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ABSTRACT

Voting Power and Survival: The Case of a Ruling Party*

In this article, we empirically study the survival of the ruling party in parliamentary democracies using a hazard rate model. We define survival of a crisis as being successful in a critical vote in the parliament. We develop a general probabilistic model of political crises and test it empirically. We find that during crises, parties in the parliament are likely to vote independently of each other. Thus, we receive as an empirical result what the previous voting power literature assumed.

JEL Classification: D72

Keywords: voting power, coalitions, cabinet duration, Shapley-Shubik index, Rae index

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1 Introduction

This paper addresses the survival of ruling (prime minister's) parties in parliamentary democracies. The question is how the ruling party's voting power is related to the party's hazard to lose power as a result of political crises. This question differs from the traditional question of coalition stability (Lijphart, 1984) in that a ruling party may form an alternative coalition as long as it stays in power. The adopted analytical tool is the event approach with a general probabilistic model of political crises.

Our analysis makes three contributions: First, it addresses a new research question about political stability in a parliamentary democracy. Second, it generalizes the concept of voting power in a general probabilistic model. This generalization, such that existing concepts of voting power are special cases of our model, is the main innovation in this article. Third, it brings empirical evidence that during political crises the parties are probably not coordinated.

The motivation for our focus on the stability of a ruling party rather than on that of a coalition or prime minister's personality relies on the fact that the prime minister's party has a special impact on government policy. In particular, as noted in Duverger (1959), the *dominant party*, is one 'identified with an epoch' and held to be dominant by public opinion (see also Sartori, 1976 for a discussion of this notion). One example is the Swedish Social Democratic party that governed between 1932 and 1976 (Pempel, 1990, p.18), the Italian Christian Democratic Party (Irving, 1979, p.59), and the German CDU, which ruled in the post-WWII period (Burkett, 1975, p.23). It is worth noting that in each of these countries, during the relevant period, many changes took place in cabinet coalition composition. Yet despite changes in cabinets and prime ministers, this same dominant party maintained an extremely high level of influence throughout its rule. Moreover, as Snyder et al. (2005) show, the formateur's party (typically the ruling party, see Warwick and Druckman, 2001) receives a higher share of cabinet offices than its electoral weight.

The difference between ruling party survival and coalition stability is illustrated by the situation in Israel between 1992 and 1996. After the 1992 election, the Israeli Labor party formed a coalition government headed by Y. Rabin, but in 1993, the Shas party left the government coalition. At the beginning of 1995, the Yiud fraction joined the coalition and then in November 1995, Rabin was assassinated and S. Peres, also of the Labor party, became the prime minister. According to the traditional approach to government duration, this period is characterized by four different cabinets (three changes in coalition composition and one change of prime minister). However, although this count is undoubtedly based on solid reasoning, it misses the fact that for the whole 1992-1996 period, the Labor party was in power and the main policy directions (e.g., towards peace agreements with the Palestinians) did not change.

A crisis is an event when the ruling party can not assure that the majority of the parliament members are on its side. For example, in Germany in 1982, the Free Democratic Party (FDP) was a member of the coalition led by the Social Democrats, but following an economic downturn, it found itself closer to the main opposition party, the CDU. As a result, the FDP decided to cooperate with the CDU and joined a new government formed by the CDU (see Lupia and Strøm, 1995 for a detailed description of these events). In our model, such an event appears as a critical vote, where the strength of the ruling party is tested.[1] The ruling party stays in power as long as it is successful (on the winning side) in such a vote. The probability to be successful is the ruling party's voting power.

[1] In real politics, or course, prime ministers may initiate dissolution of the legislature and shorten their own ruling term, which at first glance seems to contradict our political survival concept. In fact, however, such events are in line with our logic. That is, prime ministers generally shorten their term in one of two cases: if the formal end of term is close (in which case, the impact of dissolution is relatively small) or when their political standing seems unstable enough that other parties are likely to call for an election. One exception is the 2005 decision by German Chancellor Schröder to dissolve parliament (after asking his own cabinet members to abstain during a no-confidence vote) following his party's loss in the local elections. Attributing his decision to a desire 'to avoid a total blockage of the German political process as the government camp was now left without any votes to rely upon in the Bundesrat' (Poguntke, 2006), he was apparently motivated by a change in the composition of the upper chamber. In our research, however, we follow the literature in which, with no exception we know of, the formation of a government coalition and its survival are explained by the composition of the lower chamber of parliament. Taking the upper chamber into account is thus beyond our scope.

We test our model on a post-WWII panel of 13 European parliamentary democracies with a proportional representation system. In this system, ruling party rarely has an absolute majority in the parliament. Without an absolute majority, its voting power is smaller than one and a crisis may potentially lead to its loss of power.

To predict the duration of a party's rule, our analysis uses the Rae index (Rae, 1969), which is the probability that, given an equal likelihood of formation for all coalitions, the ruling party belongs to a majority coalition. When this assumption is strong, we relax it by introducing a more general probabilistic voting model. The results of our estimations confirm the Rae assumptions compared to a large set of alternatives. Specifically, while Rae assumes no correlation between the parties, we find that, indeed, this setting better fits the empirical data of the ruling parties' survival. This finding is intuitively in line with our concept of a crisis: an event when obligations do not hold.

To summarize, the aim of the exercise is to explore the impact of voting power on duration of stay in power of ruling parties. In particular, we generalize the concept of voting power, making it a parametric function.

1.1 Overview of the model and the results

In a country whose government is accountable to a parliament, each party controls a specific proportion of parliamentary seats (the party *weight*). In our baseline model, we assume that all representatives of the same party vote the same way in the parliament (a common assumption in the literature, but one that we relax in Section 4). Ideologically, the parties are located along a unidimensional left-right scale. We further assume that following the establishment of a government coalition, a shock or a crisis in the form of a Poisson event may occur on any given day. Our assumption is that a crisis is followed by a vote in the legislature, such as a no-confidence vote. If a crisis does occur, the survival of the ruling party depends on the result of this critical vote. If the majority votes like the ruling party, then this party survives the crisis and continues in power. In this case, we consider the ruling party to be *successful (on the winning side).* Otherwise, it loses its ruling party status.[2]

In our model, each party in the parliament votes 'yes' with the same probability p (which may vary from vote to vote) or 'no' with probability $1 - p$. The parameter p itself is a random variable drawn from a Beta distribution (a general method to generate a random number between 0 and 1).[3] Because we assume that the a priori likelihood of a 'yes' or 'no' vote is symmetric, we also assume that both parameters of the Beta distribution are equal and denote this parameter's value by α. With regards to the parties' ideological positions, we assume a correlation between the voting of parties that are neighbors on the right-left ideological scale. That is, if two parties are adjacent on this scale, the correlation coefficient between their voting behavior is ρ (this assumption is discussed and tested in Section 4).

We connect this model to the notion of voting power.[4] The most widely used voting power indices, the Shapley-Shubik index (Shapley and Shubik, 1954) and the Banzhaf index (Banzhaf, 1964), measure the probability that a voter is *decisive*. We are interested in the probability that the voter (in our case the party) is on the winning side, designated in the voting power literature by the term *successful* (see Laruelle and Valenciano, 2008). The Shapley-Shubik index can also be interpreted as the probability that a voter is decisive if every voter votes 'yes' independently with the same probability p, and 'no' with probability $1 - p$, when p is randomly chosen with a uniform distribution on $[0, 1]$ (Straffin, 1977). This distribution is a special case of our model where $\alpha = 1$ and $\rho = 0$, since $Beta(1, 1)$ is the uniform distribution. The Banzhaf index, on the other hand, is the probability that a voter is decisive when every voter votes 'yes' independently with probability 0.5. Again,

[2]The actual vote does not have to take place, because the prime minister may resign in face of forthcoming defeat or the opposition may withdraw the vote in absence of majority.

[3]Observing the actual distribution of voting in favor of a proposed bill by the U.S. House of Representatives (McCrary, 2008) shows that the actual distribution of voting 'yes' is a mix of Beta distributions with different parameters.

[4]For a comprehensive survey of this see Felsenthal and Machover (1998). For recent research see Holler and Nurmi (2013) and Kurz et al. (2014).

this condition is a special case in our model in which $\alpha \to \infty$ and $\rho = 0$.[5] Finally, we employ the Rae index (Rae, 1969), a linear transformation of the Banzhaf index (Dubey and Shapley, 1979), which measures the probability of a party's being on the winning side when the formation of all coalitions is equally likely.

To assess the duration of a ruling party's survival, we estimate a hazard rate model (formally defined in Section 2) in which the survival of a ruling party in power is determined by two components: the rate of crises and the ruling party's *voting power*, which is the probability to be on the winning side. The voting power is calculated according to the distribution of parliamentary seats and with respect to the values of α and ρ, means the shape of the Beta distribution from which the probability to vote 'yes' is drawn and the correlation between ideological neighbors. In the empirical specification, the rate of crises depends on a set of covariates including country fixed effects and flexible time-to-elections effect.[6] To control for the possibility that a political system's stability may depend on the existence of a sufficiently large party (Sartori, 1976), we also include a dummy variable that is equal to one if the ruling party is large (variously defined). The robustness of the assumptions and the empirical specification is tested in Section 4.

The model parameters are estimated using a panel of post-WWII coalitions in 13 European parliamentary democracies. Interestingly in the context of survival, out of the total of 215 observations, about 30% are of minority governments, which are in power thanks to ad hoc external support. According to our estimations, crises are by no means frequent: their mean rate at the beginning of the ruling party's power is 0.00075 events per day, rising to an average 0.0268 on the last day before a regular election. The estimated effect of voting power on the ruling party's probability of surviving a crisis is about 0.8 (should be 1 if the model perfectly explained the data).

[5] As $\alpha \to \infty$, $Beta(\alpha, \alpha)$ converges to the degenerate distribution $p = \frac{1}{2}$ with probability 1.
[6] This is a more flexible approach than in King et al. (1990).

Our results further reveal that the value of α, the shape of the Beta distribution from which the voting 'yes' probability is drawn, has little impact on the statistical likelihood of the model, suggesting that the true distribution could be a mix of different distributions. The main empirical result is that the models fits better the data when the correlation between ideological neighbors, ρ, is close to zero. Such an outcome implies that during crises parties do not coordinate their voting. In particular, as a matter of connection to the voting power literature, the empirical findings suggest that both $\alpha = 1$, $\rho = 0$ and $\alpha \to \infty$, $\rho = 0$ are cases in which our model fits the data well, which means that both the Rae index and the Banzhaf index show some relation to data, as does the distribution of votes the Shapley-Shubik index is based on.

We perform a set of robustness checks that test for a selection bias in the sample and relax the model's assumptions. For the first, we restrict the sample to only those coalitions in place on January 1 of every fifth year, which eliminates any possible bias caused by over-representing non-stable coalitions, in which the ruling party's stay in power is of short duration. Our results for the full sample remain similar with only slightly lower statistical significance due to a smaller number of observations. Furthermore, we relax the two model assumptions of strict intra-party discipline and a fixed correlation between ideologically neighboring parties. As an alternative to the first, we let only a proportion of the parliament members vote along party lines, while the rest vote independently. As an alternative to the second, we assume that the correlation exists between the ideologically neighboring voters (rather than parties) who are uniformly distributed on the left-right scale and that the neighboring parties correlation is inverse to the ideological distance between their median voters. Results received are similar to those of the baseline model. As a further robustness check, we test the concept of voting power by estimating the baseline model with the weight of the ruling party plugged in rather than its voting power. We find a lower statistical likelihood than in the baseline model as long as the correlation ρ is not very large in absolute terms.

Lastly, we control for the strength of the three largest parties in the legislature, as defined in Laver and Benoit (2015). The results are robust to controlling for this additional variable.

1.2 Related literature

Following seminal works by Riker (1962), Axelrod (1970) and De Swaan (1973), a broad body of literature has emerged on the formation and stability of government coalitions, which includes many proposed models of coalition formation. Among the most relevant for this study is Baron and Ferejohn (1989) game-theoretic analysis of bargaining over the allocation of resources (e.g., offices, budget) to parties during cabinet formation, which Snyder et al. (2005) extend to weighted majority games (see also Morelli, 1999). Also pertinent are Austen-Smith and Banks (1990) and Laver and Shepsle (1990) separate models of ministerial portfolio allocation in coalitional bargaining, which associates each portfolio with one policy or ideology issue.

One of the most influential contributions to the coalition survival literature is Dodd (1976) who finds that the duration of a coalition depends on such characteristics as whether it is a minimally winning coalition. As far as we know, Browne et al. (1986) are the first to suggest the event approach in which coalition termination is caused by a random shock. In a later work, King et al. (1990) use a unified approach in which the probability of a coalition termination event depends on the attributes of both the coalition and the parliament, a framework later extended by Warwick (1994). Laver and Shepsle (1998) classify different types of events and study their impact on cabinets. Elsewhere, Lupia and Strøm (1995) argue that party decisions to dissolve a coalition in the face of a 'potentially critical event' depend on strategic considerations, and suggest a strategic model for the case of three parties. For a comprehensive overview of this literature stream, see Laver and Shepsle (1996) and Mueller (2003). Although our paper is also somewhat related to the probabilistic voting literature (see Coughlin, 1992), to the best of our knowledge, no studies in that field address the survival of a ruling party .

It is also important to point out that our work differs from the studies mentioned above in that it does not retain the traditional assumption that any change in coalitional composition constitutes the end of a coalition. Thus, we are unable to compare our results with those of prior studies. Our results also contradict the Albert (2003) claim that voting power theory 'is a branch of probability theory and can safely be ignored by political scientists'[7] by providing evidence that some aspects of voting power theory can indeed be applied to the real world.

In a general context of public economics, proportional representation, studied here, is compared to other voting systems in Hillman (2009, Chapter 6).

The paper proceeds as follows. Section 2 outlines the model; Section 3 describes the data, empirical methodology, and results; Section 4 reports the robustness checks, and Section 5 concludes.

2 Model

Let $N = \{1, \ldots, n\}$ be the set of parties, ordered on the left-right ideological scale, $i < j$ means that party i is to the left of party j. We denote the ruling party by $r \in N$. Let $w = \{w_1, \ldots, w_n\}$ be the weights of the parties in N, where $w_i > 0$ for each $i \in N$. The simple majority quota is represented by $Q = 0.5$. The 'crisis' event is a Poisson event with frequency λ. Let us draw p from $[0, 1]$ according to the distribution $Beta(\alpha, \alpha)$ with $\alpha > 0$. Let X_i, $i \in N$ be a Bernoulli random variable, which is equal to 1 with probability p and 0 with probability $1 - p$:

$$x_i = \begin{cases} 1 & , i \text{ votes 'yes'} \\ 0 & , i \text{ votes 'no'} \end{cases}$$

ρ is then the correlation coefficient between X_i and X_{i+1}, $i \in N$.

[7]See Felsenthal and Machover (2003), List (2003) and Albert (2004) for a conceptual discussion that followed Albert's statement.

Lemma 2.1. When for each $i \in N$, X_i is a Bernoulli trial with parameter p and let $\rho_{X_i,X_{i+1}} = \rho$, then for $1 \leq i < n$, $Prob(X_{i+1} = 1|X_i = 1) = \rho(1-p) + p$ and $Prob(X_{i+1} = 1|X_i = 0) = p(1-\rho)$.

Proof: See Appendix.

Corollary 2.2. ρ must satisfy

$$\max\{\frac{-p}{1-p}, \frac{p-1}{p}\} \leq \rho \leq 1$$

Proof: The proof follows directly from $0 \leq Prob(X_{i+1} = 1|X_i = 1) \leq 1$ and $0 \leq Prob(X_{i+1} = 1|X_i = 0) \leq 1$. □

For $1 \leq r \leq n$, let $V(N, w, r, p, \rho)$ be the probability that r is *on the winning side*, or, in other words, that the majority votes like r:

$$V(N, w, r, p, \rho) = Prob(x_r = 1, \sum_{i \in N, x_i = 1} w_i > Q) + Prob(x_r = 0, \sum_{i \in N, x_i = 1} w_i \leq Q)$$

The probability that r stops being the ruling party on any given day is thus $\lambda[1 - V(N, w, r, p, \rho)]$.

The testable prediction of the model is that the ruling party's voting power $V(N, w, r, p, \rho)$ is correlated with the survival of a ruling party, particularly, with the number of days a ruling party would stay in power (censored by regular elections).

3 Empirics

3.1 Introduction

We proceed now to the empirical test of the model. The empirical analysis is structural. It means that we cannot simply regress two observable variables one on another because the voting power is unobservable. It can be only derived under assumed theoretical parameters

α and ρ, the shape of the distribution from which the voting 'yes' or 'no' is derived and the correlation between ideological neighbors. In what follows, we describe the data, introduce the likelihood function that we maximize, and explain the procedure that generates the voting power for each set of parameters. The results are discussed afterwards.

3.2 Data

To test the theory, we use data from countries with a proportional representation system and a relatively long history of democratic elections. A country with proportional representation is less likely than a country with a majoritarian electoral system to observe the appearance of one party with an absolute majority. We therefore exclude from our analysis countries with a majoritarian electoral system, such as the UK, France, Canada, and India. We exclude also Greece, where the majority bonus system tends to provide an absolute majority to one party. The presence in a majoritarian system of independent parliamentary members who are unassociated with any party also makes such a system less appropriate for our analysis. We further exclude the so-called new democracies since they have no sufficiently long history of elections.

Our data set covers the composition of the post-World War II parliaments (lower chambers) and of the government coalitions in 13 countries: Austria, Belgium,[8] Denmark, Finland, Germany, Ireland, Israel, Italy, Luxembourg, the Netherlands, Norway, Portugal,[9] and Sweden. For all countries other than Israel, we draw all data, including party location on the ideological scale, from Müller and Strom (2003). Naturally, the location on the left-right scale may be different for the same party in different years. Whenever the date of government dissolution is absent from this source, we use data from the *European Journal of Politi-*

[8]In Belgium, major parties spit along linguistic lines after 1965. For instance, there are formally two distinct parties: the Flemish Socialist party and the French-speaking Socialist party, which hold similar ideological positions and are generally members in the same coalitions. To avoid confusion, we do not include data from this period in the analysis.

[9]We consider coalitions in Portugal only after 1980, since before then governments were appointed by the president, and not necessarily with parliamentary support.

cal Research Political Data Yearbook (Poguntke, 2003, Fallend, 2000, O'Malley and Marsh, 2003, Aalberg, 2001, Widfeldt, 2003, Bille, 2002, Sundberg, 2000, Lucardie, 2003, Hirsch, 2000, Ignazi, 2002 and Magone, 2000). The data for Israel (including party ideological position) are taken from Chua and Felsenthal (2008) and from the official Knesset web site.[10] The maximal potential duration of a government term is based on author calculations in accordance with Israeli electoral legislation. The final data set consists of 215 observations.

3.3 Estimation

We apply the model presented in Section 2 to data by considering the rate of crises and the probability to survive a crisis by being successful. The likelihood of observation i of a country j to represent duration of power of the ruling party for y_{ij} days since the party gained power (as result of elections or under other circumstances) is the likelihood to survive y_{ij} days. The likelihood of the whole sample is given by log-likelihood function

$$\mathcal{L} = \sum_{i,j} ln(f_{ij}(y_{ij})) \tag{1}$$

where

$$f_{ij}(y_{ij}) = [\lambda_{ij}(y_{ij})]^{d_{ij}} e^{-\int_0^{y_{ij}} \lambda_{ij}(t)dt} \tag{2}$$

is the likelihood of each observation and where we consider a multiplication of rate of events with probability to survive an event:

$$\lambda_{ij}(t) = (1 - \beta V_{ij}) c_j \alpha^{I_{ij}} \gamma^{T_{ij}-t} \tag{3}$$

$1-\beta V_{ij}$ is the probability to survive the crisis because V_{ij} is the voting power - the probability to be successful. β is the main parameter of interest. Ideally for our model, β should equal one.

[10] www.knesset.gov.il

For observation i of country j, the number of days that elapse between the ruling party's formation of a government and its loss of power to another party or an election is y_{ij}, while the number of days between this formation and regular elections (i.e., their potential stay in power) is T_{ij}. The value of the censoring dummy variable d is 1 if $y_{ij} < T_{ij}$; that of dummy variable I is 1 for large ruling parties.

Plugging (2) into (1) gives the actual expression to be maximized:

$$\mathcal{L} = \sum_{i,j} (d_{ij} ln(\lambda_{ij}(y_{ij})) + \frac{\lambda_{ij}(y_{ij}) - \lambda_{ij}(0)}{ln(\gamma)}) \tag{4}$$

Thus, we estimate a hazard rate model with invariant and time-variant coefficients. Equation 4 has 16 parameters, of which 14 determine the rate of events: 13 country fixed effects c_j and the time-to-elections effect γ. The fifteenth parameter, β, is our parameter of interest: the effect of the ruling party's voting power on its probability of surviving the event. The last parameter is the large party effect α. To ensure that λ is positive, we restrict the values of the country fixed effects c_j, the time-to-elections effect γ, and the large party effect I to be non-negative by using an exponential function. Additionally, we restrict the value of β to between 0 and 1.

We perform this maximum likelihood estimation for values of α between 0.1 and 10 (for values higher than 10, the differences are negligible) and for values of ρ between -0.99 and 0.99. We are thus agnostic about the true parameters of the voting distribution and report the resulting coefficients of β for each combination of α and ρ. Finally, we repeat the estimations for different definitions of a large ruling party; namely, one with more than 10%, more than 30%, or more than 50% of the parliamentary seats.

3.4 Calculation of the voting power

The value of the voting power relies not only on the election results but also on the values of α and ρ. It it impossible to derive the voting power analytically. Thus, we calculate the voting power V_{ij} for each observation using a simulation. Recall that the voting power in our concept is the probability to be successful (on the winning side) in a vote. First, from the $Beta(\alpha, \alpha)$ distribution, we draw 100,000 random numbers p that correspond to the a priori probability of voting 'yes' in 100,000 hypothetical critical votes. We then simulate the voting results for each of them, such that the correlation between the ideologically neighboring parties is ρ. To derive the vote of the leftist party, it is sufficient to draw a Bernoulli number with probability p. We then use Lemma 2.1 to recursively simulate the vote of all other parties conditional on the leftist one. It should be noted that because $\rho(1-p)+p$ may be negative for negative values of ρ, we restrict the list of the 100,000 simulated p to the values that provide non-negative $\rho(1-p)+p$; that is, the probability to vote 'yes' conditional on the ideological neighbor's 'yes' vote. Finally, we derive voting power V_{ij} by calculating the proportion of votes when the ruling party is successful.

3.5 Results

3.5.1 Descriprive Statistics

In Table 1 we report the descriptive statistics for both the variables directly appearing in data and voting power for different values of the voting distribution parameters α and ρ, arranged by country. The first three columns list the mean duration of the ruling party's stay in power in days, the mean potential duration, and the mean weight of the ruling party in the parliament, respectively. As the table shows, in most countries, the ruling party has, on average, between 40% and 50% of parliamentary seats, with only the Netherlands and Finland being outliers at less than 30%. The next nine columns report the mean voting power for different values of α and ρ calculated according to the procedure described in

Subsection 3.4. We observe that the between-country variation in the ruling party's average voting power is much smaller than the variation in the ruling party's average weight. For example, in Finland, which has the smallest ruling parties in our sample, the average voting power is of the same size as in Luxembourg, where the ruling party holds, on average, 40% of the parliament. We also find that the voting power converges to 1 as the correlation between ideologically neighboring parties ρ rises, a finding we attribute to the fact that when the correlation between parties is positive and high, all parties vote similarly, which places the ruling party almost always on the winning side. We further note that the voting power is close to 0.9 in all countries when ρ is equal to zero.

The last two columns report the estimated average rates of critical events at the beginning of the ruling party's power and on the last day before the regular elections, respectively, although of course, in many observations, the elections come earlier.[11] We observe that crises that challenge the ruling party are very rare at the beginning of the term and fairly rare at the end.

[11] The estimates are for $\alpha = 0.5$ and $\rho = 0$.

	Data (days)			Voting power (simulated)									Rate of crises	Rate of crises
				$\alpha = 0.5$			$\alpha = 1$			$\alpha = 10$			at $t = 0$	at $t = T$
	Duration	Potential duration	Weight of the ruling party	$\rho = -0.75$	$\rho = 0$	$\rho = 0.75$	$\rho = -0.75$	$\rho = 0$	$\rho = 0.75$	$\rho = -0.75$	$\rho = 0$	$\rho = 0.75$	$\rho = 0$, $\alpha = 0.5$	$\rho = 0$, $\alpha = 0.5$
Austria	1168 (313)	1439 (28)	0.47 (0.05)	0.87 (0.14)	0.92 (0.06)	0.98 (0.03)	0.83 (0.19)	0.89 (0.08)	0.97 (0.03)	0.77 (0.29)	0.84 (0.11)	0.96 (0.05)	0.0004	0.0292
Belgium	1124 (465)	1490 (21)	0.44 (0.07)	0.85 (0.13)	0.90 (0.05)	0.98 (0.02)	0.80 (0.18)	0.87 (0.07)	0.97 (0.03)	0.74 (0.29)	0.81 (0.11)	0.95 (0.04)	0.0003	0.0224
Denmark	776 (391)	1407 (159)	0.31 (0.10)	0.87 (0.08)	0.89 (0.04)	0.93 (0.04)	0.85 (0.11)	0.85 (0.06)	0.90 (0.05)	0.82 (0.18)	0.79 (0.12)	0.86 (0.08)	0.0010	0.0539
Finland	793 (477)	1168 (352)	0.25 (0.05)	0.81 (0.07)	0.87 (0.02)	0.95 (0.03)	0.75 (0.10)	0.83 (0.03)	0.94 (0.04)	0.67 (0.19)	0.75 (0.05)	0.91 (0.06)	0.0014	0.0235
Germany	1261 (363)	1407 (178)	0.46 (0.04)	0.92 (0.04)	0.91 (0.04)	0.96 (0.02)	0.91 (0.04)	0.88 (0.06)	0.95 (0.03)	0.92 (0.05)	0.83 (0.09)	0.92 (0.04)	0.0004	0.0192
Ireland	1139 (437)	1744 (164)	0.44 (0.09)	0.89 (0.13)	0.92 (0.06)	0.98 (0.02)	0.85 (0.17)	0.90 (0.09)	0.97 (0.03)	0.82 (0.26)	0.86 (0.14)	0.96 (0.05)	0.0004	0.0535
Israel	1111 (316)	1448 (236)	0.34 (0.07)	0.89 (0.05)	0.90 (0.03)	0.93 (0.05)	0.87 (0.07)	0.88 (0.05)	0.91 (0.06)	0.87 (0.13)	0.85 (0.08)	0.87 (0.09)	0.0004	0.0219
Italy	975 (658)	1518 (485)	0.35 (0.14)	0.89 (0.09)	0.90 (0.05)	0.96 (0.03)	0.87 (0.13)	0.88 (0.07)	0.95 (0.03)	0.85 (0.21)	0.84 (0.12)	0.93 (0.05)	0.0017	0.0422
Luxembourg	1596 (364)	1638 (348)	0.40 (0.07)	0.81 (0.12)	0.90 (0.03)	0.99 (0.01)	0.75 (0.17)	0.86 (0.04)	0.98 (0.02)	0.65 (0.29)	0.81 (0.07)	0.97 (0.02)	0.0001	0.0091
Netherlands	1046 (498)	1217 (449)	0.29 (0.08)	0.86 (0.07)	0.87 (0.02)	0.95 (0.02)	0.83 (0.10)	0.83 (0.03)	0.93 (0.03)	0.80 (0.18)	0.76 (0.05)	0.90 (0.04)	0.0008	0.0074
Norway	958 (490)	1280 (326)	0.36 (0.16)	0.88 (0.11)	0.90 (0.08)	0.95 (0.05)	0.85 (0.16)	0.87 (0.11)	0.93 (0.06)	0.81 (0.25)	0.81 (0.18)	0.90 (0.09)	0.0009	0.0192
Portugal	1159 (411)	1440 (0)	0.46 (0.12)	0.93 (0.05)	0.94 (0.04)	0.99 (0.02)	0.92 (0.06)	0.93 (0.06)	0.98 (0.02)	0.94 (0.06)	0.91 (0.07)	0.98 (0.03)	0.0002	0.0146
Sweden	1091 (328)	1156 (301)	0.41 (0.12)	0.89 (0.12)	0.92 (0.05)	0.98 (0.04)	0.86 (0.16)	0.90 (0.08)	0.97 (0.05)	0.84 (0.27)	0.87 (0.13)	0.96 (0.07)	0.0004	0.0068

Note: The values in the table are the means. The standard deviations are given in parentheses.

Table 1: Descriptive statistics

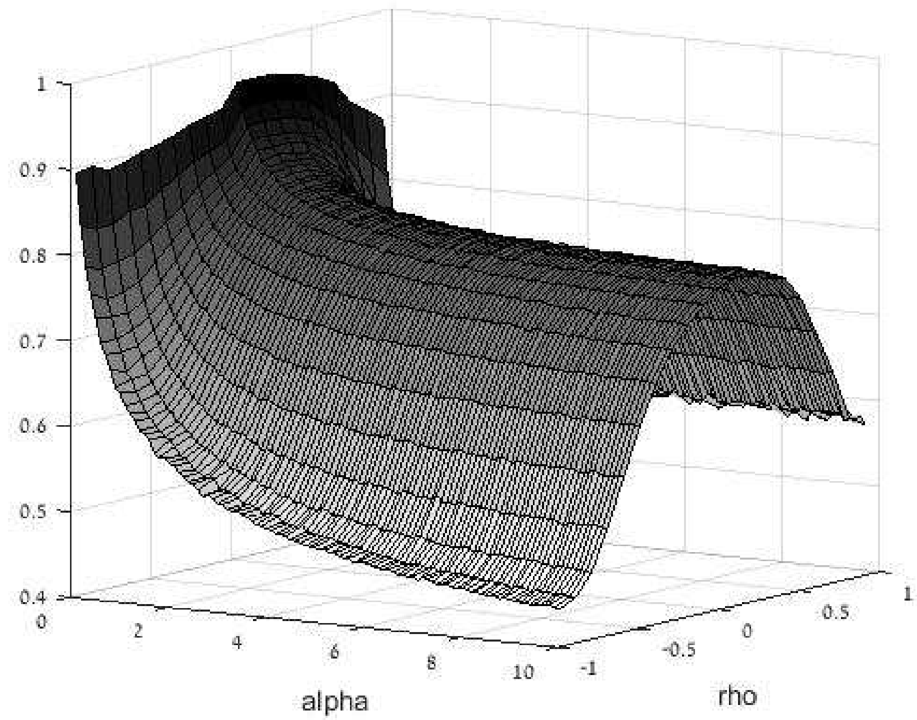
3.5.2 Estimation Results

Figure 1 reports[12] the estimated β, the effect of the ruling party's voting power on its probability to be successful as a function of voting distribution parameters α and ρ. The estimated effect is between 0.8 and 0.9 for values of ρ close to zero. The interpretation of $\beta = 0.9$ is that every percentage point increase in the ruling party's voting power is associated with a 0.9 percentage points increase in the ruling party's probability of surviving a critical vote.

The estimated β decreases in α and approaches 1 when $\alpha \to 0$. The case of a very small α corresponds to a parliament in which parties vote either 'yes' or 'no' almost unanimously (but independently of each other ?if ρ is zero). Thus, when α decreases, the voting power shifts to the right, but more so for small values (e.g., the maximal possible voting power value of 1 cannot increase). As a result, the slope between the voting power and the explained variable steepens, indicating a rising β.

[12]Because the alternative definitions of a large ruling party yield similar statistical likelihoods, with a slight advantage to the definition of more than 30% of parliamentary seats, all results reported here and in the subsequent figures are based on this definition.

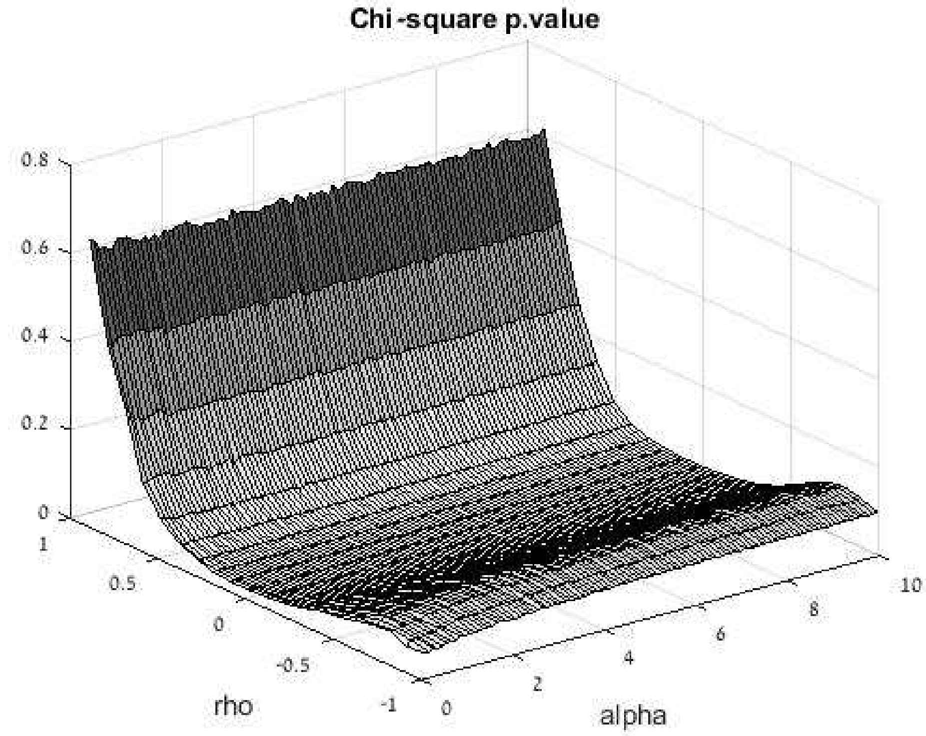
Figure 1: The estimated β, full sample



α - the shape parameter of the Beta distribution.
ρ - the correlation between ideologically neighboring parties.
β - the coefficient of the ruling party's voting power in the survival hazard rate model.

Figure 2 illustrates the p-value of the hypothesis $H_0 : \beta = 0$. As the figure shows, the voting power effect remains similarly statistically significant for different values of α. The model is sensitive, however, to ρ, the correlation coefficient between ideologically neighboring parties. More specifically, the effect of the voting power is statistically significant for negative and low positive values of ρ but not for a high positive correlation between neighboring parties. The intuitive interpretation of this asymmetrical result is that when ρ is positive and high, the parties in parliament vote similarly. As a result, the ruling party is almost always on the winning side and, according to the model, will only seldom lose power. This would, however, contradict the data. This explains a non-significant effect of the voting power when ρ is positive and high.

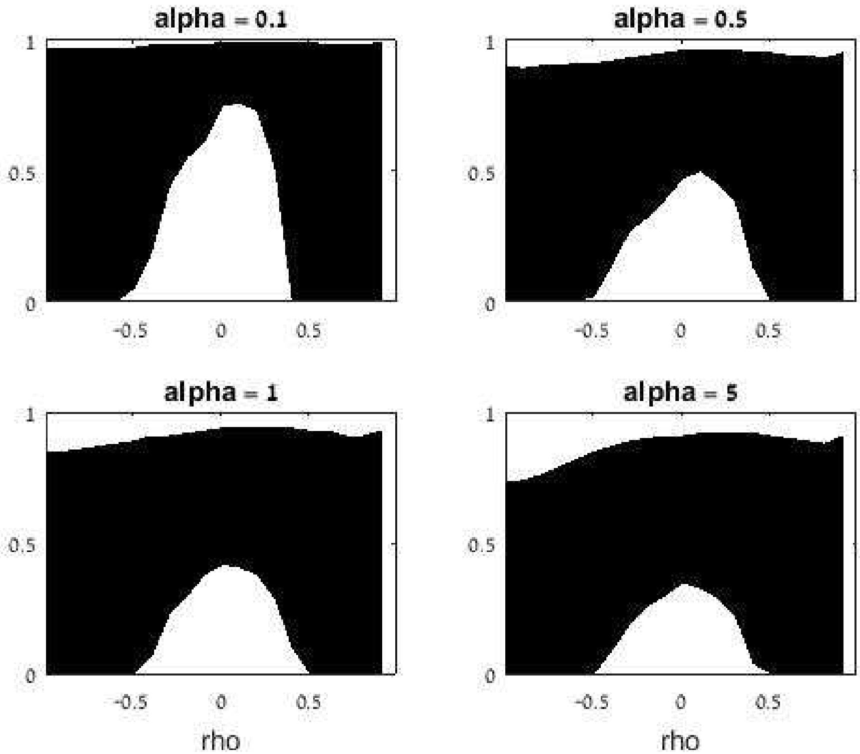
Figure 2: The p-value for the hypothesis $\beta = 0$, full sample



α - the shape parameter of the Beta distribution.
ρ - the correlation between ideologically neighboring parties.
β - the coefficient of the ruling party's voting power in the survival hazard rate model.

The difference between the case of α approaching zero and the case of ρ approaching 1 is interesting. In both cases, the probability of the ruling party (and all others) being successful (on the winning side) converges to 1 because all parties vote similarly. However, we observe a large statistically significant β in the case of a small α but a small insignificant β in the case of a large ρ. The reason for this difference is as follows: As explained above, when α is small, the voting power of all observations increases and the estimated slope β steepens. However, when the correlation between the neighboring parties ρ increases, the voting power of the parties in the center of the political scale rises more than that of the relatively extreme parties. Thus, extreme ruling parties experience a smaller increase in their voting power when ρ rises than ruling parties in the center. This difference in the mechanism

Figure 3: The 95% confidence interval for β, full sample



α - the shape parameter of the Beta distribution.
ρ - the correlation between ideologically neighboring parties.
β - the coefficient of the ruling party's voting power in the survival hazard rate model.

explains the different results for a small α and a large ρ.

The conclusion that our model works better if ρ is small is underscored by the 95% confidence interval of β as a function of ρ, for different values of α (see Figure 3). This confidence interval clearly indicates that if the correlation between the neighboring parties ρ is small in absolute terms, then β is confidently high (albeit not too high because an overly high effect of voting power would contradict the data). This result is in line with Rhae and Banzhaf indices, which simplify the calculation of voting power by assuming no correlation between parties.

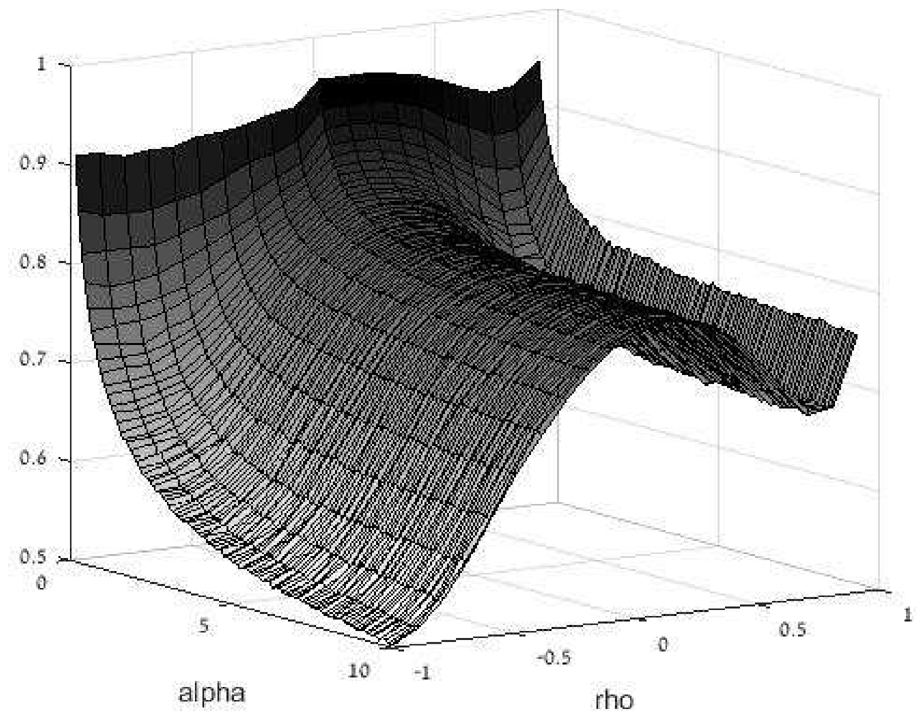
4 Robustness checks

The robustness checks reported in this section focus on three concerns: selection into the sample, the role that the assumptions play in the results, and the use of voting power as an explanatory variable. In addition, we test the sensitivity to controlling for the strength of the three largest parties.

4.1 Selection

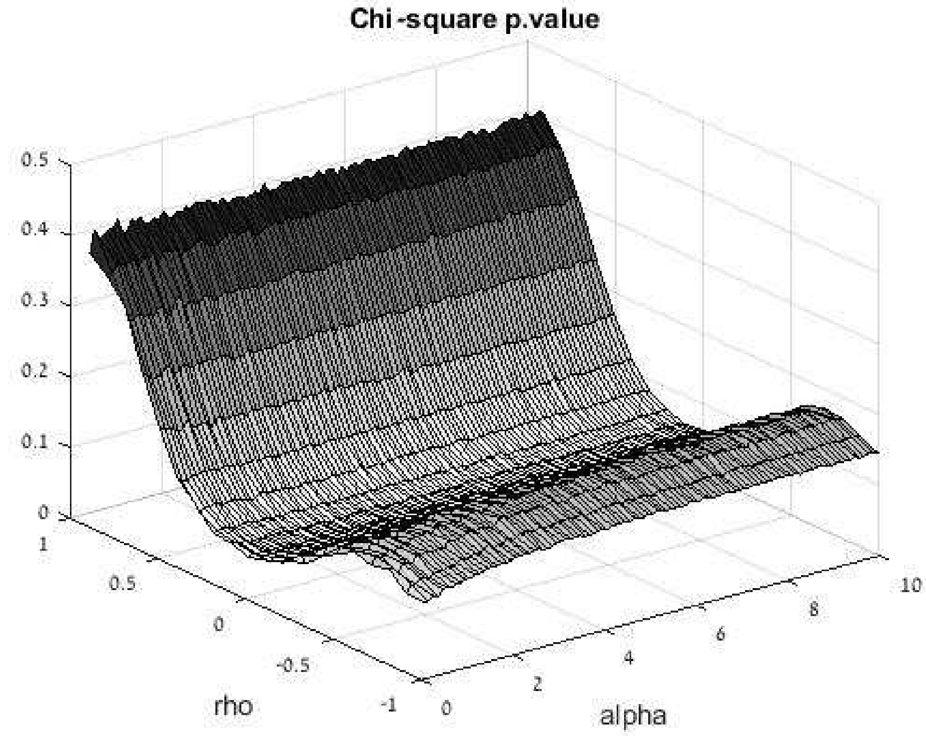
We are first concerned with the possibility that the estimated β is biased, because parties that lose power, having on average a shorter stay as ruling parties, are over-represented in the data. This selection may thus inflate or deflate the importance of crisis survival for the ruling party. To rule out this concern, we filter the sample by considering only the coalitions in place on January 1 of every fifth year, beginning with January 1950. Because no coalition exists for more than four and a half years, this filtering eliminates any selection bias. We then repeat the estimation procedure using the restricted sample, which consists of 122 observations. The estimated β, as a function of the voting distribution parameters α and ρ and the p-value corresponding to testing $H_0 : \beta = 0$, are given in Figures 4 and 5, respectively. We find that the results are very similar to the full sample results except that β has a slightly lower statistical significance because of the smaller sample size. Particularly, as Figure 6 shows, the 90% confidence interval for β is very similar to the 95% confidence interval for the full sample.

Figure 4: The estimated β, filtered sample



α - the shape parameter of the Beta distribution.
ρ - the correlation between ideologically neighboring parties.
β - the coefficient of the ruling party's voting power in the survival hazard rate model.

Figure 5: The p-value for the hypothesis $\beta = 0$, filtered sample



α - the shape parameter of the Beta distribution.
ρ - the correlation between ideologically neighboring parties.
β - the coefficient of the ruling party's voting power in the survival hazard rate model.

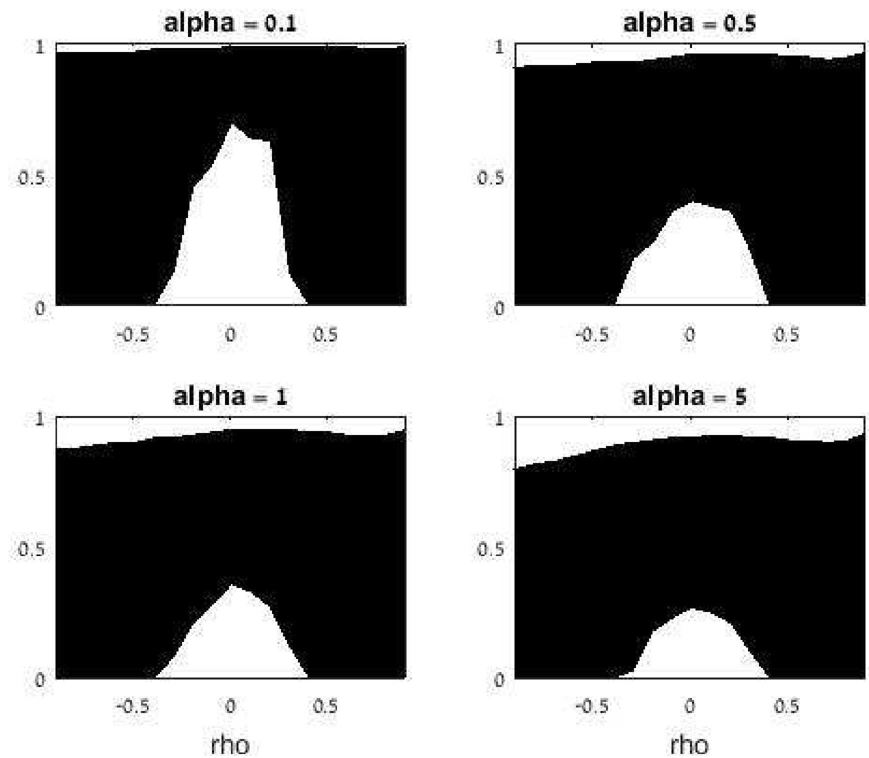
4.2 Assumptions

Two assumptions in the baseline model may be considered constraining: the fixed correlation between neighboring party votes and strict intra-party discipline. Hence, we now relax these assumptions and estimate alternative models.

4.2.1 Correlation

In the baseline model, ideologically neighboring parties vote with correlation ρ, an assumption that may be criticized for ignoring political fractionalization. For example, in a two-party system, the two parties are neighbors but may vote very differently from each other, whereas

Figure 6: The 90% confidence interval for β, filtered sample



α - the shape parameter of the Beta distribution.
ρ - the correlation between ideologically neighboring parties.
β - the coefficient of the ruling party's voting power in the survival hazard rate model.

in a system with 12 parties, the correlation between neighbors may be stronger. Because in a democracy, politicians are concerned with their voters' opinions, a viable alternative to the baseline model is to assume that the party's vote follows the correlation between neighboring *voters*. Specifically, we assume that voters are uniformly distributed along the left-right ideological scale. We define d_i as the distance between the median voters of the neighboring parties i and $i+1$:

$$d_i = \frac{w_i + w_{i+1}}{2}$$

We model the correlation between the neighboring parties as

$$\rho_{X_i X_{i+1}} = \begin{cases} \rho^{\frac{min(d_i)}{d_i}} & , \ \rho \geqslant 0 \\ \rho^{\frac{d_i}{max(d_i)}} & , \ \rho < 0 \end{cases}$$

This definition promises a correlation coefficient no larger than 1 in absolute terms that monotonically decreases in d_i. The estimated β (available from the authors upon request) for positive ρ is around 0.65, smaller than in the baseline model. However, its statistical significance is higher than in the baseline model, and unlike the baseline estimate, β is statistically significant for all values of α and ρ.

4.2.2 Intra-party discipline

To relax the second assumption of strict intra-party discipline, we assume that proportion φ of the parliamentary members vote along the party line. The remaining $1-\varphi$ members vote independently, with a priori probability p of voting 'yes'. Thus, the total proportion of 'yes' votes is

$$\sum_{i \in N, x_i = 1} \varphi w_i + (1-\varphi)p$$

Estimation of this model for $\varphi = 0.9$ yields extremely similar results (available on request) to the baseline model. In particular, plotting the estimated β and its p-value for the different values of α and ρ produces graphs that are very similar to Figures 1 and 2, respectively, while the statistical significance of β is even slightly higher than in the baseline model.

4.3 The concept

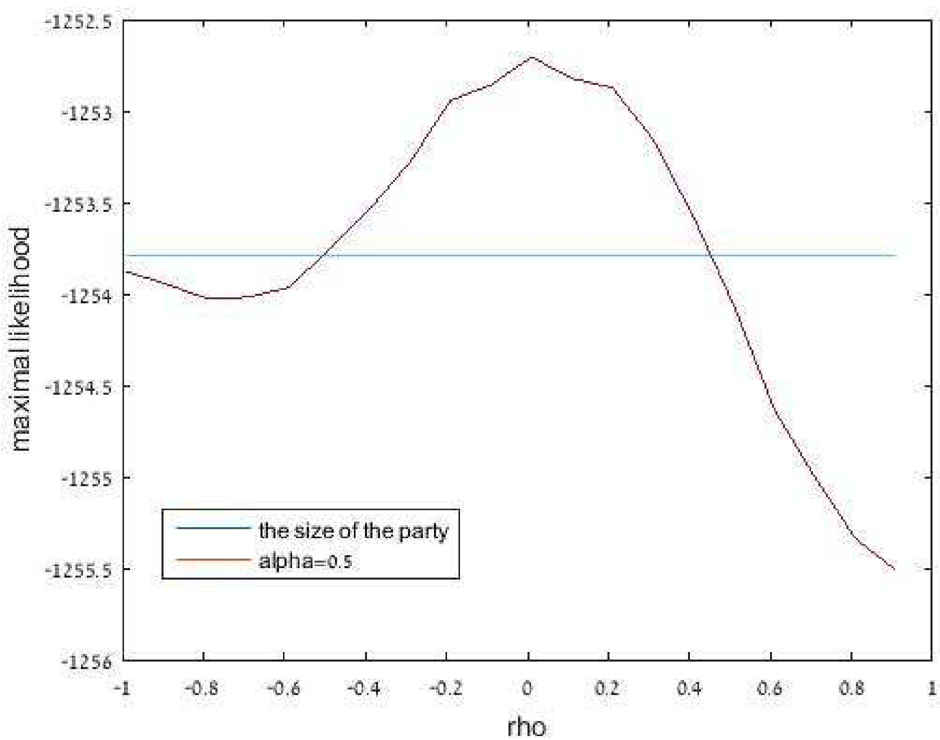
In a further robustness check, we estimate the model with the weight of the ruling party plugged in instead of its voting power, an intuitive, albeit theoretically unjustified, specification. We find that this change produces a smaller maximal likelihood than the baseline model when ρ is small in absolute terms. To illustrate, Figure 7 plots the maximal likelihood of the baseline model versus that of this alternative for the case $\alpha = 0.5$. Note that because the weight of the party is given by election results and does not depend on ρ and α, the maximal likelihood from the alternative model with respect to ρ is a horizontal line.

Finally, we control for the party system classification developed by Laver and Benoit (2015), which partitions all theoretically possible party systems based on the strength, in some sense, of the three largest parties. Because the largest parties' strength may also contribute to the stability of the political system, we control for this classification in our model and obtain results (supplied upon request) similar to those from the baseline model.

5 Conclusions

In this paper, we develop a general probabilistic voting model that predicts how long a ruling party will stay in power. According to our analysis of post-war European data, the effect of the ruling party's voting power on its survival is strongest when the correlation between parliamentary parties is weak. Thus, the model works the best when the voting of the different parliamentary parties is close to being independent during crises. Not surprisingly, the assumption of independent voting is widely used in the voting literature, particularly the voting power literature, because of its simplicity and naturalness. Indeed, the independence

Figure 7: The baseline model versus the model with weight of the ruling party instead of its voting power



ρ - the correlation between ideologically neighboring parties.

assumption follows from the interest in a political system's a priori normative properties. Our findings, however, provide yet another reason for adopting the independence assumption: empirical evidence.

6 Conflict of interest statement

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Appendix

Proof of Lemma 2.1 Denoting

$$Prob(X_{i+1} = 1 | X_i = 1) = q$$

$$Prob(X_{i+1} = 1 | X_i = 0) = z$$

let $1 \leq i < n$. Since X_i, X_{i+1} are distributed with the Bernoulli distribution, then

$$E[X_i] = E[X_{i+1}] = p \tag{5}$$

and

$$\sigma^2_{X_i} = \sigma^2_{X_{i+1}} = p(1-p) \tag{6}$$

By assumption,

$$\rho_{X_i, X_{i+1}} = \frac{Cov[X_i, X_{i+1}]}{\sigma_{X_i}\sigma_{X_{i+1}}} = \rho \tag{7}$$

and from (6) and (7)

$$Cov[X_i, X_{i+1}] = \rho p(1-p) \tag{8}$$

On the other hand,

$$Cov[X_i, X_{i+1}] = E[X_i X_{i+1}] - E[X_i]E[X_{i+1}]$$

and from (5) and (8)

$$E[X_i X_{i+1}] = \rho p(1-p) + p^2 \tag{9}$$

Since X_i, X_{i+1} yield values 0 and 1 only,

$$E[X_i X_{i+1}] = Prob(X_i = 1, X_{i+1} = 1) = Prob(X_{i+1} = 1 | X_i = 1) Prob(X_i = 1) = qp \tag{10}$$

and from (9) and (10)

$$q = \rho(1 - p) + p \tag{11}$$

as required. We can now therefore derive the formula for z.

$$Prob(X_{i+1} = 1) = Prob(X_{i+1} = 1 | X_i = 1) Prob(X_i = 1) + Prob(X_{i+1} = 1 | X_i = 0) Prob(X_i = 0)$$

Hence,

$$p = qp + z(1 - p) \tag{12}$$

and from (11) and (12)

$$z = p(1 - \rho) \; \square$$