A general approach to measuring electoral competitiveness for parties and governments*

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Abstract

We develop a general approach to measuring electoral competitiveness for parties and governments, which is distinct from existing approaches in two ways. First, it allows us to estimate the actual probability of re-electing the incumbent into office, which lies closer to the theoretical concept of interest than most widely used proxies. Second, it incorporates both *pre-electoral* competitiveness – i.e., the uncertainty about the outcome of the upcoming election – and *post-electoral* competitiveness – i.e., the uncertainty concerning who will form the government given a certain election result. The approach can easily be applied to, and compared across, a multitude of institutional settings and is particularly advantageous in analyses of multi-party democracies.

We demonstrate our approach using data on 1,700 local government elections in Sweden and document three advantages over existing approaches. Our election probability measure shows substantial variation over the election cycle, it can be accurately measured for a single party as well as a government, and its ability to predict re-election into office is higher than that of any previous measure of electoral competitiveness.

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1 Introduction

Electoral competitiveness[1] has been recognized as "simultaneously one of the most central and mismeasured constructs in the study of democratic politics" (Kayser and Lindstädt 2015, p. 242). At the most basic level, the essence of this elusive concept lies in the certainty with which it can be foreseen what coalition, party or candidate that will execute political power after the next election. The more uncertain is the outcome, the more competitive the election is said to be. In studies of the policy consequences of electoral competitiveness, the obvious focal point is the likelihood that the incumbent executive will be ousted from office at the next election (Boyne 1998; Immergut and Abou-Chadi 2014; Kayser and Lindstädt 2015; Pettersson-Lidbom 2001).

Accordingly, an ideal measure of electoral competitiveness in policy analysis would consist of truthful responses by incumbents to questions about the probability that they will remain in power after the next election, posed at the time of policy-making (cf. Boyne 1998). Although most policy analysts would probably subscribe to this ideal, the difficulties involved in collecting data on such responses have led scholars to resort to a wide variety of proxies of electoral competitiveness.

A common trait of most of these measures – which are examined in more detail in Section 4 of this paper – is that they only capture what we may call the *pre-electoral* competitiveness, as exemplified by factors such as the vote margin of the ruling coalition (Canes-Wrone and Park 2012), the historic degree of electoral volatility (Hübscher and Sattler 2017), or the plurality party's likelihood of losing plurality status (Kayser and Lindstädt 2015). As such, these measures are blind to the *post-*

[1] In this paper, we consistently use the concept electoral competitiveness. We regard this concept as largely equivalent to similar concepts used in recent studies, such as 'electoral closeness' (Fauvelle-Aymar and François 2006), 'political contestation' (Hobolt and Klemmensen 2008), 'political competition' (Svaleryd and Vlachos 2009), 'electoral vulnerability', 'replacement risk' (Immergut and Abou-Chadi 2014), or 'electoral risk' (Hübscher and Sattler 2017; Kayser and Lindstädt 2015).

electoral competitiveness associated with how the government formation process plays out once the election results are in. In studies of electoral competitiveness in multi-party systems, this omission is problematic because, as we know from the vast literature on government formation, parties differ systematically in their capability of translating parliamentary seats into cabinet seats (e.g., Glasgow and Golder 2015; Martin and Stevenson 2001, 2010). Although steps have recently been taken to incorporate some aspects of the government formation process into measures of electoral competitiveness (e.g., Immergut and Abou-Chadi 2014), this is yet to be done in a systematic and comprehensive manner.

In this paper, we propose a general approach to measuring electoral competitiveness for parties and governments, which combines the pre- and post-electoral competitiveness into one joint measure. The measure is conceptualized as the probability that a given actor will be elected into office. For most real-world applications, this actor will probably be an incumbent party or coalition, in which case it is a probability of *re-election* into office, but nothing prevents us from estimating the office probability for a non-cabinet actor. Because the measure is constructed in a way that allows for considering various behavioral and institutional factors – such as voter volatility that increases uncertainty of elections and investiture rules that make minority governments less likely to form – it should be flexible enough to be applied to and compared across any party constellation in any electoral system.

Our measure is designed so as to satisfy the six criteria helpfully proposed by Kayser and Lindstädt (2015, p. 243) for a useful measure of electoral competitiveness. It is (a) *conceptually clear*, as it measures the actual concept of interest – the expected probability of (re-)election – rather than some proxy for electoral security. It (b) applies *a unit of analysis matching the actors* – that is, a party or a constellation of parties – rather than referring to system-level characteristics such as electoral institutions or measures of democracy. It (c) provides consideration for *electoral volatility*, (d) has *a direct connection to the*

loss of power, (e) is measured at an *interval-level scale* and (f) is *in congruence with the executive's own perspective on his or her electoral security.* Some recently proposed measures have made significant advancements with respect to several of these criteria, including Kayser and Lindstädt's (2015) 'loss probability of the plurality party' and Abou-Chadi and Orlowski's (2016) 'likeliness of a vote-swing sufficiently large to alter a party's bargaining position in the legislature'. Still, to our knowledge, the measure proposed here is the first to satisfy all six criteria – at least for applications where it cannot be safely assumed that the plurality party is also the party of the chief executive (cf. Kayser and Lindstädt 2015).

Similar to Canes-Wrone and Park (2012), we recommend the use of recurrent vote intention data to estimate the re-election probabilities. We pinpoint two advantages of doing so. First, unlike most other measures of electoral competitiveness, predicted probabilities that follow the opinion polls vary considerably over the election cycle and should better approximate the politicians' perceptions of their re-election chances at the time of policy-making. Second, the use of polling data increases the predictive capability of the measure.

The paper is structured as follows. In Section 2, we present an overview of the four-step procedure that we use to construct our re-election probability measure. In Section 3 we describe in some detail how our approach can be used to estimate annual re-election probabilities of the incumbent, using a dataset that covers 1,739 municipal elections held in Sweden between 1998 and 2018. Subsequently, Section 4 reports an evaluation of the new measure's validity. The results show that our approach produces probability measures that are correctly estimated and more capable of predicting re-elections than any measure of electoral competitiveness found in the existing literature – and that this holds true even when the steps of our approach are simplified in various ways. Section 5 provides some concluding remarks about the importance of considering both pre-electoral and post-electoral uncertainty when constructing measures of electoral competitiveness.

2 A general approach to measuring electoral competitiveness for parties and governments

There are two sources of uncertainty that need to be considered when estimating the probability that a certain party or coalition of parties will enter office after the next election. The first source is the *pre-electoral* uncertainty, which captures the fact that there is an unlimited number of possible election results and that no one knows which one of them will be realized. While polls may provide a good idea of the most probable election outcome, it is – as we shall see – just as important to model the uncertainty surrounding this forecast.

The second source of uncertainty, which we may refer to as *post-electoral* uncertainty, concerns the government formation process that takes place after the election. That a party performs well in an election does not necessarily imply that it is more likely to enter the government, and vice versa. For example, a party that is located close to the center of the ideological space, and has participated in government before, is more likely to succeed in the post-electoral bargaining and join the ruling coalition than a peripheral and inexperienced party that has won a similar seat share (Bäck and Lindvall 2015). Measures that do not consider the type of competition that plays out in the post-election coalition bargaining – including standard measures of electoral closeness – are therefore not suitable in multi-party systems, where coalition governments are the norm (Strom 1989).

Combining these two uncertainties is quite straight-forward. In general terms, we can think of the pre-electoral probability $P(O)_p$ that party p enters into office as the sum of the probabilities that the party enters into office given a certain election outcome E_v, that is $P(O_p|E_v)$, over all possible election outcomes weighted by their respective probabilities $P(E_v)$ as follows:[2]

[2]In applied situations, we imagine that the possible election outcomes will usually be approximated by a number of simulations by a forecasting model or draws from an estimated multivariate

$$P(O)_p = \sum_{v=1}^{n} P(O_p|E_v) \times P(E_v) \quad (1)$$

This simple structure is intuitive and can easily be applied to virtually any institutional setting. For the reasons stated above, in a multi-party system, both these components are also necessary to create accurate election probability estimates. Hence, we believe that most attempts to estimate electoral competitiveness would benefit from using this two-component structure as their starting point. Yet, we know of no other study that attempts to capture both pre- and post-electoral uncertainty in the same measure.

2.1 A four-step procedure

How then should one proceed to estimate these probabilities? There is a myriad of different ways to model the two sources of uncertainty, and the best choice will depend on the institutional setting, what data are available, and what the measure is going to be used for. Generally, however, we believe that any approach would in one way or another involve each of the four steps outlined in Figure 1. An overview of our four-step procedure is provided below, whereas the details of our present application to Swedish municipalities are described in the subsequent section.

Step I consists of modelling the pre-electoral uncertainty. Here, we develop a forecasting model that uses data on prior election results together with polling data to predict the most likely election outcomes and to quantify the uncertainty surrounding these estimates. In our present application, we create our vote share predictions using standard OLS regressions, but in other applications it may be preferred to use other data or substitute our regressions with Bayesian forecasting models.[3] To model the uncertainty around these predictions, we have chosen

probability distribution. In these cases, each drawn or simulated election outcome will have the probability set to the inverse of the number of draws or simulations.

[3]If applying our approach to national elections, one would typically have hundreds of polls per election period. In those cases, a preferable alternative may be to use a Baysesian forecasting

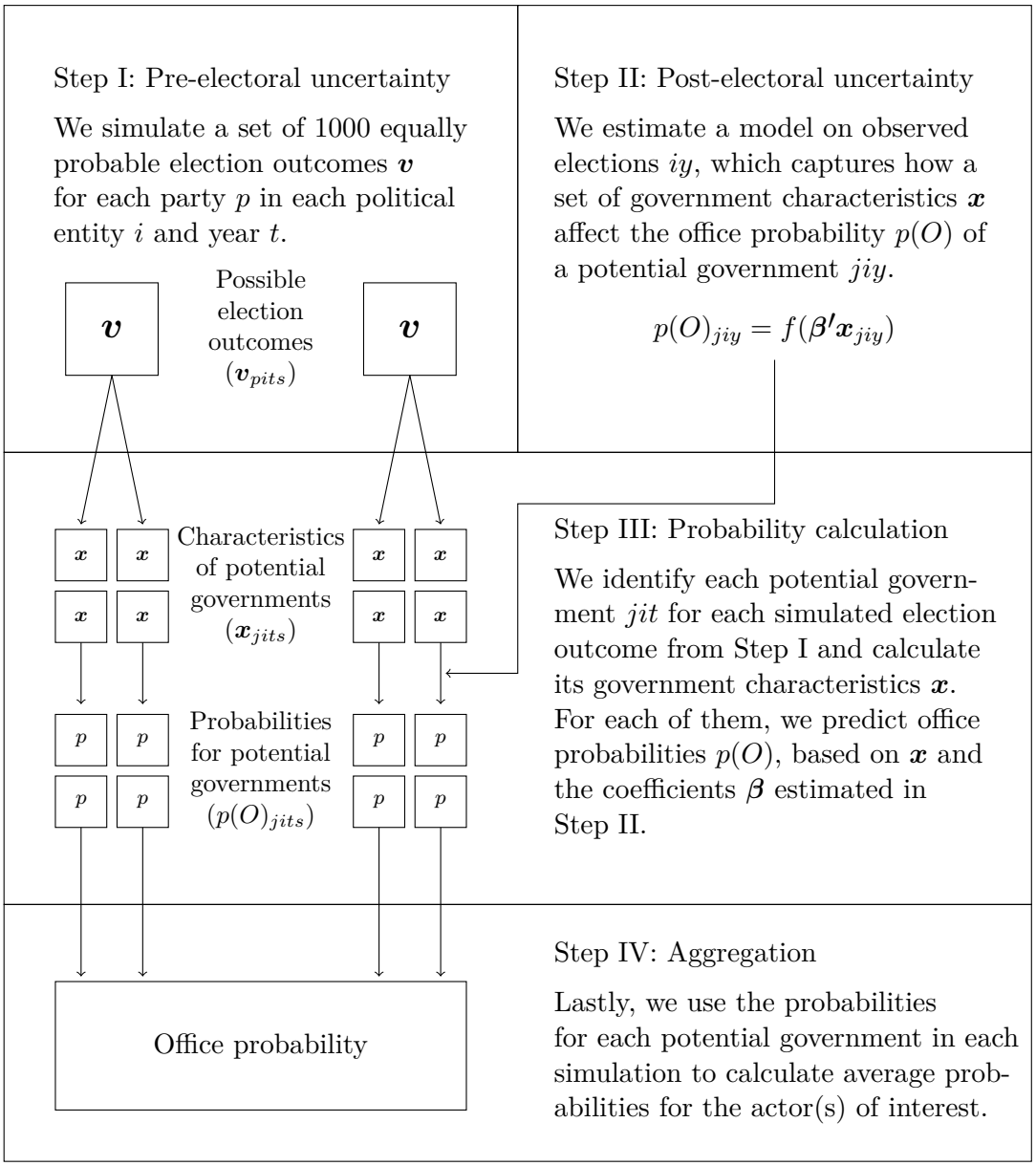

Figure 1: A four-step approach to estimating electoral competitiveness

to simulate a dataset of potential election results, by re-sampling residuals from other observations and adding them to the predicted election outcome.[4] The 1,000 simulated election outcomes (v_{pits}) generated in this step vary between parties (p),

model that is better suited to extract as much information as possible from a large number of measurements. See Stoetzer et al. (2019) for a recent example.

[4]In an application with less data, it may be a better alternative to first approximate a probability distribution for these residuals, and thereafter draw residuals from this theoretical distribution (see for example Kayser and Lindstädt 2015). However, using a theoretical distribution would make it much more difficult to model the residuals' inter-party correlation (vote share residuals are negatively correlated, and more so between ideologically adjacent parties).

simulations (s), political entities (i) and years for which the forecast was made (t).

In Step II, we estimate a model of post-electoral uncertainty, which for any given election outcome (i.e., a set of party vote shares) can predict the probability of a certain party or coalition of parties entering into power. We do so using the 'potential coalition' framework, which has dominated the empirical literature on government formation over the past 15 years (Bäck 2003; Debus and Gross 2016; Martin and Stevenson 2001, 2010). In this framework, the unit of analysis is a government formation opportunity, occurring after an election or when, for any other reason, the incumbent government resigns. The government formation process is modeled as a discrete choice problem in which the parliament selects one government from a choice set consisting of all potential governing coalitions that are, in theory, available for consideration given the number of parties in the parliament.[5]

The outcome of this exercise is a model that may predict, for each potential government coalition j in each political entity i after each election y, a probability of realization based on a number of characteristics of that coalition x_{jiy}. These are computed based on the characteristics of the parties in the parliament, including, importantly, the seat share distribution. The potential coalition framework also allows for modelling the impact of institutional factors that vary across government formation opportunities and that may favor particular types of coalitions. In our case, the sample used in this step consists of one government formation opportunity for each Swedish municipality following each local election between 1998 and 2018, and we estimate our model using conditional logit on the realized outcomes of these government formation processes.

In Step III, we take the model estimated on realized data in Step II and plug in the simulated election outcomes generated in Step I. More specifically, we first

[5]By potential government we mean a unique combination of parties, or an individual party, that could form a government in a government formation opportunity. The number of potential governments in a parliament with n parties thus equals $2^n - 1$ (Martin and Stevenson 2001).

identify all possible combinations of parties that are represented in the parliament, for all simulated election outcomes. These combinations of parties comprise the potential governments. For each potential government j, we calculate the set of characteristics that is used to estimate the coalition's probability of entering office, x_{jits}. We then use the coefficients $\boldsymbol{\beta}$ generated by the model in Step II to calculate, for each simulated potential government in each municipality-year, the predicted probability that it will enter into office, based on its vote share as forecast in Step I, $p(O)_{jits}$. Evaluations reported in Appendix I show that the model generally performs better the more data is used, but that it performs well also if run on only a limited set of factors related to parties' size, ideological proximity, and incumbency status.

In Step IV, to arrive at a measure of the electoral prospects of the actor of interest, we just need to aggregate the data in the way we desire. For example, to calculate for a given point in time the estimated probability that party p will be part of the government that enters into office after the next election, we would sum up, for that point in time, the probabilities for all simulated potential governments that include party p, and divide that sum by the number of simulated election outcomes. For the main measure of the re-election probability of the incumbent produced in our present demonstration, we calculate the average election probability for the incumbent parties, weighted by their respective seat share.

The flexibility of the proposed approach makes it possible to generate comparable election probabilities for parties and governments in any parliamentary democratic system for which a minimum of data is available. Technically, the approach may also generate comparable probabilities for parties in de-facto two-party systems, such as the United States. Yet, for someone whose only interest lies in a de-facto two-party system, there would obviously be little to gain from modelling the post-electoral uncertainty.

3 Demonstration on Swedish local governments

3.1 Description of the case and the data

In principle, our approach is applicable to any set of political entities where two or more parties compete for office. For several reasons, we choose to demonstrate and test our approach using data on Swedish local governments over the past 20 years. First and foremost, our case is motivated by the existence of rich and consistent data for many cases over a long period of time, which ensures that our application is based on comparable cases and enables us to construct and evaluate not only our own measure but also a wide variety of other measures of electoral competitiveness.

Second, elections as well as government formations in Swedish municipalities follow a similar logic to many other proportional representation (PR) systems (Bäck 2003). Municipalities are governed by a local council consisting of 21–101 seats, to which members are elected from multi-member electoral districts in September every fourth year. Swedish municipalities have a 'quasi-parliamentary' system, in which a majority coalition (or party) appoints the committee chairs and vice chairs. This coalition (or party) forms the equivalent of a national government and tends to exert a particularly strong influence on policy[6] (Bäck 2003; Karlsson and Gilljam 2008–2012). The local councils typically contain between 5 and 9 parties. Although local parties exist, most parties are local-level branches of national parties, among which policy positions mostly vary according to traditional patterns in a two-dimensional policy space (Bäck 2003).

Moreover, Swedish local government has experienced similar trends as many other PR systems in terms of an increasing number of parties both in the legislature

[6]Each local council is also required to appoint a formal executive committee (*kommunstyrelse*). Appointments to the executive committee are mostly made proportionally, which means that (almost) all parties tend to be represented. However, among scholars as well as the municipalities themselves, the parties that hold committee chairs and vice chairs are commonly the ones regarded as the governing parties (e.g., Bäck 2003; SKL 2018).

and in the governing coalition, which makes bargaining processes increasingly complicated and difficult to predict.[7] As such, it represents a case where bargaining complexity is on a similarly high level as in most other European PR systems.

Each step of our estimation procedure makes use of the same core dataset, in which each row represents one of the 290 Swedish municipalities measured at one year between 1994 and 2018. Political variables at the local level include local vote shares and seat shares in the local council, for each of the eight dominant parties in Swedish politics[8] plus a residual category for any other party (mostly local parties). These data are derived from Statistics Sweden (2018a). The dataset also includes data on which parties are members of the local government, as well as which party holds the position of Mayor, retrieved from the Swedish Association of Local Authorities and Regions (SKL 2018) and Johansson (2010).

In addition, the dataset includes a number of covariates at the national level: annual vote intention poll data for each of the eight aforementioned national parties from Statistics Sweden's (2018b) Party Preference Survey (PSU), which is carried out in May of each year, and a measure of the ideological (left–right) position of these parties retrieved from the Chapel Hill expert survey (Polk 2017). For the sake of simplicity, this measure is used as a proxy for the ideological position of the local branch of the respective party.[9] At the cost of some accuracy, we ascribe to each local party the period-specific median score among the national-level parties.

[7] To illustrate, the average number of parties in the local council has increased from 5.4 in 1973, to 6.9 in 1994, and 7.8 in 2018. Similarly, the local governing coalitions that formed after the general elections in 1994 included on average 2.3 parties, whereas for 2018 the corresponding number was 3.4; that is, a 48 percent increase (SKL 2018, 2019).

[8] These are the Center Party, the Christian Democrats, the Conservative Party, the Green Party, the Left Party, the Liberal Party, the Social Democratic Party and the Sweden Democrats.

[9] For 2008 and 2012, survey data on local politicians from Karlsson and Gilljam (2008–2012) make it possible to retrieve party positions at the local level. In line with results from Bäck (2003) on earlier data, these party positions are strongly correlated with the national-level party positions used in this paper ($r = 0.83$). Therefore, we choose to rely on the national-level data that have the advantage of being available for a longer time period. We ascribe the scores for 1999 and 2014 to the election periods 1994–1998 and 2015–2018, respectively. The empirical distribution of these scores ranges from 1.43 (the Left Party in 2010) to 8.7 (the Sweden Democrats in 2010).

3.2 Step I: Forecasting election results

The very first step of our approach is to forecast the expected vote share v in the upcoming election, for each party (p) in each municipality (i) and for each election year (y). In the current demonstration, we create predictions for each year during the election period (not only election years) so our predicted election outcomes vary between calendar years (t).

Forecasting is both about making predictions and estimating their accuracy. For many applications, prediction is the primary objective, but for our purposes, correctly estimating the uncertainty surrounding these predictions is just as important. Knowing the most likely outcome of an election says little about the incumbent's re-election prospects unless we also know how certain we are about this outcome and what the possible alternatives look like.

In order to identify the relevant alternatives and their respective likeliness, we need to create a distribution of possible election outcomes. Our forecasting model therefore consists of two components. The first component is a regression model that predicts the expected outcome in the next election. The second component is a simulation exercise where we re-sample residuals to approximate random draws of election results from an imagined probability distribution of outcomes.

3.2.1 Making the prediction

Our election predictions primarily rely on the party's previous election result in the same municipality as well as how the support for the same party on the national level has changed in the nation-wide polls. In our main specification, we also include incumbent dummies to capture the cost of ruling as well as a set of interaction variables that allow the coefficient for the national polls to differ between parties as well as depending on the time remaining to the next election. However, it should be noted that our approach works well even with a prediction

model that only includes each party's previous election result.[10] The equation, which is estimated on the period $t \in \{1995 \dots 2018\}$ using OLS, can be written as:

$$v_{piy} = \alpha_0 + \alpha_{1p} v_{piy-1} + \alpha_2 i_{pit} + \alpha_3 \Delta q_{pt} + \alpha_{4p} \Delta q^*_{pt} + \boldsymbol{\beta}' (\boldsymbol{\phi}_{pit} \Delta q_{pt}) + \boldsymbol{\gamma}_{it} + \boldsymbol{\psi}_{\boldsymbol{pit}} + e_{pit} \quad (2)$$

Here, v_{piy} is the realized vote share for party p in municipality i at the upcoming election year y, where $y \in \{1998, 2002, 2006, 2010, 2014, 2018\}$, v_{piy-1} is the party's realized vote share in the previous election year, i_{pit} is a binary indicator for whether the party is included in the incumbent coalition, and Δq_{pt} is the difference between the party's support in the national PSU poll in year t and its support in the poll in the previous election year. Δq^*_{pt} measures the change in the polls for other parties within the same side of the left–right divide, which is included because the support for ideologically adjacent parties tends to be negatively correlated. $\boldsymbol{\phi}_{pit} \Delta q_{pt}$ is a vector of interaction variables, which allow the effect of the national polls to differ (1) between parties, (2) depending on the previous election result, and (3) depending on the time left to next election. To ensure that the predicted vote shares sum to unity, we include fixed effects at the municipality–year level ($\boldsymbol{\gamma}_{\boldsymbol{it}}$). Lastly, $\boldsymbol{\psi}_{pit}$ is a vector of binary indicators for whenever there is missing data on any other variable (in which the case the missing values are replaced by zeroes).

All parties are not represented in every municipality and it is not obvious when to include a party in the forecasts. We have chosen to exclude parties that did not receive a single seat in any municipality during the previous election (that is, we give them zero votes in all simulations), but include them as soon as they have received at least one seat somewhere in Sweden – effectively giving them a small but positive probability of receiving a seat.[11]

[10] In Appendix III we present an analysis of how our measure performs if we replace this equation with a much simplified model.

[11] Because the category *other party* is present during the whole period, there is always a positive probability that a new party will emerge in a municipality without local parties, or that an

3.2.2 Modeling the uncertainty

Even if the model described above provides us with reasonably precise predictions of the local parties' vote shares, these predictions will still deviate from the actual outcomes. Because the expected size of these deviations has an effect on the probability of re-election into office, it is important that we do our best to model this uncertainty correctly.

We do so using a simulation approach with re-sampled prediction errors, in which we use the empirical distribution of residuals as our estimate of the true distribution of our model's uncertainty.[12] By re-sampling residuals from this distribution, and adding them to our fitted values, we get a set of predictions which approximate the entire probability distribution of election outcomes. Unlike most bootstrapping techniques, we do not reduce this distribution to some parameter that we are interested in. Instead, as described in Section 3.4 below, we feed this sample of possible election outcomes to a coalition formation model in order to estimate a separate probability of entering office for each party in each simulated election.

Because the outcome variable is fractional (vote shares that sum to 100 percent) the parties' residuals will be negatively correlated within each election. That is to say, if one party is under-estimated, the sum of the vote shares for the other parties will be over-estimated. If voters are more likely to switch between ideologically adjacent parties, this negative correlation will be stronger for certain pairs of parties. To replicate these correlations, we use a specific block bootstrap where we re-sample individual local elections (including 7–9 party-specific residuals) instead of individual residuals, and assign the residuals from the sampled block so that they always belong to the same party p. In other words, if the simulation s for the

existing local party will suddenly increase (or decrease) its vote share.

[12] In other settings, and especially when the number of elections is small, it may not be a viable strategy to base the simulation on re-sampling.

election result v for party p in municipality i and year t is randomly chosen to be calculated based on the prediction error ϵ from another municipality i^* and year t^*, then the simulated vote share for party pit in simulation s can be written as

$$v_{pits} = \hat{v}_{pit} + \epsilon_{pi^*t^*} \tag{3}$$

This equation underlines that the simulated outcome for a party is always based on a prediction error for the same party in another municipality, and that, for a given simulation, the simulated outcomes for every party in municipality-year it are all based on residuals re-sampled from only one (other) municipality-year i^*t^*. Because the absolute size of the residuals is correlated with the party's predicted vote share, we divide the municipal elections into 10 clusters with similarly sized parties. When re-sampling the blocks of residuals, we only draw blocks from within each of these 10 clusters of elections. On average, each cluster contains 903 blocks.

We have also evaluated two simplifications of this procedure. The most far-reaching simplification was to skip the simulation altogether and plug the predicted election outcomes directly into our coalition formation model as if there was no uncertainty around these forecasts. The other approach was to skip the blocks and clusters which were discussed above, and simply re-sample each party's residuals as if they were independent of the other parties' residuals as well as of the size of the party. In Appendix III, we present an analysis of how these simplifications affect our measure. The conclusion is that simulation is important, while the added value of blocks and clusters is small.

After the simulation is completed, we calculate the number of seats distributed to each party using the modified Sainte-Laguë method with quotient 1.4 prescribed by the Swedish election law.[13]

[13]For the sake of simplicity, we here assume that all municipalities have one electoral district, although in reality large municipalities have two or more districts. We also ignore the modifications of the Swedish electoral system that were implemented before the 2018 election.

3.3 Step II: Modeling government formation

In parallel with Step I, we need to develop a model to account for how parties' election results affect their likelihood of entering the government after the upcoming election. The perhaps simplest approach would be to use parties as the units of analysis, and set up a logistic model on whether or not the party joined the government, regressed on its election result and other characteristics. However, this approach is ill-suited for our purposes for two reasons. First, it assumes that parties can be treated as independent observations in the government formation process; second, it disregards the fact that the probability that a particular party will join the government depends not only on its own characteristics but also on those of the potential coalitions of which it is part (Glasgow and Golder 2015).

Therefore, we instead apply the aforementioned potential coalition framework, in which the units of analysis are all the potential governments that the parties in a parliament may form. In this approach, the government formation process is perceived as a discrete choice problem in which one and no more than one of these potential governments is chosen by the parliament. This approach has come to dominate the literature on government formation, both in studies of government formation at the national level (Glasgow and Golder 2015; Glasgow et al. 2012; Martin and Stevenson 2001, 2010), and in studies focusing specifically on the sub-national level (e.g. Bäck 2003; Bäck et al. 2013; Debus and Gross 2016).

The outcome of this exercise is a model that may predict a probability of realization for each potential government, based on a number of characteristics of the parties in the legislature and of the institutional context in which the formation process takes place. Having surveyed the government formation literature, we identify 32 factors that have been claimed to be important for government formation and that are applicable to Swedish local government (see Appendix II for details). Because our purpose is not to test any hypotheses but simply to predict the

outcomes of government formation processes, and because we have enough data not to be overly worried about over-fitting, we include all variables in our model.

In some applications, it may not be doable to calculate all these variables or include all of them in the estimation. In Appendix III, we therefore present results where the coalition formation model only includes ten key variables. The main take away from this exercise is that while this reduced model does not have the same predictive capability as the full model, it is still significantly better at predicting re-election than any previous measure of electoral competitiveness.

Following the bulk of the existing literature, we model the government formation process using a conditional logit model.[14] In this model, the probability $p(O)$ that the potential government j is chosen out of the set of J potential governments in the formation opportunity occurring in municipality i after election y is:

$$p(O)_{jiy} = \frac{e^{\boldsymbol{\beta}'\boldsymbol{x}_{jiy}}}{\sum_{j=1}^{J} e^{\boldsymbol{\beta}'\boldsymbol{x}_{jiy}}} \tag{4}$$

where $\boldsymbol{\beta}$ is a vector of coefficients and $\boldsymbol{x}_{jiy}$ is a vector of characteristics associated with potential government j in formation opportunity iy. Table 1 reports the output of such a model, run on the realized governing coalition outcomes of the approximately 1,700 government formation opportunities in the Swedish municipalities between 1998 and 2018. A first result is that our model has a satisfactory fit compared to existing studies; the Pseudo R^2 parameter of 0.58 reported here is higher than those reported in previous work, ranging from 0.33 to 0.57.[15] For our current exercise, the output of primary interest is the 32 coefficients reported in Table 1. The vector of coefficients ($\boldsymbol{\beta}$) is saved to be used in Step III.

[14] We have found that to use a mixed logit model, as advocated by Glasgow et al. (2012), improves the predictive capacity of our government formation model only very marginally. Thus, for the sake of simplicity, and to avoid discretionary choices about which coefficients should have a random distribution, we stick to the simpler conditional logit model.

[15] The reported range is based on the following studies: Bäck (2003, 2008), Bäck et al. (2013), Debus and Gross (2016), Gross and Debus (2018), and Olislagers and Steyvers (2015). Note that a number of recent studies do not report Pseudo R^2 parameters (Glasgow and Golder 2015; Glasgow et al. 2012; Martin and Stevenson 2010; Savage 2016).

Table 1: The government formation model

	(1)	
1. Minority cabinet	−1.933***	(0.276)
2. Minimal-winning coalition	1.101***	(0.120)
3. MWC: Connected	−0.173	(0.143)
4. MWC: Narrowest ideological range	−0.293*	(0.142)
5. MWC: Fewest parties	0.196	(0.130)
6. MWC: Minimum-winning coalition	−0.170	(0.112)
7. Seatshare	0.557***	(0.053)
8. Seatshare squared (/100)	−0.463***	(0.046)
9. Number of parties	−0.377***	(0.100)
10. Ideological range	−0.340***	(0.039)
11. Opposition ideological range	−0.218***	(0.031)
12. Opposition ideological range × Minority cabinet	0.222***	(0.046)
13. Ideological distance to median	0.094	(0.078)
14. Median party	0.400***	(0.099)
15. Largest party	0.655***	(0.179)
16. Single-party majority	1.122**	(0.360)
17. Anti-system party (SD)	−5.027***	(0.390)
18. Local party	−0.609***	(0.115)
19. Incumbent government	1.510***	(0.117)
20. Party of incumbent Mayor	−0.489***	(0.125)
21. One or some incumbent parties	−0.510**	(0.161)
22. Electoral performance	0.043**	(0.016)
23. Incumbent government × Electoral performance	0.063*	(0.029)
24. Familiarity	1.927***	(0.372)
25. Commitment potential	0.464**	(0.173)
26. Right-wing bloc	2.474***	(0.183)
27. Right-wing bloc (plus)	2.501***	(0.213)
28. Right-wing bloc (minus)	0.277	(0.161)
29. Left-wing bloc	0.522**	(0.181)
30. Left-wing bloc (plus)	−0.122	(0.252)
31. Left-wing bloc (minus)	−0.031	(0.126)
32. Bloc-transcending coalition	−1.255***	(0.128)
Observations	409,113	
Government formation opportunities	1,719	
Pseudo R^2	0.584	

Standard errors in parentheses (clustered by government formation opportunity).

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

3.4 Step III: Predicting the potential governments' office probability

We begin the third step by identifying – for every election simulation s generated in Step I – all possible combinations of parties j that are predicted to receive at least one seat in the upcoming election in municipality-year it. For all these potential governments, we then calculate exactly those 32 cabinet characteristics x_{jits} that are used in the government formation model in Step II. Many of these characteristics are a function of the simulated seat shares and therefore vary between the simulations. To predict each potential government's probability for entering office, we then use the vector of coefficients ($\boldsymbol{\beta}$) estimated in Step II and apply them to the cabinet characteristics calculated on the simulated data.

3.5 Step IV: Aggregation

For each municipality-year, we now have 1000 simulations of the outcome of the next election, and for each simulated election outcome, we have predicted the probability of entering office for each potential government. Depending on how we aggregate these probabilities, we can now calculate the predicted election probability for any possible party or set of parties.

The first step in this aggregation procedure is to calculate the office probability of party p. Formally, for any single simulation, this can be written as the sum of the product of the office probability of potential government j and a binary indicator m_{jits} for whether party p is a member of this coalition, divided by the number of potential coalitions that include party p. By averaging over all simulations $s \in \{1 \dots S\}$, we get the estimated office probability $p(O)_{pit}$ as follows:

$$p(O)_{pit} = \frac{1}{S} \sum_{s=1}^{S} \frac{\sum_{j=1}^{J} p(O)_{jits} m_{jits}}{\sum_{j=1}^{J} m_{jits}} \tag{5}$$

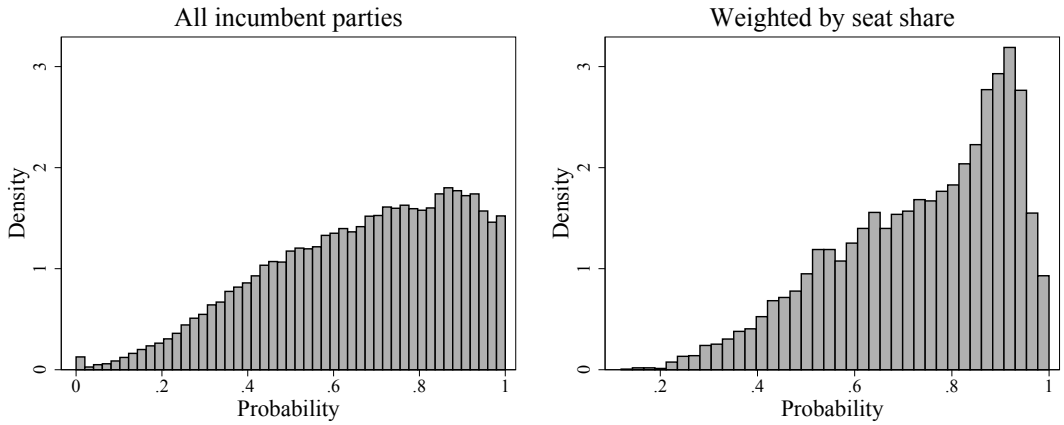

Figure 2: The distribution of estimated re-election probabilities

We may then use these party-specific probabilities to calculate re-election probabilities for, say, the largest party in the incumbent coalition or an average for all incumbent parties, weighted by their respective seat share.

Because the national vote intention polls are carried out in May of each year, the expected election outcomes vary between years. With the Swedish general election being fixed to the third Sunday in September every fourth year, we may thus produce one predicted probability for May of the election year ($t = y$), and another one for May of each of the three years before the election ($t - 1 \ldots t - 3$).

To give the reader an idea about what the estimated probabilities look like, Figure 2 shows the distribution of the re-election probabilities for all incumbent parties (left-hand panel), as well as for the incumbent government as a whole when each participating party is weighted by its seat share (right-hand panel). The reason why the two distributions look so different is that large parties as well as single-party governments are up-weighted in the right-hand panel, and they tend to have a relatively high probability of staying in office.

4 Evaluation of measurement validity

Our primary claim to measurement validity is based on (1) the theoretical closeness of our measure to the actual concept of interest in most studies of electoral competitiveness – the probability of being (re-)elected into office – and (2) our estimation procedure which takes into account both pre- and post-electoral uncertainty and allows for modeling the effects of behavioral and institutional factors. Nevertheless, the validity of our measure can and should also be evaluated empirically.

In this section, we evaluate our measure according to two empirical criteria: (1) accuracy of uncertainty estimation, and (2) predictive capability. The first criterion concerns whether our measure of uncertainty corresponds to the actual level of uncertainty in the sample for which we make predictions. The second criterion refers to how well our measure performs in terms of predicting when an incumbent government will be replaced or re-elected into office. This test will be done in comparison with other measures that have been used as indicators of electoral competitiveness in previous research.

4.1 Accuracy of uncertainty estimation

If we have estimated the uncertainty correctly, there should be a 1:1 relationship between our prediction of election probability and the outcome – that is, successful election into office – such that, for any given set of predictions, the share of actual successes should equal the average estimated probability. To test this, Figure 3 shows the share of successful elections into office over the estimated probability of success, with data being 'binned' into 20 sub-samples based on percentiles. The theoretical 1:1 relationship is illustrated by the diagonal line.

Figure 3 contains three panels. As regards the left-hand panel, the y-axis reports an indicator on the rate of actual entry into office after the next election

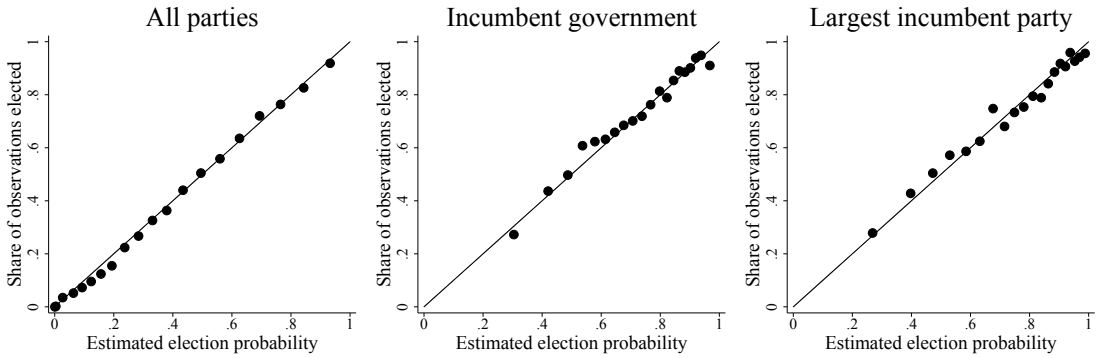

Figure 3: Comparison between predicted probabilities and average outcomes

of *all individual parties* in our dataset, for each observed year between 1995 and 2018 (in total 61,848 party-year observations). The bins on the x-axis divide these observations into 20 sub-samples based on our measure of election probability in that year. The center panel instead reports an indicator on the rate of actual re-election into office of the *incumbent government*, where each incumbent party is weighted by its seat share.[16] The bins on the x-axis divide the 6,772 observed municipality-years into 20 sub-samples based on our measure of the seat share weighted re-election probability of the incumbent, as described in Step IV above. In the right-hand panel, the outcome indicator instead reports the rate of actual re-election of the *largest party among the incumbent parties*, and the bins are now based on the specific election probability for the largest incumbent party.

In all three panels of Figure 3, all the bins lie reasonably close to the diagonal line. These tests suggest that our probabilities are correctly estimated and that there is no systematic over- or underestimation in our measure. To demonstrate the importance of modelling both pre- and post-electoral uncertainty, Figure A2 in Appendix III presents similar plots for the re-election of the incumbent government, for cases where our probability estimates have been constructed with various

[16] This indicator ranges from 0 to 1. To illustrate, suppose that the incumbent government consists of Party A and Party B, and the seat share of Party A is four times that of Party B. If only Party A successfully re-enters the cabinet, the weighted re-election indicator scores 0.8. If instead only Party B remains in office, the score is 0.2.

simplifications imposed on Step I and II. Most importantly, this exercise reveals that the electoral competitiveness would be heavily under-estimated if, instead of the simulated values, parties' most likely election outcomes were and plugged into the coalition formation model in Step III.

4.2 Capability to predict re-election into office

The second part of the validity evaluation consists of testing how well our probability measure performs in terms of predicting when an incumbent government will be replaced or re-elected into office. In fields where probabilistic forecasts are commonplace, such as epidemiology and meteorology, predictions of probabilities are often evaluated using Brier scores or other types of scoring rules (Brier 1950). That would had been a good practice also within this field, if most measures of electoral competitiveness could be interpreted as probabilities. Because this is not the case, we can only calculate Brier scores to compare the performance of different versions of our own measure. These comparisons are reported in Appendix III.

Instead, to enable a meaningful comparison with previous measures, we here use a regression approach. Specifically, we evaluate our re-election probability of the incumbent as measured at four time points (t, $t-1$, $t-2$, and $t-3$) and compare their predictive capability with that of previous measures of electoral competitiveness. The comparisons include 18 existing measures, which are previewed in Figure 4 and described more closely in Appendix II. For some of the measures, we have made minor adaptations to make them applicable to the Swedish case.

To be clear, most of these measures are not devised specifically to predict re-election into office, but are based on other – mostly pre-electoral – conceptions of electoral competitiveness. Nevertheless, to the extent that one conceives of electoral competitiveness in terms of the probability that the incumbent executive will remain in power, it should follow that some predictive power with respect to

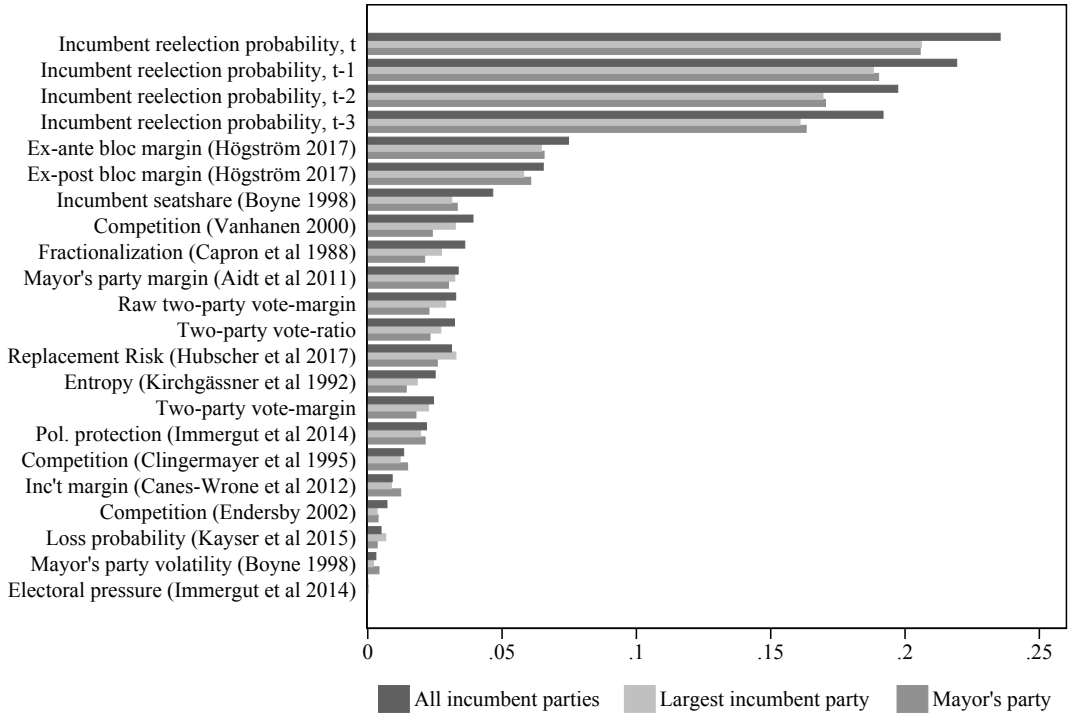

Figure 4: Capability to predict re-election into office (Adjusted R^2)

that probability is a desirable feature of any measure of electoral competitiveness.[17]

The bar chart in Figure 4 confirms that our measure substantially outperforms all others in terms of predicting re-election into office. For each measure, the bar in the darkest shade of grey represents the Adjusted R^2 coefficient from an OLS regression of the seat share weighted re-election of the incumbent parties (see Footnote 16) with the measure in question as a single predictor. Analogously, the two bars in lighter shades of grey represent the Adjusted R^2 coefficients from OLS regressions of the re-election of the largest incumbent party into the governing coalition and – as a harder test – of the Mayor's party into the Mayor's office, respectively, with the measure in question as a single predictor. In these three models, our incumbent re-election probability measure refers to that of 1) all incumbent parties weighted by their seat share, 2) the largest incumbent party and 3) the Mayor's party, respectively. The results are unambiguous: At each of

[17]Kayser and Lindstädt (2015) make the same argument with respect to their probability measure.

the four forecasting horizons, our measure outperforms each existing measure in each of the three models.

Another encouraging result from Figure 4, is that, in line with expectations, our measure performs better the shorter the forecasting horizon to the upcoming election. For the model of all incumbent parties, the Adjusted R^2 score of our measure in May of the election year (t), at 0.235, represent a 23 percent improvement over the same measure three years prior to the election year ($t-3$), which is at 0.192. This confirms the added value of using vote intention polls – even on the national level – to update parties' popularity perceptions.

In conclusion, the validity evaluation has documented a number of attractive features of our election probability measure. First, the probabilities appear to be accurately estimated; there is no evidence of systematic over- or underestimation in relation to the actual probability of reelection at the point of measurement. Second, the measure shows substantial variation over the election cycle and its predictive capacity improves the as the forecasting horizon before the election shrinks. Third, irrespective of which forecasting horizon we consider, the capability to predict re-elections is higher for our measure than for any other evaluated measure.

5 Concluding remarks

This paper has demonstrated a general approach to measuring electoral competitiveness for parties and governments, which incorporates both pre-electoral and post-electoral competitiveness into a joint measurement that lies close to the theoretical concept of interest and satisfies Kayser and Lindstädt's (2015) six useful measurement criteria. Our evaluations have demonstrated that the election probabilities generated in our four-step procedure are accurately estimated and that the predictive capability of our measurement exceeds that of all previous measures of electoral competitiveness.

Like any previous measure of electoral competitiveness, ours have certain limitations. Specifically, it is both complex and computationally demanding, and it is mostly useful in analyses that include multi-party electoral systems and for research questions where parties (rather than, for instance, individual candidates) are the actors of primary interest.

For methodological reasons, the demonstration in this paper was applied to Swedish local government. However, our approach should be able to produce comparable election probability measurements for essentially any multi-party democratic system for which a minimum set of data is available. This includes applications that cover multiple systems, such as cross-national analysis, as well as applications that include de facto two-party systems.

As emphasized in the paper, the specific choices that need to be made when applying our approach depend on the institutional context and on the available data. However, the key takeaway from this paper is a general one, namely that when devising measures of electoral competitiveness in multi-party systems, scholars will do well to carefully consider not only pre- but also post-electoral uncertainty.

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