu(A_d) \equiv \lim_{n \rightarrow \infty} \frac{\log(\Pr[A_d])}{n} = \lim_{n \rightarrow \infty} \max_{x_d \in A_d} \sum_{c \in \{l, m, r\}} \tau_d(c) \psi \left( \frac{x_d(c)}{n\tau_d(c)} \right) \quad (13)$$

where  $\psi(\theta) = \theta(1 - \log(\theta)) - 1$ . That is, as  $n \rightarrow \infty$ , the magnitude of an event  $A_d$  is simply the magnitude of the most likely vote profile  $x_d \in A_d$ . The magnitude  $\mu(A_d) \in [-1, 0]$  represents the speed at which the probability of the event goes to zero as  $n \rightarrow \infty$ ; the more negative its magnitude, the faster that event's probability converges to zero.

**Corollary to the Magnitude Theorem** If two events  $A_d$  and  $A'_d$  have  $\mu(A_d) > \mu(A'_d)$ , then their probability ratio converges to zero as  $n \rightarrow \infty$ .

$$\mu(A'_d) < \mu(A_d) \Rightarrow \lim_{n \rightarrow \infty} \frac{\Pr[A'_d]}{\Pr[A_d]} = 0 \quad (14)$$

It is possible that two distinct events have the same magnitude. In this case, we must use the offset theorem to compare their relative probabilities.

**Offset Theorem** Take two distinct events,  $A_d \neq A'_d$  with the same magnitude, then

$$\mu(A_d) = \mu(A'_d) \Rightarrow \lim_{n \rightarrow \infty} \frac{\Pr[A_d]}{\Pr[A'_d]} = \phi \quad 0 < \phi < \infty \quad (15)$$

Suppose we have  $\tau_d(c_1) > \tau_d(c_2) > \tau_d(c_3)$ , so that the subscript denotes a party's expected ranking in terms of vote share. Maximising Equation 13 subject to the appropriate

constraints we get

$$\begin{aligned}
\mu(\text{piv}(i, j)) &= \mu(\text{piv}(j, i)) \quad \forall i, j \in C \\
\mu(c_1\text{-win}) &= 0 \\
\mu(c_2\text{-win}) = \mu(\text{piv}(c_1, c_2)) &= 2\sqrt{\tau_d(c_1)\tau_d(c_2)} - 1 + \tau_d(c_3) \\
\mu(c_3\text{-win}) = \mu(\text{piv}(c_2, c_3)) = \mu(\text{piv}(c_1, c_3)) &= 3\sqrt[3]{\tau_d(c_1)\tau_d(c_2)\tau_d(c_3)} - 1 \quad \text{if } \tau_d(c_1)\tau_d(c_3) < \tau_d(c_2)^2 \\
\mu(c_3\text{-win}) = \mu(\text{piv}(c_1, c_3)) &= 2\sqrt{\tau_d(c_1)\tau_d(c_3)} - 1 + \tau_d(c_2) \quad \text{if } \tau_d(c_1)\tau_d(c_3) > \tau_d(c_2)^2
\end{aligned} \tag{16}$$

With a magnitude of zero, by the corollary, the probability of candidate  $c_1$  winning goes to 1 as  $n$  gets large. Also, as the magnitude of a pivotal event between  $c_1$  and  $c_2$  is greater than all other pivotal events, a pivotal event between  $c_1$  and  $c_2$  is infinitely more likely than a pivotal event between any other pair as  $n$  gets large.

## A.2 Proof of Lemma 1

To prove the lemma, I show that the magnitude theorem and its corollary extend to a multi-district setting.

**Step 1:**  $\mu(\mathbf{x}) = \sum_d \mu(x_d)$ .

Let  $\mathbf{x} \equiv (x_1, \dots, x_d, \dots, x_D)$  be the realised profile of votes across districts. The probability of a particular profile of votes is

$$Pr[\mathbf{x}|n\boldsymbol{\tau}] = \prod_{\substack{d \in D \\ c \in \{l, m, r\}}} \left( \frac{e^{-n\tau_d(c)} (n\tau_d(c))^{x_d(c)}}{x_d(c)!} \right) \tag{17}$$

After some manipulation, taking the log of both sides, and taking the limit as  $n \rightarrow \infty$  we get the magnitude of this profile of votes

$$\mu(\mathbf{x}) \equiv \lim_{n \rightarrow \infty} \frac{\log(Pr[\mathbf{x}|n\boldsymbol{\tau}])}{n} = \lim_{n \rightarrow \infty} \sum_{c \in \{l, m, r\}} \sum_{d \in D} \tau_d(c) \psi\left(\frac{x_d(c)}{n\tau_d(c)}\right) \tag{18}$$

Notice that the magnitude of a particular profile of votes across districts is simply the sum of the magnitudes in each district. This is because each district's realised profile of votes is independent of all other districts. So while  $\mu(x_d) \in (-1, 0)$  in a single district, we have  $\mu(\mathbf{x}) \in (-D, 0)$  when considering the profile of votes in all districts.

**Step 2:** *If a particular profile of votes across districts,  $\mathbf{x}$ , has a larger magnitude than another,  $\mathbf{x}'$ , the former is infinitely more likely to occur as  $n \rightarrow \infty$ .*

The rate at which  $Pr[\mathbf{x}|n\boldsymbol{\tau}]$  goes to zero is  $e^{n\mu(\mathbf{x})}$ . Take another profile of votes across districts  $\mathbf{x}'$  where  $\mu(\mathbf{x}') < \mu(\mathbf{x})$ , then

$$\lim_{n \rightarrow \infty} \frac{Pr[\mathbf{x}'|n\boldsymbol{\tau}]}{Pr[\mathbf{x}|n\boldsymbol{\tau}]} = \lim_{n \rightarrow \infty} \frac{e^{n\mu(\mathbf{x}')}}{e^{n\mu(\mathbf{x})}} = \lim_{n \rightarrow \infty} e^{n(\mu(\mathbf{x}') - \mu(\mathbf{x}))} = 0 \quad (19)$$

As their probability ratio converges to zero,  $\mathbf{x}$  is infinitely more likely than  $\mathbf{x}'$  to occur as  $n \rightarrow \infty$ .

**Step 3: Multi-District Magnitude Theorem.** The magnitude theorem (Equation 13) shows that the magnitude of an event occurring in a given district (such as a tie for first) is simply to equal the magnitude of the most likely district vote profile in the set of district vote profiles comprising that event. Here I extend this to the multi-district case. Let  $\mathbf{A} = (A_1, \dots, A_d, \dots, A_D)$  be a multi-district event, where each  $A_d$  is a particular district event. Let  $\bar{x}_d \in A_d = \operatorname{argmax}_{x_d} \sum_{c \in \{l, m, r\}} \tau_d(c) \psi\left(\frac{x_d(c)}{n\tau_d(c)}\right)$ , that is,  $\bar{x}_d$  is the most likely district vote profile in  $A_d$  given  $\tau_d$ . Then, we have

$$\mu(\mathbf{A}) = \sum_{d=1}^D \mu(A_d) = \sum_{d=1}^D \mu(\bar{x}_d) = \mu(\bar{\mathbf{x}}) \quad (20)$$

The first inequality follows from the independence of districts, the second equality follows from the magnitude theorem and the independence of districts, the third equality follows from Equation 18. Together they show that the single district magnitude theorem extends to a multi-district setting.

Following from this, and using Equation 19, we have that the corollary to the magnitude theorem also extends to the multi-district case. If  $\mu(\mathbf{A}') < \mu(\mathbf{A})$ , then

$$\lim_{n \rightarrow \infty} \frac{Pr[\mathbf{A}'|n\boldsymbol{\tau}]}{Pr[\mathbf{A}|n\boldsymbol{\tau}]} = \lim_{n \rightarrow \infty} \frac{e^{n\mu(\mathbf{A}')}}{e^{n\mu(\mathbf{A})}} = \lim_{n \rightarrow \infty} e^{n(\mu(\bar{\mathbf{x}}') - \mu(\bar{\mathbf{x}}))} = 0 \quad (21)$$

#### Step 4: Voter's Decision Problem

Let  $\mathcal{A}(z, z') = \{\mathbf{A}(z, z'), \mathbf{A}'(z, z'), \mathbf{A}''(z, z'), \dots\}$  be the set of multi-district events such that a single vote in district  $d$  is pivotal and decisive between policies  $z$  and  $z'$ . There are six different cases in which a vote may be pivotal and decisive here:  $piv_d(l, m)\lambda(z, z', z'')$ ,  $piv_d(l, m)\lambda(z', z, z'')$ ,  $piv_d(l, r)\lambda(z, z'', z')$ ,  $piv_d(l, r)\lambda(z', z'', z)$ ,  $piv_d(m, r)\lambda(z'', z, z')$ ,  $piv_d(m, r)\lambda(z'', z', z)$ . Each case can occur from many different multi-district events e.g  $\mathbf{A}(z, z')$  may have  $x_{d'}(l) > x_{d'}(m) > x_{d'}(r)$  and  $x_{d''}(m) > x_{d''}(l) > x_{d''}(r)$  while  $\mathbf{A}'(z, z')$  has the winners in  $d'$  and  $d''$  reversed.<sup>34</sup> Using Equation 21 and Equation 20

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<sup>34</sup>From the perspective of a voter in district  $d$  the exact seats which are won in other districts don't matter, only their number.

we get

$$\mu(\mathcal{A}(z, z')) = \mu(\bar{\mathcal{A}}(z, z')) = \mu(\bar{\mathbf{x}}(z, z')) \quad (22)$$

Where  $\bar{\mathcal{A}}(z, z')$  is the event in  $\mathcal{A}(z, z')$  with largest magnitude, and  $\bar{\mathbf{x}}(z, z')$  is the vote profile in  $\bar{\mathcal{A}}(z, z')$  with largest magnitude.

Let  $Piv\Lambda_d \equiv \{\mathcal{A}(z, z'), \mathcal{A}(\tilde{z}, \tilde{z}'), \dots\}$  be the set of all distinct pivotal and decisive cases. By Equation 22, comparing the elements in  $Piv\Lambda_d$  requires simply comparing the vote profiles with largest magnitude in each  $\mathcal{A}$ . From Equation 19 we know that if one vote profile has a larger magnitude than another other it is infinitely more likely to occur as  $n$  goes to infinity. Thus, if  $\mu(\mathcal{A}(z, z')) > \mu(\mathcal{A}(\tilde{z}, \tilde{z}'))$  for all  $\mathcal{A}(\tilde{z}, \tilde{z}') \in Piv\Lambda_d$  then the former event is infinitely more likely to occur. This being the case, the voter need only condition his vote choice on the most likely vote profile  $\bar{\mathbf{x}}(z, z') \in Piv\Lambda_d$ .  $\square$

### A.3 Proof of Proposition 1

#### Step 1: All races are Duvergerian.

Note that if the decisive event with the largest magnitude  $\lambda_d^1$  is a  $\lambda(3)$  or  $\lambda(2')$  event then it is immediate that the most likely pivotal and decisive event is  $piv_d(c_1, c_2)\lambda_d^1$ . I now show that this event is unique in a strictly perfect equilibrium.

*Case 1:  $\lambda_d^1$  is a  $\lambda(3)$  or  $\lambda(2')$  event*

- If in a given district  $\tau_d(c_1) = \tau_d(c_2) = \tau_d(c_3) = \frac{1}{3}$  then the most likely pivotal and decisive event would not be unique, and we could support non-duvergerian results. However, these equilibria are knife edge and do not survive when we adjust voter strategies by  $\epsilon$ .
- Similarly, any equilibrium in which  $\tau_d(c_1) = \tau_d(c_2) > \tau_d(c_3) > 0$  or  $\tau_d(c_1) > \tau_d(c_2) = \tau_d(c_3) > 0$  is not robust to trembles and is thus ruled out by strict perfection.
- If  $Pr[piv_d(c_1, c_2)\lambda_d^1] = Pr[piv_d(c_1, c_2)\lambda_d^2]$ , so that two distinct decisive events are equally likely, then again a tremble on strategies in a district will ensure one decisive event is more likely than the other.

*Case 2:  $\lambda_d^1$  is a  $\lambda(2)$  event and  $z_{c_1}^1 = z_{c_2}^1$  so voters are indifferent between the top two candidates*

- Suppose  $Pr[piv_d(c_1, c_3)\lambda_d^1] = Pr[piv_d(c_1, c_2)\lambda_d^2]$  so that some voters are conditioning on the second most likely decisive event, while other voters in the district are conditioning on the most likely decisive event and the imbalance is exactly offset by the fact that

the probability of a tie between  $c_1$  and  $c_2$  is higher than that between  $c_1$  and  $c_3$ . Here, once again a tremble on players strategies in a district will break this equality, and the race will become duvergerian.

- Can we have  $Pr[piv_d(c_2, c_3)\lambda_d^1] = Pr[piv_d(c_1, c_3)\lambda_d^1] > Pr[piv_d(c_1, c_2)\lambda_d^2]$  ? We see from Equation 16 that this is the only case in which two different pivotal events have the same magnitude. That is when  $\tau(c_1)\tau(c_3) < \tau(c_2)^2$  so that  $\mu(piv(c_2, c_3)) = \mu(piv(c_1, c_3)) = 3\sqrt[3]{\tau(c_1)\tau(c_2)\tau(c_3)} - 1$ . This occurs when the least popular candidate has much less support than the other two. Trembles will do no good here for two reasons. Firstly, it may not effect the behaviour of other districts if district  $d$  is a relatively safe seat i.e. other districts are not conditioning on an upset occurring in  $d$ . Secondly, and more importantly, the magnitudes of the pivotal events are not affected by such trembles here; any tremble will leave  $3\sqrt[3]{\tau(c_1)\tau(c_2)\tau(c_3)} - 1$  unchanged, so we have a candidate for a strictly perfect equilibrium which is non-duvergerian. However, while these magnitudes are the same, we can use the offset theorem to see that their probabilities are not. Specifically  $piv_d(c_1, c_3) \neq piv_d(c_2, c_3)$ . We know from the offset theorem that

$$\frac{Pr[piv_d(c_1, c_3)]}{Pr[piv_d(c_2, c_3)]} = \phi > 0 \quad (23)$$

The magnitudes of these events are the same because the most likely event in which they occur is when all three candidates get exactly the same number of votes. However, the events consist of more than just this event. In an event  $piv_d(c_1, c_3)$ , candidate  $c_2$  must have the same or fewer votes than the others. Similarly, in an event  $piv_d(c_2, c_3)$ , candidate  $c_1$  must have the same or fewer votes than the others. By the decomposition property, for any given number of votes  $c_3$  has,  $c_1$  is always more likely to have more votes than  $c_2$ . Therefore, it must be that  $\phi > 1$ . Returning to the decision of a voter facing

$$\mu(piv_d(c_1, c_3)\lambda_d^1) = \mu(piv_d(c_2, c_3)\lambda_d^1)$$

and given that  $\lambda_d^1$  is a  $\lambda(2)$  event, voters are indifferent between having  $c_1$  or  $c_2$  elected. As I have just shown,  $Pr[piv_d(c_1, c_3)] > Pr[piv_d(c_2, c_3)]$ , therefore all voters should focus on this event, which will mean the previous second placed candidates loses all her support to the leading candidate, thus ensuring a duvergerian equilibrium.

Therefore, all strictly perfect equilibria involve duvergerian races in every district.

### Step 2: Multiple Equilibria always exist.

A simple example proves the existence of multiple pure strategy equilibria for any bargaining rule where a majority is needed to implement a policy  $z$ . For any  $\mathbf{f}$ , suppose the

right party is never serious in any district. All races will be between  $l$  and  $m$ . We will have  $E(S_{-d_l}) = (k-1, D-k, 0)$  and  $E(S_{-d_m}) = (k, D-k-1, 0)$  for some  $k \in (0, D)$ . As party  $r$  receives no votes, every district must be conditioning on the same decisive event  $(\frac{D-1}{2}, \frac{D-1}{2}, 0)$ . When conditioning on this  $\lambda$ , voters will face a choice between  $a_l$ ,  $a_m$ , and a third policy which would come about if  $r$  wins a seat. All the districts focusing on races between  $l$  and  $m$  is an equilibrium as no individual would deviate and vote for  $r$ . Similarly, it is possible that all districts ignore the left party, and so an equilibrium will have every district conditioning on  $(0, \frac{D-1}{2}, \frac{D-1}{2})$ , or that all districts ignore the moderate party and all condition on  $(\frac{D-1}{2}, 0, \frac{D-1}{2})$ . These three equilibria always exist for any majoritarian bargaining rule.  $\square$

## A.4 Lemma 2

A sufficient condition for  $\mu(\lambda_d^i(z^i)) > \mu(\lambda_d^j(z^j))$  is that the set of pivotal events with largest magnitude required for  $\lambda_d^i(z^i)$  to occur,  $\mathbf{K}_d(z^i)$ , is a subset of those required for  $\lambda_d^j(z^j)$  to occur,  $\mathbf{K}_d(z^j)$ .

## A.5 Proof of Lemma 2

From Equation 22 we have  $\mu(\lambda_d^i(z^i)) = \sum_{d'=1}^{D-1} \mu(\bar{x}_{d'}) \in (-D+1, 0)$ . That is the magnitude of a particular decisive event, from the point of view of district  $d$  is simply the sum of the magnitudes of the most likely vote profiles in each district  $d' \neq d$  which bring about that decisive event. We can use  $\mu(c_1 - \text{win}) = 0$  and  $\mu(c_2 - \text{win}) = \mu(\text{piv}_{d'}(c_1, c_2))$  from Equation 16 and re-write

$$\mu(\lambda_d^i(z^i)) = \sum_{d'=1}^k \mu(\text{piv}_{d'}(c_1, c_2)) \in (-k, 0)$$

Where there are  $k$  districts in which the expected winner loses. Let  $\mathbf{K}_d(z^i)$  be the set of these  $k$  pivotal events. Let another decisive event for district  $d$  be  $z^j$  with magnitude

$$\mu(\lambda_d^j(z^j)) = \sum_{d'=1}^{k'} \mu(\text{piv}_{d'}(c_1, c_2)) \in (-k', 0)$$

Where there are  $k'$  districts in which the expected winner loses. Let  $\mathbf{K}_d(z^j)$  be the set of these  $k'$  pivotal events. Furthermore let  $\mathbf{K}_d(z^i) \subset \mathbf{K}_d(z^j)$ . As magnitudes are negative

numbers, it must be that

$$\sum_{d'=1}^k \mu(\text{piv}_{d'}(c_1, c_2)) > \sum_{d'=1}^k \mu(\text{piv}_{d'}(c_1, c_2)) + \sum_{d'=k+1}^{k'} \mu(\text{piv}_{d'}(c_1, c_2))$$

or

$$\mu(\lambda_d^i(z^i)) > \mu(\lambda_d^j(z^j)) \quad (24)$$

Thus if  $\mathbf{K}_d(z^i) \subset \mathbf{K}_d(z^j)$  then  $\mu(\lambda_d^i(z^i)) > \mu(\lambda_d^j(z^j))$ .  $\square$

## A.6 Corollary to Lemma 2

For a given  $E(S_{-d})$  and  $\Lambda$ , we have  $\lambda_d(z) = \lambda_d^1$  if  $\forall \lambda(z') \neq \lambda(z) \in \Lambda$  we have  $\mathbf{K}_d(z) \subset \mathbf{K}_d(z')$ .

## A.7 Proof of Proposition 2

From Equation 4, for  $E(z) = a_l$  we must have an expected majority for the left party,  $E(s_l) > \frac{D-1}{2}$ . By Proposition 1, each  $d_l$  district must have either  $l$  and  $m$  or  $l$  and  $r$  as the serious candidates. Therefore, also by Proposition 1, if a  $d_l$  district has  $\lambda_{d_l}^1 = \lambda(a_l, a_m, a_m)$ , it must be conditioning on this decisive event. If a district  $d$  is conditioning on  $\lambda(a_l, a_m, a_m)$ , the expected winner will be party  $l$  if the expected median voter prefers  $a_l$  to  $a_m$ , that is if  $\tilde{t}_d < a_{lm}$ . As party  $l$  is the expected winner in  $d_l$  districts, any  $d_l$  district conditioning on  $\lambda(a_l, a_m, a_m)$  must have  $\tilde{t}_d < a_{lm}$ . If each  $d_l$  has  $\lambda_{d_l}^1 = \lambda(a_l, a_m, a_m)$  and  $E(s_l) > \frac{D-1}{2}$  then  $\tilde{t}_{\frac{D+1}{2}} < a_{lm}$ .

All that remains is to show that when  $E(z) = a_l$  and  $E(s_m) > 0$  each  $d_l$  has  $\lambda_{d_l}^1 = \lambda(a_l, a_m, a_m)$ . I show that case of  $E(s_m) = 1$  as the case of  $E(s_m) > 1$  is analogous.

Let  $\mathbf{K}_{d_l}(\lambda(a_m, a_m, a_r))$  be the sequence of pivotal events with largest magnitude resulting in  $\lambda_{d_l} = \lambda(a_m, a_m, a_r)$ . Let  $\mathbf{K}_{d_l}(\lambda(a_l, a_m, a_r))$  be the sequence of pivotal events with largest magnitude resulting in  $\lambda_{d_l} = \lambda(a_l, a_m, a_r)$ . Then given  $E(S_{-d_l}) = (\frac{D-1}{2} + k, 1, \frac{D-3}{2} - k)$  it must be that  $\mathbf{K}_{d_l}(\lambda(a_l, a_m, a_m)) \subset \mathbf{K}_{d_l}(\lambda(a_m, a_m, a_r))$  and  $\mathbf{K}_{d_l}(\lambda(a_l, a_m, a_m)) \subset \mathbf{K}_{d_l}(\lambda(a_l, a_m, a_r))$ . This can be seen graphically in Figure 1 as the pivotal events needed to move from  $E(S_{-d_l})$  to  $\lambda(a_l, a_m, a_m)$  are a subset of those needed to move from  $E(S_{-d_l})$  to  $\lambda(a_m, a_m, a_r)$  or  $\lambda(a_l, a_m, a_r)$ . By the Corollary to Lemma 2 this means  $\lambda_d^1 = \lambda(a_l, a_m, a_m)$ .

It is analogous to show that a necessary condition for  $E(z) = a_r$  is  $\tilde{t}_{\frac{D+1}{2}} > a_{mr}$ .  $\square$



## A.8 Proof of Proposition 3

By Proposition 1, only two candidates will receive votes in each district. With  $D$  districts there will be  $2D$  serious candidates. If party  $r$ 's candidates are serious in less than  $\frac{D-1}{2}$  districts, the decisive event in which an extra seat for party  $r$  gives them a majority can never come about. Therefore, in any equilibrium where party  $r$  is serious in less than  $\frac{D-1}{2}$  districts, the only decisive event voters can condition on is  $\lambda(a_l, a_m, a_m)$ . As this is the only decisive event, in each district, voters with  $t < a_{lm}$  will vote  $v_l$  while those with  $t > a_{lm}$  will vote for whichever of  $m$  or  $r$  is a serious candidate. An analogous result holds when party  $l$  is serious in less than  $\frac{D-1}{2}$  districts.  $\square$

## A.9 Proof of Proposition 4

From Table 1 we see that when  $3\Delta_l > \Delta_r$ ,  $z = a_l$  is only possible if  $s_l > \frac{D-1}{2}$ . As such  $E(z) = a_l$  requires  $E(s_l) > \frac{D-1}{2}$ . By Lemma 2, if  $E(s_l) > \frac{D-1}{2}$  then  $\lambda_{d_l}^1$  must be in the set of decisive events  $\Lambda_{s_l=\frac{D-1}{2}} \subset \Lambda$ . In addition if  $E(s_m) > 1$  then  $\lambda_{d_l}^1$  must be in the set of decisive events  $\Lambda_{s_m>1, s_l=\frac{D-1}{2}} \subset \Lambda_{s_l=\frac{D-1}{2}}$ .

From Table 1 we see that when  $3\Delta_l > \Delta_r$ , any decisive event  $\lambda^i$  in the set  $\Lambda_{s_m>1, s_l=\frac{D-1}{2}}$  has  $z_l^i = a_l \neq z_m^i, z_r^i$ . From Proposition 1, each  $d_l$  must have either  $l$  and  $r$  or else  $l$  and  $m$  as serious candidates. Therefore, with  $E(s_l) > \frac{D-1}{2}$ , all  $d_l$  districts must be conditioning on decisive events in  $\Lambda_{s_m>1, s_l=\frac{D-1}{2}}$ .

By the definition of a  $d_l$  district, the median voter in  $d_l$  must prefer  $z_l^i = a_l$  to the some alternative: either  $z_m^i$  or  $z_r^i$ . The set of policies in  $\Lambda_{s_m>1, s_l=\frac{D-1}{2}}$  are  $\{a_l, a_{lm}, a_{lr}, 2a_m - a_{lr}, a_m\}$ . Suppose a district  $d_l$  conditions on a race where the  $z_l^i = a_l$  and the serious alternative is  $a_m$ . It is immediate to see that  $\tilde{t}_{d_l} < a_{lm}$ . It is also immediate to see that if the serious alternative was some other policy  $z'$  then  $\tilde{t}_{d_l} < \frac{a_l + z'}{2}$ . As  $a_m$  is the rightmost policy in the set, a necessary condition for a  $d_l$  district when  $E(s_l) > \frac{D-1}{2}$  is  $\tilde{t} < a_{lm}$ . Thus, it must be that  $\tilde{t}_{\frac{D+1}{2}} < a_{lm}$  in order for  $z = a_l$  to come about.

Following the same steps as above, it is analogous to show that when  $3\Delta_r > \Delta_l$  and  $E(s_m) > 1$ , then  $E(z) = a_r$  requires  $\tilde{t}_{\frac{D+1}{2}} > a_{mr}$ .

## A.10 Proof of Proposition 5

*Case 1:*  $\Delta_l = \Delta_r$ . Suppose party  $r$  is a serious candidate in less than  $\frac{D-1}{4}$  districts; then it can win at most that many seats. The possible election outcomes are either a party  $l$  majority giving  $z = a_l$ , a party  $m$  majority giving  $z = a_m$ , or no majority but where party  $r$  has the least seats. From Table 1 we see that when  $\Delta_l = \Delta_r$ , the policy outcome will be  $a_m$

if no party has a majority and  $r$  is the smallest party. Conditional on  $r$  winning less than  $\frac{D-1}{4}$  districts, the only decisive event is therefore  $\lambda(a_l, a_m, a_m)$ , when  $l$  wins  $\frac{D-1}{2}$  seats and  $m$  is the second largest party. Given that only this distinct decisive event exists, all voters must be conditioning on it. As electing  $m$  or  $r$  here brings about the same policy, voters are indifferent between the two. In each district, those with  $t < a_{lm}$  will vote  $v_l$  while those with  $t > a_{lm}$  will coordinate on either  $v_m$  or  $v_r$ . With a choice over 2 policies in each district, no voter will be casting a misaligned vote. The case of  $l$  being a serious candidate in less than  $\frac{D-1}{4}$  districts is analogous.

*Case 2:*  $\Delta_l < \Delta_r$ . The only difference from Case 1 we need to consider is when  $s_r < \frac{D-1}{4}$  and no party has a majority. From Table 1 we see that when  $\Delta_l < \Delta_r$ , then with  $\frac{D+1}{2} > s_l, s_m > s_r$  the policy outcome will be  $a_m$ . As shown above, when  $r$  is serious in less than  $\frac{D-1}{4}$  districts, the only distinct decisive case is  $\lambda(a_l, a_m, a_m)$ . All districts will condition on this event and, as before, there is no misaligned voting.

*Case 3:*  $\Delta_l < \Delta_r$ . The possible election outcomes are either a party  $r$  majority giving  $z = a_r$ , a party  $m$  majority giving  $z = a_m$ , or no majority but where party  $l$  has the least seats. From Table 1 we see that when  $\Delta_r < \Delta_l$ , if  $\frac{D+1}{2} > s_r, s_m > s_l$  the policy outcome will be  $a_m$ . Therefore, when  $l$  is serious in less than  $\frac{D-1}{4}$  districts, the only distinct decisive event is  $\lambda(a_m, a_m, a_r)$ . All districts will condition on this event and there is no misaligned voting.  $\square$

## A.11 Proof of Proposition 6

*Case 1:* Recall from Proposition 1 that if  $\lambda_d^1 = \lambda(2')$  then voters in  $d$  must be conditioning on it. Furthermore, by Lemma 1 this event is infinitely more likely to occur than any other decisive event, and given that voters are not indifferent between any of the options, whichever option a voter prefers in this case will also be his preferred over all possible decisive events. By the definition of a  $\lambda(2')$  event, one of the 3 policy outcomes,  $z_{c''}^1$ , is dominated for each voter by one of the two other policies,  $z_c^1$  and  $z_{c'}^1$ . Therefore as long as  $z_{c''}^1$  is not serious, there will be no misaligned voting - no voter would wish to change their vote if it could unilaterally decide the district.

*Case 2:* Let the most likely decisive event  $\lambda_d^1$  be a  $\lambda(2)$  event where candidates  $c$  and  $c'$  are serious. If voters are conditioning on  $\lambda_d^1$  it must be that  $z_c^1 = z_{c'}^1$  or  $z_{c'}^1 = z_{c''}^1$ ; Here, I take it to be the former. Without loss of generality let  $z_c^1 < z_{c'}^1$ . Any voter type with  $t > \frac{z_c^1 + z_{c'}^1}{2}$  will vote  $v_{c'}$ , while any other type will vote  $v_c$ . The former group cannot be casting misaligned votes as they have  $u_t(z_{c'}^1) > u_t(z_c^1)$ , and the decisive event  $\lambda_d^1$  is infinitely more likely than all others. Next, we need to consider whether any of the voters choosing

$v_c$  might be misaligned. All of these voters have  $u_t(z_c^1) = u_t(z_{c'}^1) > u_t(z_{c''}^1)$ , so that they want to beat  $c'$  but are indifferent between  $c$  and  $c''$  in this most likely decisive event. If one of these voters could unilaterally decide which candidate coordination takes place on, he would decide by looking at the most likely pivotal event in which  $z_c \neq z_{c''}$ , call this event  $\lambda^i$ . If  $u_t(z_c^i) > u_t(z_{c''}^i)$  then voter type  $t$  would prefer coordination to take place on candidate  $c$ , while if  $u_t(z_c^i) < u_t(z_{c''}^i)$  she'd want coordination on  $c''$ . Therefore, there is no misaligned voting in the district if there exists no type such that  $u_t(z_c^i) < u_t(z_{c''}^i)$  and  $u_t(z_c^1) = u_t(z_{c'}^1) > u_t(z_{c''}^1)$  when  $c$  and  $c'$  are the serious candidates.  $\square$

## A.12 Bargaining Equilibrium for Fixed Order Protocol and $\delta < 1$

As equilibria are stationary we need only consider two orderings:  $l > r > m > l > r > \dots$  and  $r > l > m > r > l > \dots$ . I will derive the equilibrium offers for the case of  $l > r > m$ , the other is almost identical. I solve the game by backward induction. At stage 3, party  $m$  will make an offer  $y_m$  which maximises its payoff subject to the proposal being accepted by either party  $l$  or  $r$ .

At stage 2, party  $r$  will either make an offer  $y_r(m)$  to attract party  $m$ , or an offer  $y_r(l)$  to attract party  $l$ . For these proposals to be accepted by  $m$  and  $l$  respectively requires

$$\begin{aligned} -y_r(m)^2 &\geq -(1-\delta)Q^2 - \delta y_m^2 \\ -(a_l - y_r(l))^2 &\geq -(1-\delta)(a_l - Q)^2 - \delta(a_l - y_m)^2 \end{aligned}$$

If  $y_r(m)$  is chosen then the first inequality will bind and we have  $y_r(m) = \sqrt{(1-\delta)Q^2 + \delta y_m^2}$ . We can now compare the payoff of party  $l$  when  $y_r(m)$  and  $y_r(l)$  are implemented.

$$\begin{aligned} -(a_l - \sqrt{(1-\delta)Q^2 + \delta y_m^2})^2 &= -a_l^2 - (1-\delta)Q^2 - \delta y_m^2 + 2a_l\sqrt{(1-\delta)Q^2 + \delta y_m^2} \\ -(a_l - y_r(l))^2 &= -a_l^2 - (1-\delta)Q^2 - \delta y_m^2 + (1-\delta)2a_lQ + \delta 2a_ly_m \end{aligned}$$

Party  $l$  prefers policy  $y_r(l)$  when

$$\begin{aligned} (1-\delta)2a_lQ + \delta 2a_ly_m &> 2a_l\sqrt{(1-\delta)Q^2 + \delta y_m^2} \\ 2a_l((1-\delta)Q + \delta y_m) &> 2a_l\sqrt{(1-\delta)Q^2 + \delta y_m^2} \\ (1-\delta)Q + \delta y_m &< \sqrt{(1-\delta)Q^2 + \delta y_m^2} \end{aligned}$$

the final inequality always holds. As party  $l$  gets a higher payoff from  $y_r(l)$  than  $y_r(m)$ , the former must be closer to  $a_l$  on the policy line, and therefore further away from  $a_r$ . Clearly then, party  $r$  maximises its utility by choosing  $y_r = \sqrt{(1-\delta)Q^2 + \delta y_m^2}$ .

At stage 1, party  $l$  will either make an offer  $y_l(m)$  to attract party  $m$ , or an offer  $y_l(r)$  to attract party  $r$ . For these proposals to be accepted by  $m$  and  $r$  respectively requires

$$\begin{aligned} -y_l(m)^2 &\geq -(1-\delta)Q^2 - \delta(-\sqrt{(1-\delta)Q^2 + \delta y_m^2})^2 \\ -(a_r - y_l(r))^2 &\geq -(1-\delta)(a_r - Q)^2 - \delta(a_r - \sqrt{(1-\delta)Q^2 + \delta y_m^2})^2 \end{aligned}$$

If  $y_l(m)$  is chosen then the first inequality will bind and we have  $y_l(m) = -\sqrt{(1-\delta^2)Q^2 + \delta^2 y_m^2}$ . We can now compare the payoff of party  $r$  when  $y_l(m)$  and  $y_l(r)$  are implemented.

$$\begin{aligned} -(a_r + \sqrt{(1-\delta^2)Q^2 + \delta^2 y_m^2})^2 &= -a_r^2 - (1-\delta^2)Q^2 - \delta^2 y_m^2 - 2a_r \sqrt{(1-\delta^2)Q^2 + \delta^2 y_m^2} \\ -(a_r - y_l(r))^2 &= -(1-\delta)(a_r^2 + Q^2 - 2a_r Q) - \delta a_r^2 - \delta(1-\delta)Q^2 - \delta^2 y_m^2 + \delta 2a_r \sqrt{(1-\delta)Q^2 + \delta y_m^2} \end{aligned}$$

Party  $r$  prefers policy  $y_l(r)$  when

$$\begin{aligned} (1-\delta)2a_r Q + \delta 2a_r \sqrt{(1-\delta)Q^2 + \delta y_m^2} &> -2a_r \sqrt{(1-\delta^2)Q^2 + \delta^2 y_m^2} \\ (1-\delta)Q + \delta \sqrt{(1-\delta)Q^2 + \delta y_m^2} &> -\sqrt{(1-\delta^2)Q^2 + \delta^2 y_m^2} \end{aligned}$$

the final inequality always holds. As party  $r$  gets a higher payoff from  $y_l(r)$  than  $y_l(m)$ , the former must be closer to  $a_r$  on the policy line, and therefore further away from  $a_l$ . Clearly then, party  $l$  maximises its utility by choosing  $y_l = -\sqrt{(1-\delta^2)Q^2 + \delta^2 y_m^2}$ .

Now, we can return to stage 3 to show that  $y_m = 0$ . By stationarity, if  $y_m$  is rejected at stage 3, then in stage 4  $y_l = -\sqrt{(1-\delta^2)Q^2 + \delta^2 y_m^2}$  will be proposed and accepted. Parties  $l$  and  $r$  will accept proposal  $y_m$  if

$$\begin{aligned} -(a_l - y_m)^2 &\geq -(1-\delta)(a_l - Q)^2 - \delta(a_l + \sqrt{(1-\delta^2)Q^2 + \delta^2 y_m^2})^2 \\ -(a_r - y_m)^2 &\geq -(1-\delta)(a_r - Q)^2 - \delta(a_r + \sqrt{(1-\delta^2)Q^2 + \delta^2 y_m^2})^2 \end{aligned}$$

Party  $m$ 's payoff is maximised when  $y_m = 0$  (because  $a_m = 0$ ), so we want to check whether

this is an implementable proposal. Letting  $y_m = 0$  and rearranging, the two inequalities above become

$$\begin{aligned} 0 &\leq (1 - \delta^3)Q^2 + 2a_l[\delta\sqrt{(1 - \delta^2)Q} - (1 - \delta)Q] \\ 0 &\leq (1 - \delta^3)Q^2 + 2a_r[\delta\sqrt{(1 - \delta^2)Q} - (1 - \delta)Q] \end{aligned}$$

The term in square brackets may be positive or negative. If it is positive then, party  $r$  will accept  $y_m = 0$ , if the term is negative then party  $l$  will accept  $y_m = 0$ .<sup>35</sup>

Given  $y_m = 0$ , we can now characterise the accepted policy proposals (and therefore policy outcomes) for the fixed order protocol when  $l > r > m > l > r > \dots$

$$\begin{aligned} y_l &= -\sqrt{(1 - \delta^2)Q^2} \\ y_r &= \sqrt{(1 - \delta)Q^2} \\ y_m &= 0 \end{aligned}$$

Instead when  $r > l > m > r > l > \dots$ , the same process gives:

$$\begin{aligned} y_r &= \sqrt{(1 - \delta^2)Q^2} \\ y_l &= -\sqrt{(1 - \delta)Q^2} \\ y_m &= 0 \end{aligned}$$

### A.13 Proof of Proposition 7

For  $z = a_l$  to be the expected outcome it must be that  $E(s_l) > \frac{D-1}{2}$ . Given the restriction that  $E(s_m), E(s_r) > 1$ , the set of distinct decisive events which  $d_l$  districts can be conditioning on is reduced to

$$\begin{aligned} \Lambda_{s_l = \frac{D-1}{2}, s_m > 1, s_r > 1} &= \{ \lambda(a_l, -\sqrt{(1 - \delta^2)Q^2}, -\sqrt{(1 - \delta^2)Q^2}), \\ &\quad \lambda(a_l, -\sqrt{(1 - \delta^2)Q^2}, -\sqrt{(1 - \delta)Q^2}), \\ &\quad \lambda(a_l, -\sqrt{(1 - \delta)Q^2}, -\sqrt{(1 - \delta)Q^2}) \} \end{aligned}$$

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<sup>35</sup>Whenever  $\delta > 0.543689$  then the term is positive. Given that we mostly care about values of  $\delta$  close to one, we can say that it is generally party  $r$  who accepts  $m$ 's offer.

Any race between  $a_l$  and  $-\sqrt{(1-\delta)Q^2}$ , where the former is the expected winner, must have  $\tilde{t} < \frac{a_l - \sqrt{(1-\delta)Q^2}}{2}$ . Any race between  $a_l$  and  $-\sqrt{(1-\delta^2)Q^2}$ , where the former is the expected winner, must have  $\tilde{t} < \frac{a_l - \sqrt{(1-\delta^2)Q^2}}{2}$ , a stricter condition. Therefore in order to for a party  $l$  to win a majority in expectation when  $E(s_m), E(s_r) > 1$  it must be at least that  $\tilde{t}_{\frac{D+1}{2}} < \frac{a_l - \sqrt{(1-\delta)Q^2}}{2}$ . Notice that since  $-\sqrt{(1-\delta)Q^2} < a_m$ , then  $\frac{a_l - \sqrt{(1-\delta)Q^2}}{2} < a_{lm}$ . Similarly, for party  $r$  to win a majority in expectation when  $E(s_m), E(s_l) > 1$  it must be that  $\tilde{t}_{\frac{D+1}{2}} > \frac{a_r + \sqrt{(1-\delta)Q^2}}{2} > a_{mr}$ .  $\square$

## A.14 Proof of Proposition 9

Under this bargaining rule, we can only have  $E(z) = a_l$  if  $E(s_l) > \frac{D-1}{2}$ . If this is the case, any  $d_l$  district must be conditioning on a decisive event in  $\Lambda_{s_l = \frac{D-1}{2}}$ . Each of these decisive events are distinct: by increasing a party's seat share by one, it alters the expected policy outcome  $E(z)$ . In order to find the weakest condition for  $E(z) = a_l$  to occur, I proceed in the following steps. Steps 1 and 2 show that electing party  $l$  is always the worst option for a player with  $t < 0$ . Step 3 shows that  $S = (\frac{D-1}{2}, 1, \frac{D-1}{2})$  gives the lowest utility for any  $t < 0$  type conditional on  $s_m > 0$ . Step 4 identifies the type who is indifferent between  $S = (\frac{D-1}{2}, 1, \frac{D-1}{2})$  and a party  $l$  majority. Let  $\Omega(r) \equiv \sqrt{\frac{1-\delta}{1-\delta\frac{D-s_m}{D}}Q^2}$  and  $\Omega(m) \equiv \sqrt{\frac{1-\delta}{1-\delta\frac{D-(s_m+1)}{D}}Q^2}$ . Note that  $\Omega(m) < \Omega(r)$ .

*Step 1: If  $u_t(a_l) > u_t(E(z_m^i))$  or  $u_t(a_l) > u_t(E(z_r^i))$ , it must be that  $t < 0$ .* I show the case of  $u_t(a_l) > u_t(E(z_m^i))$  as the other is analogous. Comparing the expected utility of a voter voting for  $l$  or  $m$  where  $s_l = \frac{D-1}{2}$ ,  $s_m > 0$  and  $s_r > 0$  we have:

$$\begin{aligned} u_t(l) &= -(a_l - t)^2 \\ u_t(m) &= -\frac{D-1}{2D}(-\Omega(m) - t)^2 - \frac{s_m+1}{D}(t)^2 - \frac{D-1-2s_m}{2D}(\Omega(m) - t)^2 \end{aligned}$$

Some algebra shows that a player has  $u_t(l) > u_t(m)$  if

$$t < \frac{Da_l^2 - (D-s_m)\Omega(m)^2}{2Da_l - (1-s_m)2\Omega(m)}$$

The RHS must always be negative. It is easy to see that this would also be the case comparing  $u_t(l)$  to  $u_t(r)$ . Thus any player type who prefers  $a_l$  to a lottery over coalition policies must have  $t < 0$ .

*Step 2: At any decisive event  $\lambda^i \in \Lambda_{s_l = \frac{D-1}{2}, s_r} > 0$  every  $t \leq 0$  prefers  $E(z_m^i)$  to  $E(z_r^i)$ .* Comparing the expected utility of a voter voting for  $m$  or  $r$  for any case where  $s_l = \frac{D-1}{2}$ ,

$s_m > 0$  and  $s_r > 0$  we have:

$$\begin{aligned} u_t(m) &= -\frac{D-1}{2D}(-\Omega(m)-t)^2 - \frac{s_m+1}{D}(t)^2 - \frac{D-1-2s_m}{2D}(\Omega(m)-t)^2 \\ u_t(r) &= -\frac{D-1}{2D}(-\Omega(r)-t)^2 - \frac{s_m}{D}(t)^2 - \frac{D+1-2s_m}{2D}(\Omega(r)-t)^2 \end{aligned}$$

Some algebra shows that a player has  $u_t(m) > u_t(r)$  if

$$t < \frac{(D-s_m)(\Omega(r)^2 - \Omega(m)^2) + \Omega(r)^2}{2(s_m-1)(\Omega(r) - \Omega(m)) + 2\Omega(m)}$$

The RHS must always be positive. This means that any type  $t \leq 0$  always prefers  $E(z_m^i)$  to  $E(z_r^i)$ .

*Step 3:*  $S = (\frac{D-1}{2}, 1, \frac{D-1}{2})$  gives the lowest utility for any  $t < 0$  type conditional on  $s_m > 0$ . Using the result from Step 2 and noting that  $E(z|S_{-d_r} = (\frac{D-1}{2}, k, \frac{D-1-2k}{2})) = E(z|S_{-d_m} = (\frac{D-1}{2}, k-1, \frac{D+1-2k}{2}))$  we can see that for a  $t \leq 0$  the least preferred expected policy is  $E(z|S = (\frac{D-1}{2}, 1, \frac{D-1}{2}))$ .

*Step 4:* Identifying the type who prefers  $a_l$  to  $E(z|S = (\frac{D-1}{2}, 1, \frac{D-1}{2}))$ . To find the rightmost type who prefers  $a_l$  to a coalition we thus examine  $S = (\frac{D-1}{2}, 1, \frac{D-3}{2})$ . At this point, electing party  $l$  gives them a majority and brings about  $z = a_l$ , while electing party  $r$  leads to a coalition with an ex ante expected policy of

$$E\left(z|S = \left(\frac{D-1}{2}, 1, \frac{D-1}{2}\right)\right) = -\frac{D-1}{2D} \left( \sqrt{\frac{1-\delta}{1-\delta\frac{D-1}{D}}} Q^2 \right) + \frac{2}{2D}(0) + \frac{D-1}{2D} \left( \sqrt{\frac{1-\delta}{1-\delta\frac{D-1}{D}}} Q^2 \right)$$

A voter will prefer the former if

$$-(a_l - t)^2 > -\frac{D-1}{2D} \left( -\sqrt{\frac{1-\delta}{1-\delta\frac{D-1}{D}}} Q^2 - t \right)^2 - \frac{2}{2D}(-t)^2 - \frac{D-1}{2D} \left( \sqrt{\frac{1-\delta}{1-\delta\frac{D-1}{D}}} Q^2 - t \right)^2$$

rearranging this we get that a voter prefers  $a_l$  if

$$t < \frac{a_l}{2} - \frac{D-1}{2Da_l} \left( \frac{1-\delta}{1-\delta(\frac{D-1}{D})} Q^2 \right)$$

As  $a_l < 0$ , the right hand side is greater than  $\frac{a_l}{2}$ , which is the cutoff point in the benchmark case (recalling that  $a_{lm} = \frac{a_l}{2}$  when  $a_m = 0$ ). The cutoff for a party  $l$  majority is thus given

by

$$\tilde{t}_{\frac{D+1}{2}} < z_l^* \equiv \frac{a_l}{2} - \frac{D-1}{2Da_l} \left( \frac{1-\delta}{1-\delta(\frac{D-1}{D})} Q^2 \right) > a_{lm} \quad (25)$$

As  $z_l^* > a_{lm}$ , the above result must also hold when  $s_r = 0$  as well as  $s_r > 0$ .

Next we show that  $z_l^* < a_m, a_{lr}$ . First, I show  $z_l^* < a_m$ . Some manipulation shows

$$\frac{D-1}{2Da_l} \left( \frac{1-\delta}{1-\delta(\frac{D-1}{D})} Q^2 \right) = \frac{Q^2}{2a_l} \frac{\frac{D-1}{D} - \delta \frac{D-1}{D}}{\frac{D-1}{D} - \delta \frac{D-1}{D} + \frac{1}{D}} > \frac{Q^2}{2a_l} \quad (26)$$

Let  $P \equiv \frac{\frac{D-1}{D} - \delta \frac{D-1}{D}}{\frac{D-1}{D} - \delta \frac{D-1}{D} + \frac{1}{D}}$  where the inequality in Equation 26 comes from  $P < 1$ . In order to show  $z_l^* < a_m$  we need to show  $\frac{a_l}{2} - \frac{P(Q)^2}{2a_l} < 0$ . Given  $P < 1$  and  $|Q| \leq |a_l|$ , this immediately follows.

Second, I show  $z_l^* < a_{lr}$ . If  $\Delta_l < \Delta_r$  then necessarily  $a_{lr} > a_m$ , so the proof above applies. If  $\Delta_l > \Delta_r$  we have  $z_l^* < a_{lr}$  if

$$\begin{aligned} \frac{a_l}{2} - \frac{P(Q)^2}{2a_l} &< \frac{a_l}{2} + \frac{a_r}{2} \\ \frac{P(Q)^2}{2|a_l|} &< \frac{a_r}{2} \end{aligned}$$

As  $Q^2 \leq a_r^2$  and  $|a_l| > |a_r|$ , the inequality above must hold.

Therefore, we have that a majority for party  $l$ , which brings about  $a_l$  can only occur if  $\tilde{t}_{\frac{D+1}{2}} < z_l^* \equiv \frac{a_l}{2} - \frac{D-1}{2Da_l} \left( \frac{1-\delta}{1-\delta(\frac{D-1}{D})} Q^2 \right)$  where  $z_l^* < a_m, a_{lr}$ .

Analogously, a majority for party  $r$ , which brings about  $a_r$  can only occur if  $\tilde{t}_{\frac{D+1}{2}} > z_r^* \equiv \frac{a_r}{2} + \frac{D-1}{2Da_r} \left( \frac{1-\delta}{1-\delta(\frac{D-1}{D})} Q^2 \right)$  where  $z_r^* > a_m, a_{lr}$ .  $\square$

## A.15 Proof of Proposition 10

**Case 1: If  $-|Q| < \frac{a_l}{\zeta}$  or  $\frac{a_r}{\zeta} < |Q|$  there exist equilibria with no misaligned voting in any district.** When  $E(s_l) > \frac{D-1}{2}$  and  $E(s_r) = 0$ , voters will be conditioning on the point  $(\frac{D-1}{2}, \frac{D-1}{2}, 0)$ . Electing  $l$  or  $m$  brings about  $z = a_l$  or  $z = a_m = 0$  respectively, each of which are the preferred policies of  $t = -1$  and  $t = 0$ . Electing  $r$  leads to an expected coalition policy given by

$$u_t(r) = -\frac{D-1}{2D} \left( -\sqrt{\frac{1-\delta}{1-\delta\frac{D+1}{2D}}} Q^2 - t \right)^2 - \frac{D-1}{2D} (t)^2 - \frac{2}{2D} \left( \sqrt{\frac{1-\delta}{1-\delta\frac{D+1}{2D}}} Q^2 - t \right)^2 \quad (27)$$



Some algebra shows that there exists a type for which Equation 27 is greater than both  $u_t(l)$  and  $u_t(m)$  if

$$-|Q| > \frac{a_l}{\zeta} \quad (28)$$

where  $\zeta \equiv \frac{D+1}{D-3} \sqrt{\frac{1-\delta}{1-\delta \frac{D+1}{2D}}}$ . Otherwise, if  $-|Q| < \frac{a_l}{\zeta}$ , then  $u_t(r)$  is dominated for all voter types, making  $(\frac{D-1}{2}, \frac{D-1}{2}, 0)$  a  $\lambda(2')$  event. If each district has  $l$  and  $m$  as serious candidates then there will be no misaligned voting. It is analogous to show that if  $\frac{a_r}{\zeta} < |Q| < a_r$  and all districts have  $m$  and  $r$  as serious candidates, there is no misaligned voting.

**Case 2: If  $|Q| > |\frac{a_l}{\zeta}|, |\frac{a_r}{\zeta}|$  there will be misaligned voting in at least one district.**

*Case 2A: When  $s_l > \frac{D-1}{2}$  or  $s_r > \frac{D-1}{2}$  there will always be misaligned voting in some districts.* I examine the case where  $l$  is expected to win a majority; the other case is identical.

1) *When  $E(s_l) > \frac{D-1}{2}$ ,  $E(s_r) > 0$  and  $E(s_m) > 0$  there will be misaligned voting.* Voters must be conditioning on a decisive event where  $s_l = \frac{D-1}{2}$ ; the expected utility of electing the three different candidates is

$$\begin{aligned} u_t(l) &= -(a_l - t)^2 \\ u_t(m) &= -\frac{D-1}{2D} \left( -\sqrt{\frac{1-\delta}{1-\delta \frac{D-(s_m+1)}{D}}} Q^2 - t \right)^2 - \frac{s_m+1}{D} (t)^2 - \frac{D-1-2s_m}{2D} \left( \sqrt{\frac{1-\delta}{1-\delta \frac{D-(s_m+1)}{D}}} Q^2 - t \right)^2 \\ u_t(r) &= -\frac{D-1}{2D} \left( -\sqrt{\frac{1-\delta}{1-\delta \frac{D-s_m}{D}}} Q^2 - t \right)^2 - \frac{s_m}{D} (t)^2 - \frac{D+1-2s_m}{2D} \left( \sqrt{\frac{1-\delta}{1-\delta \frac{D-s_m}{D}}} Q^2 - t \right)^2 \end{aligned}$$

It suffices to consider the most extreme types  $t = -1$ ,  $t = 0$  and  $t = 1$ . Subbing these values in we see that a type  $t = -1$  will always want to elect  $l$  and a type  $t = 0$  will always want to elect  $m$ . For any case  $E(s_l) > \frac{D-1}{2}$ ,  $E(s_r) > 0$ ,  $E(s_m) > 0$ , there must therefore be misaligned voting as in the districts where  $r$  is expected to win, the other voters coordinate on either  $l$  or  $m$ . The supporters of that candidate which is not serious must be casting misaligned votes.

2) *When  $E(s_l) > \frac{D-1}{2}$  and  $E(s_m) = 0$  there will be misaligned voting in every district.* Voters will be conditioning on the point  $(\frac{D-1}{2}, 0, \frac{D-1}{2})$  where electing  $l$  or  $r$  brings about  $z = a_l$  or  $z = a_r$  respectively, each of which are the preferred policies of  $t = -1$  and  $t = 1$ . Electing  $m$  leads to an expected coalition policy given by

$$u_t(m) = -\frac{D-1}{2D} \left( -\sqrt{\frac{1-\delta}{1-\delta \frac{D-1}{D}}} Q^2 - t \right)^2 - \frac{2}{2D} (t)^2 - \frac{D-1}{2D} \left( \sqrt{\frac{1-\delta}{1-\delta \frac{D-1}{D}}} Q^2 - t \right)^2$$

Subbing in for  $t = 0$ , it is clear that  $u_0(m) > u_0(l), u_0(r)$ . As only 2 candidates receive votes,

one of these player types must be casting a misaligned vote.

3) When  $E(s_l) > \frac{D-1}{2}$  and  $E(s_r) = 0$  there will be misaligned voting when  $-\zeta|Q| > a_l$ . This follows directly from Case 1.

*Case 2B: When no party has an expected majority there will be misaligned voting in some districts.* For any expected seat distribution where no party has a majority, the expected utility of electing the three different candidates is

$$\begin{aligned} u_t(l) &= -\frac{s_l + 1}{D} \left( -\sqrt{\frac{1-\delta}{1-\delta\frac{D-s_m}{D}}} Q^2 - t \right)^2 - \frac{s_m}{D} (t)^2 - \frac{s_r}{D} \left( \sqrt{\frac{1-\delta}{1-\delta\frac{D-s_m}{D}}} Q^2 - t \right)^2 \\ u_t(m) &= -\frac{s_l}{D} \left( -\sqrt{\frac{1-\delta}{1-\delta\frac{D-(s_m+1)}{D}}} Q^2 - t \right)^2 - \frac{s_m + 1}{D} (t)^2 - \frac{s_r}{D} \left( \sqrt{\frac{1-\delta}{1-\delta\frac{D-(s_m+1)}{D}}} Q^2 - t \right)^2 \\ u_t(r) &= -\frac{s_l}{D} \left( -\sqrt{\frac{1-\delta}{1-\delta\frac{D-s_m}{D}}} Q^2 - t \right)^2 - \frac{s_m}{D} (t)^2 - \frac{s_r + 1}{D} \left( \sqrt{\frac{1-\delta}{1-\delta\frac{D-s_m}{D}}} Q^2 - t \right)^2 \end{aligned}$$

Where I abuse notation slightly to let  $s_c$  to be the expected number of seats of party  $c$  before district  $d$  votes, so that  $s_l + s_m + s_r = D - 1$ . By subbing in  $t = 0$ , we see that this type will always want  $m$  elected. For there to be no misaligned voting it must therefore be the case that  $m$  is a serious candidate in every district. Suppose this is the case so that in a  $d_r$  district  $r$  and  $m$  are serious candidates and in a  $d_l$  district  $l$  and  $m$  are the serious candidates. In a  $d_r$  district a type  $t = 1$  must have  $u_1(r) > u_1(m)$ . Note that a  $d_r$  district conditions on  $r$  having one less seat and  $l$  having one more seat than a  $d_l$  district conditions on (Graphically,  $E(S_{-d_r})$  is one point to the left of  $E(S_{-d_l})$ ). Using the equations above one can show that if  $u_1(r|(s_l, s_m, s_r)) > u_1(m|(s_l, s_m, s_r))$  then  $u_1(r|(s_l - 1, s_m, s_r + 1)) > u_1(m|(s_l - 1, s_m, s_r + 1))$ . That is, in a given equilibrium, if a type  $t = 1$  in a  $d_r$  district prefers  $r$  to  $m$ , then a type  $t = 1$  in a  $d_l$  district also prefers  $r$  to  $m$ . As this type also prefers  $r$  to  $l$  and the focal candidates in the  $d_l$  district are  $l$  and  $m$ , he must be casting a misaligned vote.

*Case 2C: When  $s_m > \frac{D-1}{2}$  there will be misaligned voting in at least one district.*

If  $s_m > \frac{D-1}{2}$ , all districts must be conditioning on decisive events where  $s_m = \frac{D-1}{2}$ . In

such cases the expected utility of a type  $t$  voter in voting for each of the parties is

$$\begin{aligned}
u_t(l) &= -\frac{s_l + 1}{D} \left( -\sqrt{\frac{1 - \delta}{1 - \delta \frac{D+1}{2D}}} Q^2 - t \right)^2 - \frac{D - 1}{2D} (t)^2 - \frac{D - 1 - 2s_l}{2D} \left( \sqrt{\frac{1 - \delta}{1 - \delta \frac{D+1}{2D}}} Q^2 - t \right)^2 \\
u_t(m) &= -(t)^2 \\
u_t(r) &= -\frac{s_l}{D} \left( -\sqrt{\frac{1 - \delta}{1 - \delta \frac{D+1}{2D}}} Q^2 - t \right)^2 - \frac{D - 1}{2D} (t)^2 - \frac{D + 1 - 2s_l}{2D} \left( \sqrt{\frac{1 - \delta}{1 - \delta \frac{D+1}{2D}}} Q^2 - t \right)^2
\end{aligned}$$

Note that for  $t = 0$  we have  $u_t(m) > u_t(l) = u_t(r)$ . Any voter type with  $t < 0$  has  $u_t(l) > u_t(r)$ , while any voter with  $t > 0$  has  $u_t(l) < u_t(r)$ . However, it could be that some of these types prefer  $u_t(m)$  to either of the other two. In order to check this I calculate the derivative of each of the expected utilities with respect to  $t$ .

$$\begin{aligned}
\frac{d[u(l)]}{dt} &= -2t + \frac{D - 3 - 4s_l}{D} \left( \sqrt{\frac{1 - \delta}{1 - \delta \frac{D+1}{2D}}} Q^2 \right) \\
\frac{d[u(m)]}{dt} &= -2t \\
\frac{d[u(r)]}{dt} &= -2t + \frac{D + 1 - 4s_l}{D} \left( \sqrt{\frac{1 - \delta}{1 - \delta \frac{D+1}{2D}}} Q^2 \right)
\end{aligned}$$

When  $s_l < \frac{D-3}{4}$  then for any  $t < 0$  we have  $\frac{d[u(m)]}{dt} < \frac{d[u(l)]}{dt} < \frac{d[u(r)]}{dt}$ . Utility is increasing for all three cases as we move towards 0. Given  $\frac{d[u(m)]}{dt} < \frac{d[u(l)]}{dt}$  for any  $t < 0$  and  $u_t(m) > u_t(l) = u_t(r)$  for  $t = 0$ , it must be that for  $s_l < \frac{D-3}{4}$  there is no type with  $u_t(l) > u_t(m), u_t(r)$ . When  $s_l > \frac{D+1}{4}$  then for any  $t > 0$  we have  $\frac{d[u(m)]}{dt} < \frac{d[u(r)]}{dt} < \frac{d[u(l)]}{dt}$ . Combined, with the fact that we have  $u_t(m) > u_t(l) = u_t(r)$  for  $t = 0$ , this means that for  $s_l > \frac{D+1}{4}$  there is no type with  $u_t(r) > u_t(m), u_t(l)$ .

What this means is that, conditional on  $s_m = \frac{D-1}{2}$ , if  $s_l < \frac{D-3}{4}$ , a district in which  $m$  and  $r$  are the serious candidates will have no misaligned voting; and if  $s_l > \frac{D+1}{4}$  then a district in which  $m$  and  $l$  are the serious candidates will have no misaligned voting.

However, each equilibrium has misaligned voting in a least one district. Recall that  $E(S_{-d_l}) = (s_l - 1, s_m, s_r)$ ,  $E(S_{-d_m}) = (s_l, s_m - 1, s_r)$  and  $E(S_{-d_r}) = (s_l, s_m, s_r - 1)$ . As all the relevant decisive events occur at  $s_m = \frac{D-1}{2}$ ,  $d_l$  and  $d_r$  districts will have the same “route” to being decisive. That is, in any equilibrium if  $d_l$  districts are conditioning on  $(k, \frac{D-1}{2}, \frac{D-1}{2} - k)$ , then  $d_r$  districts must be conditioning on  $(k + 1, \frac{D-1}{2}, \frac{D-1}{2} - (k + 1))$ .

When  $0 < s_l < \frac{D-3}{4}$ , all  $d_m$  and  $d_r$  districts are conditioning on  $\lambda(2')$  events. In any of

these districts if the serious candidates are  $m$  and  $r$ , there is no misaligned voting. However, we know that  $d_l$  districts must either be conditioning on a  $\lambda(2')$  event or else a  $\lambda(3)$  event (if it conditions on  $S_{-d} = (0, \frac{D-1}{2}, \frac{D-1}{2})$ ). Whichever one of these is the case, there will always be misaligned voting in these  $d_l$  districts. Indeed, if it conditions on  $S_{-d} = (0, \frac{D-1}{2}, \frac{D-1}{2})$ , and the other districts are all races between  $m$  and  $r$ , it must be that there is only misaligned voting in this single  $d_l$  district. Examining the  $\frac{D+1}{4} < s_l < \frac{D-1}{2}$  case gives the same insight for the mirror case; there'll be no misaligned voting in  $d_l$  or  $d_m$  districts if they focus on races between  $l$  and  $m$ , but there will always be misaligned voting in the  $d_r$  districts.  $\square$

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