To the seminar

The paper that we submitted to SWEPSA was intended to study the effects of electoral competitiveness on public investments in Swedish municipalities in the recent decades. As is turns out, we have not yet gotten that far in the process. Instead, we found it necessary to first develop a measure of electoral competitiveness that satisfies two specific requirements of ours: it needs to be expressed as a re-election probability of the incumbent government, and it needs to be meaningful in a multi-party setting such as Swedish local politics, where the government formation cannot be easily derived from the election results.

Therefore, what you are reading now is a very first draft of our attempt to do so. At this early stage, we are particularly curious to hear your thoughts on four matters:

1. Our approach includes a forecasting component which bears much resemblance with Bayesian forecasting models, and if we were more familiar with Bayesian methods and terminology we might have chosen to go that way. However, because election forecasters are more interested in predicting the immediate future than understanding what re-election probabilities have looked like in the past, the existing forecasting models we know of are ill-suited for a situation with only two national polls per year. Literature recommendations along these lines, and especially suitable models we can build on, are very welcome.

2. We need a measure of parties' ideological position, preferably a time variant measure. We currently use data on the national parties from the Chapel Hill expert surveys. We wonder how you would rate these data compared to other alternatives, such as the Manifesto Project indicators or some measure derived from the SOM or election surveys? And what would be a desirable approach for scoring local parties?

3. We currently do not distinguish between the different local parties that might have seats in a given municipality and election term, but collapse them into one. How crucial would you think it is to treat these parties separately, given the purpose of our exercise?

4. We also present an approach for generating plausibly exogenous variation in the local incumbent's re-election probability by making use of national-level vote-intention polls. How convincing is this approach in its present form, if it were to be used to study policy consequences of electoral competitiveness? How do you think it could be improved?

We are of course also grateful for any other comments or questions that you might have!

Axel & Pär

A general approach to measuring electoral competitiveness for parties and governments

Axel Cronert and Pär Nyman

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Abstract

We develop a general approach to measuring electoral competitiveness. What distinguishes our approach from existing measures is partly that it allows us to measure the actual probability of re-electing the incumbent into office, which lies close to the theoretical concept of interest in most studies, and partly that it considers both pre- and post-electoral competitiveness, including what governing coalitions are likely to form given a certain electoral outcome. These two properties ensure that the approach can easily be applied to and compared across a multitude of institutional settings.

We apply our method to 1,400 municipal elections in Sweden and our analysis confirm three advantages that our estimated re-election probability has over the measures of competitiveness commonly used in the literature. It shows substantial variation over the election cycle, its ability to predict re-elections is higher than the joint predictive capability of all competing measures, and it can be adapted to any actor of interest – a party, government or mayor – and still be interpreted as a re-election probability.

1 Introduction

No other political concept is mis-measured as frequently as electoral competitiveness.[1]. At the most basic level, the essence of the concept lies in the certainty with which we can foresee 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 possibility that the incumbent executive will be ousted from office at

[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).

the next election (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 likeliness 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 (described in more detail in the last part of this paper) is that they only capture the *pre-electoral* competitiveness, like the vote margin of the incumbent or the historic degree of electoral volatility. As a consequence, these measures ignore the *post-electoral* competitiveness associated with how the government formation process plays out once the election results are in. Because this process is of particular importance in multi-party systems where coalition governments are the norm, standard measures of electoral closeness are not particularly suitable in such situations (Strom 1989).

In this paper we propose a general approach to measuring electoral competitiveness, which combines the pre- and post-electoral competitiveness into one joint measure. The measure is conceptualized as the *election probability* of a given actor. 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*, but nothing prevents us from estimating the election 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 and investiture votes – it should be flexible enough to be applied to and compared across any party constellation in any electoral system.

Similar to Canes-Wrone and Park (2012), we also use polling data to estimate the re-election probabilities. In addition to the increase in predictive capability, there are two other advantages of using polling data. First, unlike most other measures of electoral competitiveness, predicted probabilities that follow the opinion polls will vary a lot over the election cycle and should better approximate the politicians' perceptions of their re-election chances. Second, because the national polls are unlikely to be much affected by local policy, and because their effect on the re-election prospects of the incumbent differs between local political contexts, national-level vote intention polls can provide a plausible source of exogenous variation in the incumbent's re-election probability.

We apply our approach to 1,400 municipal elections in Sweden between 1998 and 2014. A comparison with 17 other measures found in previous literature shows that our approach is better at predicting re-elections than all the previous measures taken together.

2 Measurement construction in four steps

We follow a four-step procedure for developing our measure of electoral competitiveness facing the incumbent government, as illustrated by Figure 1.

In the first step, we create a forecasting model to simulate a distribution of equally possible election outcomes (vote and seat shares). The forecast is primarily based on the municipal-level vote shares from the previous election and from national-level vote intention polls, with the uncertainty surrounding this forecast simulated by re-sampling of residuals. The simulated outcomes vary between parties (p), simulations (i), municipalities (m) and years for which the forecast was made (y).

In step two, we build a model that may help us predict how changes in vote shares may affect the composition of the government following the next election. Here, we rely on the conditional logit 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 governments that are in theory available for consideration given the number of parties in the parliament.[2] The outcome of this exercise is a model that may predict for each potential government configuration a probability of realization, based on a number of characteristics of the parties in the assembly, including, importantly, the seat share distribution. Our sample consists of one government formation opportunity for each Swedish municipality following each local election between 1998 and 2014, and we estimate our model based on the observed outcomes of these government formation processes.

In the third step, we identify all possible combinations of parties that are represented in the parliament, for all simulated outcomes. These combinations of parties comprise the potential governments. For each potential government, we calculate the set of characteristics that is used to estimate the potential government's probability of entering office. We then use the coefficients generated by the conditional logit model in the previous step to calculate, for each potential government in each municipality-year, the predicted probability that it will enter into office, based on its vote share as forecast in step one.

To eventually arrive at a measure of the electoral prospects of the incumbent government for each municipality and year, we create a new variable defined as the sum of the probabilities of each party that form the incum-

[2]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 an assembly with n parties thus equals $2^n - 1$ (Martin and Stevenson 2001).

bent government, weighted by its share of seats in the assembly held by government parties.

2.1 Description of the data

First of all, however, we need to describe the data used in the procedure outlined above. In different ways, each step of the procedure makes use of the same core dataset, in which each row represents one of the 290 Swedish municipalities measured at one year between 1973 and 2014. Political variables at the local level includes local vote shares and seat shares in the local assembly, for the each of the eight dominant parties in Swedish politics[3] and a residual category for any *other party* (mostly local parties), as well as an indicator on which party holds the position of Mayor. These data are derived from Statistics Sweden (2018) and from the Kfakta database (Leif Johansson, 2010) respectively, and are generally available from 1973 and onwards.[4] Beginning in 1994, the dataset also includes data on which parties are members of the local government (SKL 2018).[5] The shorter time span of these data is essentially what limits parts of the analysis to the more recent election cycles.

In addition, the dataset includes a number of covariates at the national level: biannual vote intention data for each of the eight aforementioned national parties from Statistics Sweden's Party Preference Survey (PSU) available for all years except 1982–1983, as well as indicators on which parties are members of the national government and which parties hold some key portfolios in said government. Finally, the dataset includes measures of the ideological position of the eight aforementioned national parties, which are used as proxies for the ideological (left-right) position of the local branch of the respective party. These measures are derived from the Chapel Hill expert survey (Polk 2017), and their empirical distribution ranges from 1.54 (the Left Party) to 8.7 (the Sweden Democrats). At the cost of some accuracy, we ascribe each local party a score of 5, which is close to the median.

2.2 Step I: Forecasting election results

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

[3] 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.

[4] In later versions we might instead use election data from the Election Authority, which makes it possible to distinguish between different local parties.

[5] According to the definition used by SKL, a party is a member of the local government if it holds the position of chair or vice chair of one or more committees (nämnder) in the local assembly (kommunfullmäktige) (SKL 2018).

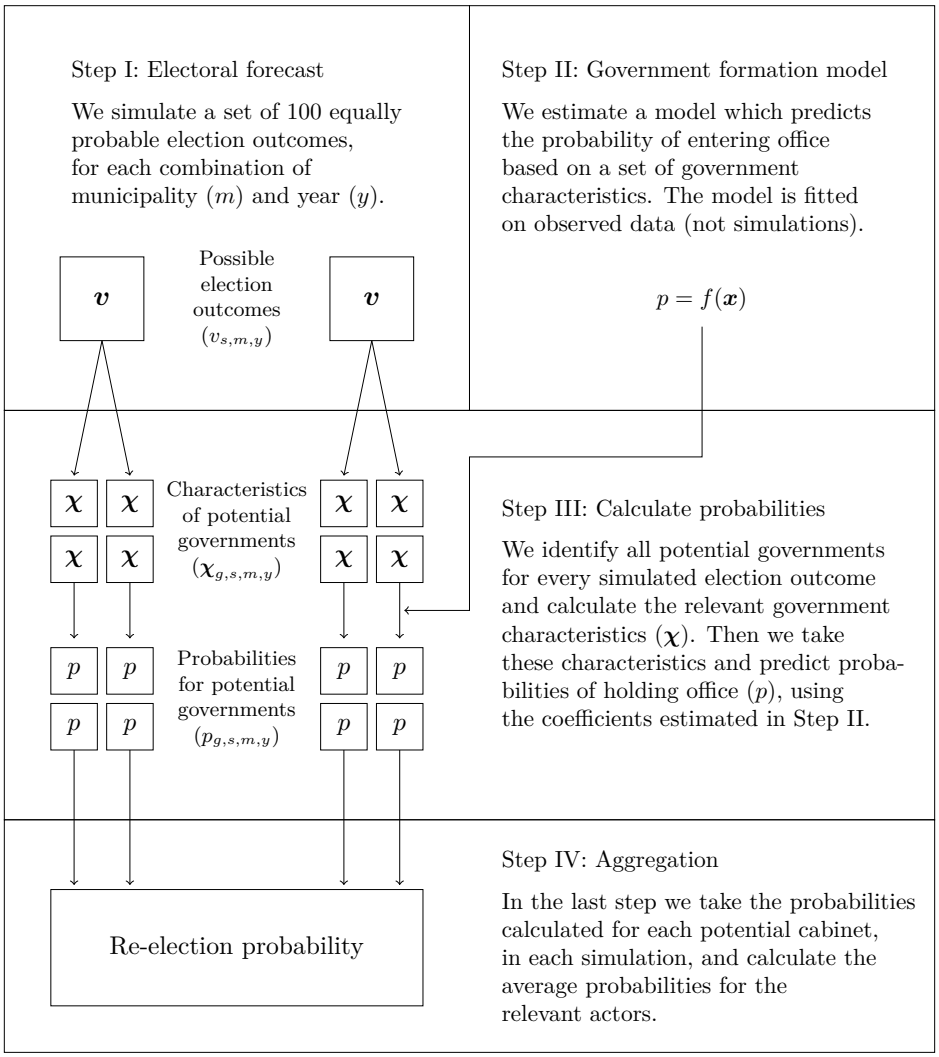

Figure 1: Illustration of our four steps

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 would look like.

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

2.2.1 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 national party has changed in the national polls. We also include incumbent dummies to capture the cost of ruling as well as a set of interacting 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.

It is a well-known problem that fitting linear models to fractional data can result in totals larger than 100 percent (Papke and Wooldridge 1996). However, we do think it is reasonable to assume that the relationship between our outcome and the other fractional variables actually is linear. To ensure that the predicted vote shares sum to unity, we simply include fixed effects at the municipality–year level (to make out of sample predictions, one can instead mean-center the independent variables within each municipality-year). The equation, which is estimated on the full period 1973–2014 using OLS, can then be written as:

$$v_p = a + b_1 v_p^p + b_{2,p}\delta q_p + b_{3,p} i_p + \boldsymbol{\beta_1 \gamma_p} + \boldsymbol{\beta_2 \phi_p} + \boldsymbol{\beta_3 \psi_p} + e_p \qquad (1)$$

Where the next vote share for party p is regressed on the party's vote share in the previous election (w_p), the change in the national polls since the previous election (δq_p), a binary indicator for whether the party is included in the incumbent coalition (i_p) – to capture the electoral cost of ruling – and a fixed effect at the municipality-year level ($\boldsymbol{\gamma_p}$). We also include a vector of interaction variables ($\boldsymbol{\phi_p}$), which allows the effect of the national polls to differ between parties as well as depending on the previous election result and the time left to next election, and a vector of binary indicators ($\boldsymbol{\psi_p}$) for whenever there is missing data on any of the other variables (in which the case the missing values are replaced by zeroes).

All parties are not represented in every municipality and it is not an obvious choice when a party should be included in our forecasts. We have

chosen to exclude parties that did not receive a single seat in any municipality during the previous election (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). 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 existing local party will suddenly increase (or decrease) its vote share.

2.2.2 Modeling the uncertainty

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

We have chosen to do so using a simulation approach with re-sampled residuals, in which we use the empirical distribution of residuals as our estimate of the true distribution of our model's uncertainty. 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 don't reduce this distribution to some parameter that we are interested in. Instead, and as described in Section 2.4, 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 simulated election. Averaging over these simulations, we can then calculate the pre-election probability of different governing coalitions.

Because the outcome variable is fractional (vote shares that sum to 100 percent), the residuals will be negatively correlated within each election (if one party is under-estimated, the sum of the vote share 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 elections (consisting of 7–9 residuals) instead of individual residuals, and assign the residuals from the sampled bloc so that they always belong to the same party. In other words, if the simulation s for the election result v in municipality m and year y is randomly chosen to be based on the prediction error e from municipality n and year v, then the simulated vote share for party p can be written as

$$v_{p,i,m,y} = \hat{v}_{p,i,m,y} + e_{p,i,m,y} \tag{2}$$

This equation underlines that the simulated outcome for a party will always be based on another prediction error for the same party, and that the

simulated outcomes for every party in municipality-year m–y are (for a given simulation) all based on residuals re-sampled from only one municipality-year n–v.

Moreover, the number of parties differ over time, and because we need to re-sample from elections with identical sets of parties, we have divided our data into three time periods, divided by the years that the Green party and the Sweden democrats received their first seats. Because the absolute size of the residuals is correlated with the party's predicted vote share, we have also divided the municipal elections within each time period into 10 clusters with similarly sized parties. When we re-sample the residuals, we then only draw blocs from within each of these 30 clusters of elections. On average, each cluster consists of 390 blocs.

While the blocked re-sampling technique is primarily motivated as a way to replicate the correlation between residuals, it should be noted that it also corresponds to our model of electoral volatility. In other words, we assume that the (total as well as party-specific) volatility is constant within each time period and within each cluster of municipalities. If we had reasons to believe that volatility follows some other pattern, it would be easy to take that into consideration when forming or clusters.

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. Yet, our approach requires a (approximated) probability distribution of election outcomes. The alternative that remains is then to assume a theoretical probability distribution, estimate its parameters on the observed data and then draw the residuals from that distribution when performing the simulations. In those cases, we would like to point out that the three most important things to keep in mind when choosing the distribution is i) the between-party correlation caused by ideological proximity, ii) the heteroscedasticity that arises from large parties having a larger variability, and iii) that the empirical distribution of residuals has fatter tails than the normal distribution (the Laplace distribution provides a good fit for our residuals).

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. For simplicity, we here assume that all municipalities consist of one constituency.

2.3 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 results as well as other party characteristics (such as incumbency, ideology, etc.). 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, p. 739)

In this study, we instead apply the aforementioned potential government approach, in which the units of analysis are all the potential governments that the parties in an assembly may form. In this approach, the government formation process is perceived as a discrete choice problem, – typically estimated a with conditional logit model – which results in one and no more than one of these potential governments being chosen by the parliament. Since the approach was introduced to the field by Martin and Stevenson in 2001, it 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 and on the interplay between government formations on different levels (e.g. Bäck 2003; Bäck et al. 2013; Debus and Gross 2016; Skjæveland et al. 2007).

Having surveyed much of this literature, we have identified and operationalized 35 factors claimed to be important in government formation processes.[6] Because the purpose of our exercise is not to test any individual hypotheses but simply to predict the outcomes of government formation processes, and because we have enough data not to be overly worried about overfitting, we simply include all available variables in a conditional logit model.

The variables in the first and largest group are related to size and ideology. Among the earliest hypotheses in the literature is that potential governments are less likely to form if they control only (1) a *minority* of the seats (see Martin and Stevenson 2010). An early refinement to this hypothesis suggests that those majority cabinets are more likely to form that are (2) *minimal-winning coalitions*, meaning a coalition from which no partner is unnecessary to the majority status of the coalition (Morgenstern and Von Neumann 1953). In such cabinets, the benefits associated with being in power are shared by as few partners as possible. As there are often more than one minimal-winning coalitions, several further refinements have been made to this theory. Among them is that minimal-winning coalitions are more likely to form if they are (3)

[6] While we have tried to include as many of these original hypotheses as possible, we have disregarded factors that either are irrelevant to the Swedish local context, do not vary between municipalities, or are impossible for us to measure. Examples of factors include the formally appointed formateur, of which there are none in Swedish municipalities (Bäck 2003), the existence of an investiture vote, for which there is no variation in the sample (Martin and Stevenson 2001), or the circumstances that ended the tenure of the previous cabinet, for which there is little data on the local level (Martin and Stevenson 2010).

connected, in the sense that they contain only ideologically adjacent parties (Axelrod 1970), if they have (4) the *narrowest ideological range* (De Swaan 1973), if they contain (5) the *fewest parties* among available minimal-winning coalitions, or if they are (6) the *minimum-winning coalition* meaning that they control the smallest share of seats among available minimal-winning coalitions (Laver and Schofield 1990).

As regards cabinet size, Glasgow and Golder (2015) include the two variables (7) *cabinet seat share* and (8) *cabinet seat share squared* to capture an idea strongly related to the minimal-winning coalition theory, namely that both small minority cabinets and large surplus majority cabinets are less likely to form than cabinets whose seat share is slightly above 50 percent. As far as (9) *number of parties* are concerned, the standard account suggests that cabinets are more likely to form the fewer parties they include (Glasgow and Golder 2015).

Later policy-centered theories, in the vein of Axelrod and Swaan, have suggested that irrespective of their size, ideologically divided cabinets should be less attractive to potential coalitions partners than more compact ones. Following Martin and Stevenson (2001), we account for this by including a measure of (10) the *ideological range* between the two most distant parties in the potential government along the left-right continuum.[7] A related theory by Laver and Schofield (1990) holds that potential minority cabinets should be more likely to form the larger the ideological divisions within the majority opposition they would face (Martin and Stevenson 2001). We capture this by including a measure of the (11) *ideological range between the most distant parties in the opposition* and (12) by *interacting* that measure with the minority cabinet variable mentioned above.

A more recent theory about the relevance of the cabinet's ideological composition is provided by Glasgow and Golder (2015). They suggest that as the ideological distance of the partners in a potential coalition to the median left-right position in the parliament increases, the probability that these coalitions will form decreases. Following Glasgow and Golder (2015), we therefore include a measure of (13) the *ideological distance from the median* computed as the weighted mean ideological distance between the partners in the coalition and the median, with the weights for each party based on its seat share.

Several theories suggest that potential governments are more likely to form if they contain particular parties that have a strong bargaining position. Among those most frequently occurring in the literature are (14) the party that controls the *median seat* on the left-right dimension, (15) the *largest party*, (16) the *largest party if it also the median party* and (17) the *largest party if it is also a "dominant player"*. A dominant player is "included in a least one winning coalition, which it can leave to form another winning

[7] This variable scores a 0 for single-party cabinets.

coalition with new parties, which the old partners cannot make winning" (Skjæveland et al. 2007; Van Roozendaal 1990, p. 724). For obvious reasons, the potential government with the strongest bargaining position of them all is one that consists of (18) a *single majority party*. This is not a rare phenomenon in Swedish municipalities; out of the approximately 1400 coalitions in place between 1998 and 2014, 7 percent were single party majority governments (SKL 2018).

The literature has also considered that certain parties may make potential governments less attractive to join, because doing so with incur high electoral costs to prospective partners. This is particularly the case with parties that promote 'anti-system' political views (Martin and Stevenson 2010). In the context and period studied here, this phenomenon should be properly captured by a variable indicating whether or not the potential government includes the radical right party (19) the *Sweden Democrats*. In a local setting such as the one we study, it also makes sense to include a variable on whether or not the potential government includes (20) a *local party*, since these are often elected on an anti-establishment agenda.

A second set of factors relate to the incumbent and to its recent electoral performance. First, incumbency theory holds that for a number of reasons a potential government is more likely to form if it is constituted by the same set of parties that formed (21) the *incumbent government* (see Martin and Stevenson 2001). Considering the greater discretion that comes with leading a government, the same logic would suggest that a potential government is more likely to form if it includes (22) the *party of the chief executive* (Martin and Stevenson 2010); in our case, the Mayor. In a recent contribution to the incumbency theory, Glasgow and Golder (2015) distinguishes between the incumbent coalition and the incumbent parties. Their analysis specifically links the incumbency advantage to the coalition; in case it does not re-form as a whole, other potential coalitions that include (23) *one or more but not all incumbent parties* are less likely to form.

Martin and Stevenson (2010) have furthermore hypothesized that the recent electoral performance of the incumbent affects its prospects of returning into office because parties should be more willing to join or re-form a coalition that has performed well, even after considering the ways that the election may have changed the seat distribution. As a measure of (24) *electoral performance*, we calculate the average seat change experienced by each potential government between the most recent election and the election prior to that. Because this effect is expected to matter particularly for the incumbent government, we include (25) an *interaction* between the electoral performance measure and the incumbent government indicator.

A third set of factors has to do with pre-electoral coalitions. Martin and Stevenson (2010) hypothesize that if parties make pre-electoral commitments to form certain coalitions, these coalitions are more likely to form. Lacking data on actual statements on the local level, we resort to including dummy

variables for the two long-standing political blocs within Swedish politics, namely (26) the *right-wing bloc* consisting of the Center Party, the Christian Democrats, the Conservative Party, and the Liberal Party, and (29) the *left-wing bloc* consisting of the Social Democrats and the Left Party.[8] Inspired by Skjæveland et al. (2007), we also include two additional variants of each of these bloc dummies. The (27, 30) *bloc-plus* variables score 1 if the coalition contains all parties from the bloc, including cases where it contains all parties from the bloc and one or more other parties. The (28, 31) *bloc-minus* variables score 1 if the coalition contains some parties from the bloc, as well as one or more other party. The expectation is that breaking a pre-electoral coalition is a less appealing option in a government formation process than extending a pre-electoral bloc with a party from the outside. In addition, we include a variable indicating a (32) *bloc-transcending coalition* that includes parties from both blocs.

A fourth set have to do with the interplay between the local and the national level political systems. First, a number of scholars have stressed the advantages to governments of congruence in multi-level systems; meaning that the party composition of coalitions at the sub-national level corresponds with the one of the national government (e.g., Bäck et al. 2013; Ştefuriuc 2009). Accordingly, Bäck et al. (2013) argue that (33) *cross-cutting coalitions*, meaning coalitions that cut across the national government–opposition divide, are less likely to form than those that correspond with either the government or the opposition. Lastly, it has been hypothesized that potential coalitions at the local level become more attractive if they contain the parties of the national-level ministers that exert the most influence over financial grants and other economic benefits available for distribution to the local level (Debus and Gross 2016; Ştefuriuc 2009). In the Swedish context, (34) the *minister of infrastructure* and the (35) *minister of finance* should have most pertinent portfolios. Therefore, we include two dummy variables that score 1 if the potential coalition includes the party of the respective minister.

[8] In recent years, the Green Party has moved closer to the left-wing bloc, especially so at the national level. However, at the municipality level the Green Party is best perceived as bloc independent (Folke 2014).

Table 1: The coalition formation model

	(1)	
1. Minority cabinet	−2.010***	(0.362)
2. Minimal-winning coalition	1.283***	(0.136)
3. MWC: Connected	−0.496***	(0.148)
4. MWC: Narrowest ideological range	−0.401**	(0.143)
5. MWC: Fewest parties	0.137	(0.148)
6. MWC: Minimum-winning coalition	−0.118	(0.123)
7. Seatshare	0.535***	(0.063)
8. Seatshare squared (/100)	−0.451***	(0.054)
9. Number of parties	−0.354**	(0.113)
10. Ideological range	−0.581***	(0.049)
11. Opposition ideological range	−0.266***	(0.037)
12. Opposition ideological range × Minority cabinet	0.217***	(0.055)
13. Ideological distance to median	0.240	(0.145)
14. Median party	0.636***	(0.139)
15. Largest party	0.582***	(0.175)
16. Largest party, also the median	0.027	(0.297)
17. Dominant player	0.033	(0.134)
18. Single-party majority	1.528***	(0.358)
19. Sweden Democrats	−18.829***	(0.138)
20. Local party	−0.740***	(0.132)
21. Incumbent government	1.872***	(0.110)
22. Party of incumbent Mayor	−0.196	(0.131)
23. One or some incumbent parties	−0.684***	(0.157)
24. Electoral performance	0.031	(0.018)
25. Incumbent government × Electoral performance	0.037	(0.029)
26. Right-wing bloc	2.500***	(0.219)
27. Right-wing bloc (plus)	2.944***	(0.257)
28. Right-wing bloc (minus)	0.585**	(0.193)
29. Left-wing bloc	0.594**	(0.193)
30. Left-wing bloc (plus)	0.200	(0.260)
31. Left-wing bloc (minus)	−0.077	(0.136)
32. Bloc-transcending coalition	−1.163***	(0.139)
33. Cross-cutting coalition	−0.121	(0.118)
34. Party of Minister of Infrastructure	0.274	(0.170)
35. Party of Minister of Finance	0.258	(0.165)
Observations	329,594	
Government formation opportunities	1430	
Pseudo R^2	0.613	

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

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

Following the bulk of the existing literature, we model the government formation problem using a conditional logit model. Table 1 reports the output of such a model, run on the realized outcomes of the approximately 1,400 government formation opportunities in the Swedish municipalities between 1998 and 2014, using the 35 variables described above. A first result reported in Table 1 is that our model has a more than satisfactory fit compared to existing studies; the Pseudo R^2 of 0.61 reported here is higher than those reported in previous work, ranging from 0.33 to 0.57.[9] In later versions of this study, we intend to explore options for improving the fit of the model further, for instance by interacting the coalition variables with higher-level variables (e.g., Bäck et al. 2013; Martin and Stevenson 2010) or by using a mixed logit approach which can generate parameters that capture the variation in the coefficients across government formation opportunities (Glasgow and Golder 2015; Glasgow et al. 2012).

For our current exercise, the output of primary interest is the 35 coefficients. For the sake of brevity, we refrain from interpreting individual coefficients here. The vector of coefficients is saved to be used in Step III below.

2.4 Step III: Predicting the incumbent's re-election probability

We begin the third step by identifying – for every simulated election – all possible combinations of parties that are predicted to receive at least one seat in the election. For all these potential governments, we then calculate exactly those 35 cabinet characteristics (χ) 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 use the coefficients that were estimated in Step II and apply them to the cabinet characteristics calculated on the simulated data.

2.5 Step IV: Aggregation

For each municipality-year, we now have 100 simulations 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 calculate the predicted election probability for any possible set of relevant actors.

[9]The reported range is based on the following studies: Bäck (2003, 2008), Bäck et al. (2013), Debus and Gross (2016), Gross and Debus (2018), Olislagers and Steyvers (2015), and Skjæveland et al. (2007). Note that a number of recent studies do not report Pseudo R^2 (Glasgow and Golder 2015; Glasgow et al. 2012; Martin and Stevenson 2010).

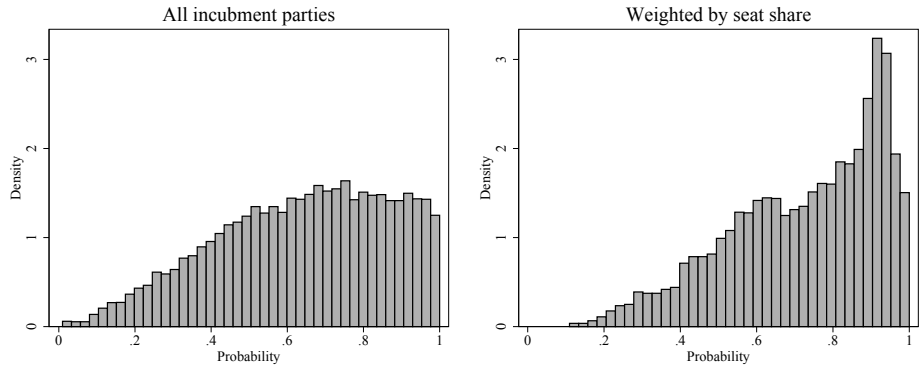

Figure 2: The distribution of estimated re-election probabilities

For example, by summing the predicted probability for all potential governments that include a certain party, in a given municipality-year, and dividing by the number of simulations, we get the predicted probability that this party will be in office after next election. We may then use these party-specific probabilities to calculate re-election probabilities for the largest party in the incumbent coalition as well as an average for all incumbent parties, weighted by their respective seat share.

Because we have annual data, we may produce one predicted probability the year before the election $(t-1)$, another one two years before $(t-2)$, and so on. However, the predictions made during the election year (t) are partly based on polling data collected after the election and they are therefore not included in any of the analyses presented in this paper.

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

2.6 Generating plausibly exogenous variation in re-election probability

A problem for anyone who seeks to analyze how incumbent governments adapt policy depending on their re-election prospects is that the government's popularity may be affected by announced or implemented policy, or that there may be some other factor which affects both policy and the chances of re-election.

We argue that this problem can be alleviated by the use of national-level

vote intention polls to predict local-level election outcomes. Because public opinion at the national level is unlikely to be much affected by policy at the local level, the risk for reverse causation is small. And more importantly, how national polling data affects the re-election prospects for local governments depends on – among other things – the composition of the local government as well as the previous local election result. If, say, left-wing parties are performing well in the national polls, municipalities with left-wing incumbents will have a high probability of re-electing the incumbent while municipalities with small right-wing majorities are likely to face a close election, and vice versa when right-wing parties are doing well.

When this heterogeneity is captured in the measure of electoral competitiveness, it is possible to regress policy changes on the incumbent's re-election probability, while at the same time keeping all time-invariant and spatially invariant factors constant. While there is no guarantee that this strategy will create a variation in electoral competitiveness that is exogenous to policy, we argue that it substantially decreases the risk for estimation bias.

3 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 elected into office – and 2) our estimation procedure which takes into account both pre- and post-electoral competitiveness 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 three empirical criteria: i) accuracy of uncertainty estimation, ii), predictive capability, iii) instrument validity. 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 reelected or replaced. This test will be done in comparison with other measures of electoral competitiveness used in previous studies. The third and last criteria assesses the strength or relevance of our measure, if one simultaneously controls for obviously endogenous variables like previous vote shares and trends in the national polls.

3.1 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, i.e., successful election, 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 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 four panels. As regards the upper-left panel, the Y-axis reports an indicator on the rate of actual reelection of the *incumbent government parties*, weighted by the seat shares of each party. This indicator ranges from 0 to 1.[10] The bins on the X-axis divide the 1,406 observed municipality-elections into 20 sub-samples based on our measure of re-election probability of the incumbent at $t-1$ aggregated in Step IV above. The upper-right panel instead reports an indicator on the rate of actual election into office of *all individual parties* in our dataset. These approximately 12,000 party-specific observations are binned based on the predicted probability that the individual party will be brought into office (at $t-1$). In the lower-left panel, the outcome indicator instead reports the share of 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 (at $t-1$). Finally, as a somewhat harder test, the lower-right panel plots the actual re-election of *the incumbent Mayor's party* into the Mayor's office. Granted that our election probabilities refer to entering into office to begin with and not specifically to win the appointment of Mayor, we bin the observations based on the aforementioned election probability for the largest incumbent party (at $t-1$), which we consider to be the best available proxy.

In all four panels of Figure 3, all the bins lie reasonably close to the diagonal line. This is especially true for the election of individual parties and for the incumbent government, but the two bottom panels also match the expectations in a satisfactory way. These tests suggest that there our probabilities are correctly estimated and that there is no systematic over- or underestimation in our measure of re-election probabilities.

3.2 Predictive capability compared to existing measures

The second part of the validity evaluation consists of testing how well our measure performs in terms of predicting when an incumbent government will be replaced or re-elected. Here, we test our re-election probability of the incumbent measured at three time points: $t-1$, $t-2$, and $t-3$. Throughout the test, these measures are compared to competing measures of electoral competitiveness used in previous studies.

[10] 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.

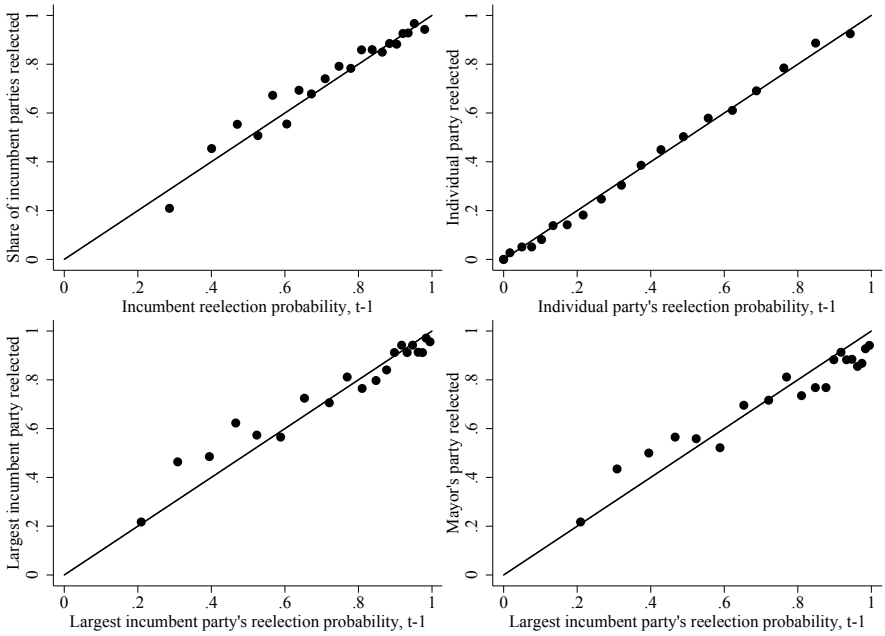

Figure 3: Comparison between predicted probabilities and average outcomes

3.2.1 Previous measures

More specifically, we have included 17 competing measures.[11] For some measures, we have made minor adaptations to make them applicable to the Swedish case. In the interest of space, we outline each measure only very briefly below. For exact definitions and scales we refer the reader to the respective study.

To begin, we include four measures of electoral competition that are derived from vote share (or the seat share) of the partisan majority, the incumbent, the ruling coalition, and the largest party, respectively, developed by Clingermayer and Wood (1995), Canes-Wrone and Park (2012), Boyne (1998) and Vanhanen (2000).

In addition, we include three measures that capture the closeness between the two major parties in the parliament: The *two-party margin*, the *two-party ratio*, and the *raw vote margin* (in percentage points) separating the two major parties. These measures are described in Fauvelle-Aymar and François (2006). A related measure by Aidt et al. (2011) of the win-margin of the *mayor's party* over the largest opposition party, is also included. Applicable

[11] Due to time constraints, we have omitted two relatively recent and sophisticated measures from the current version of this exercise. These are Kayser and Lindstädt's (2015) Loss Probability Rate of the largest party in the parliament, and Abou-Chadi and Orlowski's 2016 measure of parties' electoral insulation with respect to their bargaining position in the parliament.

specifically to the Swedish case, Högström (2017) proposes a measure of electoral closeness defined as the difference between the two major *blocs* in Swedish politics (described above). Here, we include both versions of this closeness measure, one based on *ex-ante* vote shares and one based on (the more problematic) *ex-post* vote shares.

Next, we include three more advanced indexes based on vote shares, designed more specifically for multi-party systems: Kirchgässner and co-authors' (1992) *entropy index*, which is a measure of the instability in the election; Endersby and co-authors' (2002) *competition index*, and Capron and Kruseman's (1988, p. 33) *fractionalization index*, which "measures the probability that any two voters randomly chosen from the electorate have voted for different parties". For definitions, see Fauvelle-Aymar and François (2006).

We also include a *volatility* measure proposed by Boyne (1998), applied, in our case, on the changes in vote shares of the Mayor's party over three most recent elections. In a similar vein, following Hübscher and Sattler (2017), we also include a logarithmized measure of the *replacement risk* of the largest incumbent party, which is a function of its closeness to the second party in the parliament as well as changes in vote shares among all parties over the five past elections.

Finally, we include two measures of *electoral pressure* and *political protection*, developed by Immergut and Abou-Chadi (2014). The two measures are derived from a factor analysis performed on six variables related to electoral competition: voter volatility, the disproportionality of the electoral system (LSQ index), the effective number of parties, the fraction of electoral winners in government, the size of government majority, and the size of government majority relative to the number of governing parties.[12]

3.2.2 Results

We begin by considering some visual data mapping how the distributions of the tested measures vary between two sub-samples of the data, one with municipality-elections after which re-election took place and one with municipality-elections after which it did not (cf. Kayser and Lindstädt 2015, appendix). If a measure is to have a predictive capability, we should expect its scores to be unevenly distributed across the two sub-samples. Our preferred outcome indicator – the weighted re-election of the incumbent – is not dichotomous, hence we resort here to the indicator on reelection (or ejection) of the largest incumbent party.

The box plots reported in Figure 4 show how the scores of the 20 compared

[12]Immergut and Abou-Chadi (2014) first apply a varimax rotation to the results of the factor analysis, and then create their two variables. We skip rotation, because the factors generated on our sample appeared unsuitable for rotation and because the unrotated versions perform better in the comparisons.

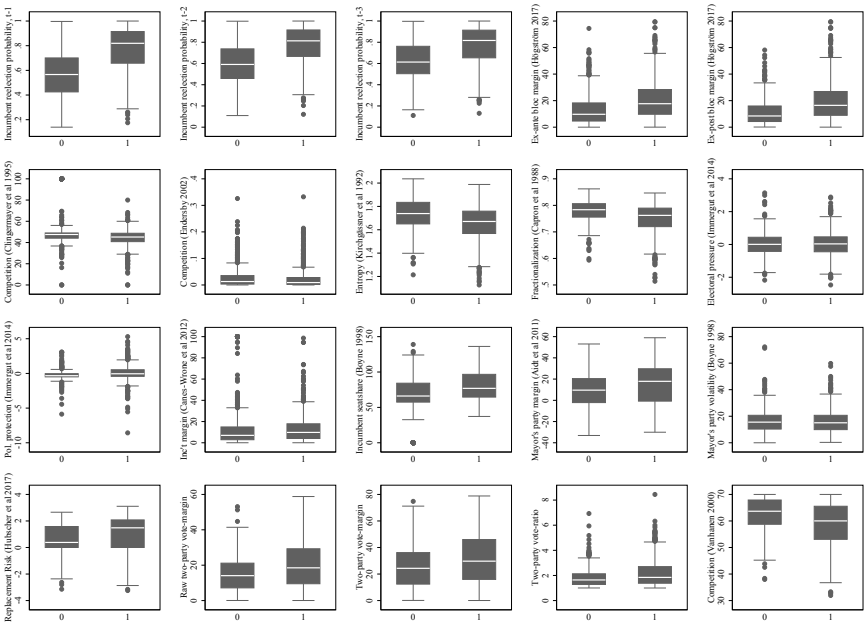

Figure 4: Boxplots for largest incumbent party re-elected

measures are distributed across the two sub-samples. Plotted to the left in the top row, the three versions of our re-election probability turn out to be the ones for which the distribution of the predictor varies most clearly across the two realized outcomes. Consider, for instance, that for elections after which the largest incumbent party remained in office, the re-election probability predicted one year before the election was at around or above in 66 percent in 75 percent of the cases, whereas little more than 25 percent of the probabilities were that high for elections after which the largest incumbent party was ousted. Also, consider that the difference in the median predicted probability across the two outcome is around 25 percent of the full range of values. An inspection of the plots for the other 17 measures reveals that none of them comes close to being that much differently distributed across the two outcomes. Indeed, for several measures the two distributions are largely indistinguishable. These patterns are consistent if we consider an alternative dichotomous outcome, reported in Figure 6 in the appendix, namely the reelection or replacement of the Mayor (defined as a re-election if the person appointed as Mayor belongs to the same party before and after the election).

Turning from visual inspection to statistical tests, the bar chart in Figure 5 confirm that our measure strongly outperforms the others in terms of predicting re-election. In this chart, the bar in the darkest shade of grey represents the R^2 coefficient from an OLS regression of the weighted re-election of the incumbent parties (see footnote 10) with the measure in

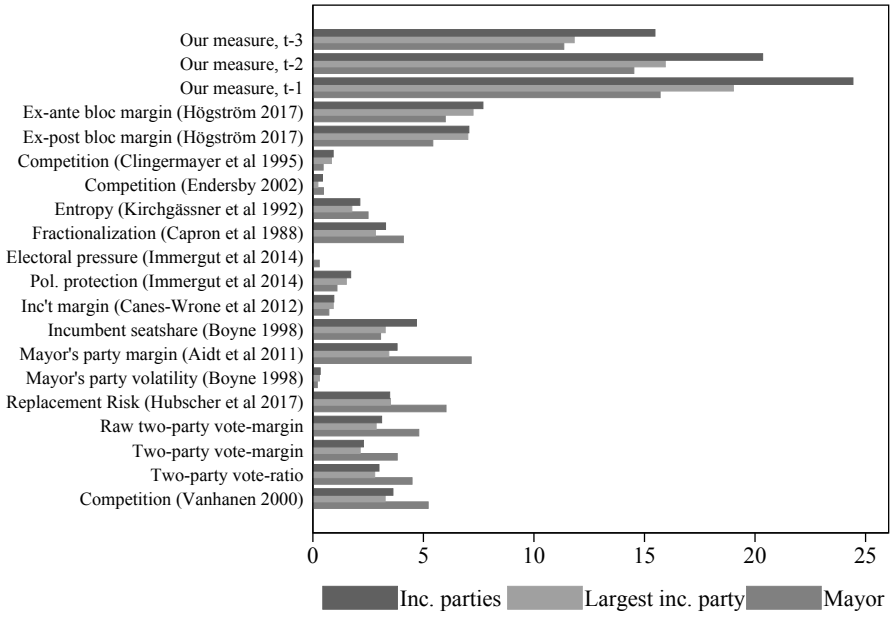

Figure 5: Capability to predict re-election (R^2 and Pseudo R^2)

question as a single predictor. Analogously, the two bars in lighter shades of grey represent the Pseudo R^2 coefficient from a logistic regression of the re-election of the largest incumbent party and of the Mayor's party, respectively, with the measure in question as a single predictor. The results are unambiguous: At each of the three forecasting horizons, our measure outperforms each of the competing measures in each of the three indicators.

Another encouraging result from Figure 5, is that in line with expectations, our measure performs better the shorter the forecasting horizon to the upcoming election. This confirms the added value of using vote intention polls (even on the national level) to update parties' popularity perceptions.

Table 2 provide additional evidence on the added value of our measure. The Table compares the Adjusted R^2 in three models of weighted re-election of the incumbent parties: A first one in which our measure for $t-1$ is the only predictor, a second one in which all 17 competing measures are included together, and a third one which combines the two previous models. The results are clear: not even when considered jointly, the 17 previous measures together account for the same share of the variability in the in the weighted re-election variable as our single measure in Model 1 (Figure 5 reveals that this holds even for the version of our measure that refers to three years before the election). Another noteworthy result is that adding all 17 previous measures to the best-performing version of our measure, only increases the amount of variability accounted for by three percentage points, from 24.5

to 27.5. That is to say, our measure overall does a good job of taking into account the factors that the various previous measures are also capturing.

To conclude thus far, 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 the joint predictive capability of all other evaluated measures.

Table 2: The predictive capability of different measures

	(1)	(2)	(3)
Incumbent reelection probability, t-1	0.97***		0.99***
	(0.05)		(0.06)
Raw two-party vote-margin		0.01	0.00
		(0.02)	(0.01)
Two-party vote-margin		−0.01	−0.01
		(0.01)	(0.01)
Two-party vote-ratio		0.04	0.01
		(0.05)	(0.04)
Entropy (Kirchgässner et al 1992)		0.17	0.13
		(0.39)	(0.32)
Competition (Endersby 2002)		−0.07	0.43
		(0.36)	(0.34)
Fractionalization (Capron et al 1988)		1.82	0.16
		(2.49)	(2.02)
Replacement Risk (Hubscher et al 2017)		0.04	0.05**
		(0.03)	(0.03)
Pol. protection (Immergut et al 2014)		0.04	0.03
		(0.04)	(0.03)
Electoral pressure (Immergut et al 2014)		0.13***	0.08**
		(0.04)	(0.04)
Inc't margin (Canes-Wrone et al 2012)		0.00	0.00*
		(0.00)	(0.00)
Mayor's party margin (Aidt et al 2011)		0.00	−0.00
		(0.00)	(0.00)
Competition (Vanhanen 2000)		−0.03*	−0.01
		(0.02)	(0.01)
Incumbent seatshare (Boyne 1998)		0.00*	0.00
		(0.00)	(0.00)
Mayor's party volatility (Boyne 1998)		−0.01***	−0.00**
		(0.00)	(0.00)
Competition (Clingermayer et al 1995)		0.01*	0.01
		(0.01)	(0.01)
Ex-ante bloc margin (Högström 2017)		0.00**	−0.00***
		(0.00)	(0.00)
Ex-post bloc margin (Högström 2017)		0.00***	0.00***
		(0.00)	(0.00)
Constant	0.04	0.22	0.20
	(0.04)	(0.86)	(0.75)
Observations	1406	1406	1406
Adjusted R^2	0.244	0.125	0.266

Standard errors in parentheses (clustered by municipality).

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

Table 3: The relevance of our measure conditioned on possible confounders

	(1)	(2)	(3)	(4)
Change in polls	0.012***	0.004**	0.011***	0.006***
	(0.002)	(0.002)	(0.002)	(0.002)
Previous vote share	0.004***	−0.000	0.001	−0.001
	(0.001)	(0.001)	(0.002)	(0.002)
Our probability measure		0.961***		0.828***
		(0.050)		(0.083)
Year FE	Yes	Yes	Yes	Yes
Muni FE	No	No	Yes	Yes
Observations	1403	1403	1403	1403
Adjusted R^2	0.033	0.258	0.197	0.304

Standard errors in parentheses (clustered by municipality).

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

3.3 Instrument validity

We argued in Section 2.6 that the risk of estimation bias when regressing policy on electoral competitiveness should be substantially reduced when using our measure of re-election probability while controlling for party popularity and other factors that are obviously endogenous to policy. As a final test, we will therefore analyse how much variation that remains in our measure when we control for national polling trends and the most obvious confounders. The sample used here consists of municipality-years measured one year before an election, beginning in 1997 and ending in 2013.

The first column shows a model where the weighted share of the incumbent parties that is re-elected is regressed on their joint vote share in the previous election as well as the aggregate change in support that these parties have in the national polls. The model also includes year fixed effects. As shown by the R2, these variables are weak predictors of whether the incumbent government is re-elected or not. It is therefore not surprising that when we add our measure to the model, the fit improves dramatically.

However, Column 3 shows that adding municipality fixed effects to Column 1 increases the (adjusted) R2 to almost the same levels as in Column 2. Once again adding our measure to the model shows that it still is a reasonable strong "instrument", but it only predicts about 10 percent of the total variation when we control for the between-municipality differences. We find this a little bit disappointing, but since the variables included in our models of pre- and post-electoral competitiveness should at least in theory vary primarily within municipalities, we hope that the within-municipality variation will increase as we add more elections to our sample. While others have used municipality-fixed effects as a source of exogenous variation in re-election probability, we believe it is easier to argue that the *exclusion restriction* holds when the strictly spatial variation is controlled for.

Eventually, we will make a more systematic evaluation of where our variation comes from and how much variation that remains after cancelling out all factors that we regard as problematic for our conditional exogeneity argument. However, to do that properly, and to relax assumptions about linearity and additive effects, we would need to integrate those tests with the simulations where we create the measure.

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Appendix

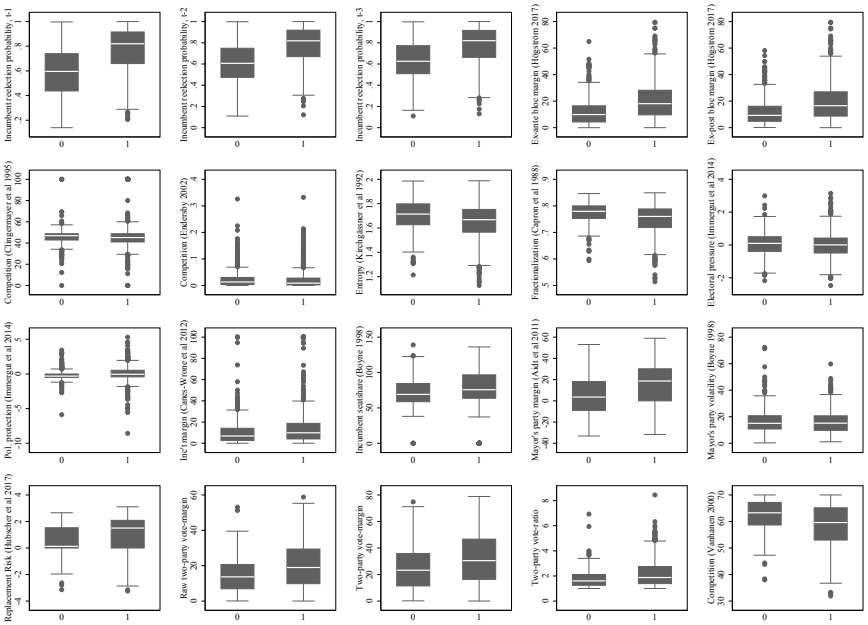

Figure 6: Boxplots for the Mayor's party reappointed as Mayor