

Estimating the Probability of Acting as a Trustee

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Abstract

We introduce a binomial mixture model for estimating the probability of a political representative acting as a delegate or a trustee. The model also returns the probability of congruence of politicians with the will of the national median voter. The estimated probability of congruence strongly correlates with the observed frequency of congruence, which was obtained by matching parliamentary roll-call votes with the will of the median voter revealed in Swiss national referendums on identical legislative proposals. Our method uses the roll-call vote record of political representatives as sole input. Thus, it can be used to infer congruence levels of politicians even if the will of the median voter is unknown.

Keywords: Political representation, delegate, trustee, binomial mixture model.

JEL-Codes: C13, D72.

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1 Introduction

The political delegate vs. trustee behavioral dichotomy is a classical theme in political science. It dates at least back to the analysis of political representation by the Irish statesman and philosopher Edmund Burke in the 18th century (Pitkin 1967). Simply put, delegates vote the way their constituents want them to vote, whereas trustees exercise their independent judgment to vote what, in their view, is best in the public interest. This theme has been at the heart of the theory of political representation for more than two centuries,¹ with a normative and a positive aspect to it.

The normative question of how political representatives *should act* is, of course, controversial. In his 1774 speech to the Electors of Bristol, Burke argued in favor of the trustee model of representation: ‘Your representative owes you, not his industry only, but his judgement; and he betrays you instead of serving you if he sacrifices it to your opinion.’ Being normative to a significant degree, this question is unlikely to be settled by an application of scientific method alone. Nevertheless, contemporary political science addresses several related positive issues that require knowing how political representatives *do act*. Such positive questions relate to how certain factors encourage the representatives to act rather as a delegate or a trustee (see, for example, Stokes 2001, Fox and Shotts 2009). Moreover, extensive empirical literature analyzes the strength of the link between the political representatives and the voters.² In this paper we contribute to the latter type of literature by proposing a novel empirical approach for estimating the probability that a representative follows the will of the median voter, and the probability that she acts as trustee or as delegate.

Theoretically many explanations can be advanced of why representatives may act as delegates or trustees (Fox and Shotts 2009). The competence of the representative with respect to the issue on the ballot may matter.³ However, if the competence assessment of the representative is not shared by the electorate, the politician might be better off acting as a delegate rather than acting as a trustee. A potential mismatch between the preferences of the representatives and those of the electorate plays a role too. Fox and Shotts (2009) argue that the incentive to act as a delegate increases if the representative believes that the electorate is uncertain about her preferences. In this case, the representative has an incentive to gain trust. By gaining trust the representative gets more leeway for exercising independent judgment as a trustee. Another group of factors includes the democratic institutions and the electoral behavior that shape the feedback process by which the electorate rewards or punishes the representative. Do the voters judge the representatives on the basis of their policies or the outcomes of their policies? The im-

¹Comprehensive surveys can be found in Przeworski, Stokes and Manin (1999) or Ashworth (2012).

²Examples of such positive empirical studies include Portmann (2014) and Matsusaka (2015). A discussion on citizen-elite ideological congruence can be found in Golder and Ferland (2018). Further contributions to the theory of political representation include Denzau and Munger (1986), Grofman (2004), Carey (2008), Golder and Stramski (2010), Kauder and Potrafke (2016).

³A school teacher, for example, serving as an MP might feel competent to exercise independent judgment on education and less inclined to do so on defense.

portance of policies compels the representative seeking a reelection to act as a delegate. When the voters vote retrospectively by judging the outcomes, exercising independent judgment will be rewarded if it leads to a successful policy outcome.

The main implication of the above considerations is that the diversity of ballot issues should induce frequent changes in the mode of representation by each single representative, which in turn makes the outcome of an election a very imperfect indicator of whether the representative was more of a trustee or a delegate. This is especially true if the issues differ in their salience, so that a single false step on a key issue may preclude the reelection of an otherwise popular or competent representative. Moreover, the representatives vote on issues much more frequently than the voters vote for the representatives or their parties in general elections.

This gives rise to an important empirical question of how to determine the mode of behavior based on data, i.e. the degree to which representatives act as trustees or delegates. Indeed, identifying the actual mode of representation has been difficult in practice. Whether representatives vote according to their own preferences or the preferences of their constituents cannot be tested directly, unless surveys of public opinion or instruments of direct democracy are used to reveal the latter (Stadelmann, Portmann and Eichenberger 2013, Brunner, Ross and Washington 2013, Barcelo 2018). A test of the fidelity of political representation in an indirect democracy must remain an indirect one by nature, as preferences of constituents are usually unobservable. In practice, such tests would have to compare the ideological position of a legislator to that of the median voter (Poole and Rosenthal 1997, Gerber and Lewis 2004, Matsusaka 2010). The ideological position of the legislator follows from her voting record (roll-call votes), whereas the ideological position of the median voter can be estimated from opinion surveys and election results, with estimates ranging from single-dimensional scores to multi-dimensional spatial fixings. But no matter how accurate ex post measures of congruence might be, there will always be doubt borne by observational equivalence regarding the mode of representation. The mere observation of congruence between a representative and her constituency does not imply the delegate mode of representation, as the representative may make a popular choice for *idiosyncratic* reasons. Put differently, the representative may be congruent with the constituency while acting as a trustee.

We contribute to the empirical literature on political representation by proposing a method of estimating the degree (technically a probability) to which a representative acts as a delegate or a trustee. Our approach overcomes the problem of observational equivalence between the two modes of representation. Specifically, we propose a binomial mixture model of the representatives' votes. The model involves unobservable idiosyncratic signals, two for each representative, as well as a single unobservable common signal. The model is estimated using the roll-call votes of the representatives as sole input. The estimates are then used to compute the probability of a representative acting as a trustee. The second quantity of interest is the probability of a representative voting according to an unobserved common signal that influences the votes of all representatives. This would be the probability of congruence with the median voter should the common signal indeed reflect the will of the median voter. Under this assumption, we can use the model to

estimate the fidelity of representation based on roll-call votes alone.

The approach proposed in this paper resonates with some ideas found in the mathematical social science literature on the Condorcet Jury Theorem. One problem in the jury setting is how to verify the quality of a decision. Whereas the jurisdiction of a lesser court can be reviewed by a higher judicial authority, the correctness of the jurisdiction by a Supreme Court is unobservable. How can we judge the Justices? The older literature on the classical Condorcet Jury Theorem, reviewed in Grofman, Owen and Feld (1983), proposed comparing an individual's vote with the majority vote. The more often an individual is congruent with the majority, the more frequently is she correct. This approach is not entirely satisfactory due to a degree of tautology inherent in it. In contrast, the interpretation of the common signal in this paper is inspired by the analysis of voting in the US Supreme Court (Iaryczower and Shum 2012). The reasoning is as follows: If judges vote according to a common signal, which by exclusion must be the evidence presented rather than an idiosyncratic signal such as personal ideology, we can be confident that the decision was a good one. Similarly, if a legislator votes in parliament according to a factor that influences the votes of *all* legislators, then we may trust that her decision will coincide with the countrywide will of the median voter, i.e. the countrywide majority. We can then calculate the probability of congruence from our model.

The cornerstone assumption of the common signal representing the will of the median voter cannot be tested if the latter is not observed, as is usually the case in practice of political decision making. The Swiss political system offers a quasi-experimental design for testing congruence by requiring the representatives to vote in Parliament before placing the same issue on a country-wide referendum. All constitutional amendments passed by parliament require a referendum. A small group of citizens can start an initiative to amend the constitution or demand a referendum on laws enacted by parliament (Stadelmann et al. 2013, Portmann 2014, Hessami 2016). These elements of direct democracy make Switzerland exemplary.

Observing the actual will of the median voter allows us to *validate* our model. We compare the predicted individual probabilities of congruence with the observed individual frequencies of congruence. Briefly anticipating our results, we find that the estimated probabilities of congruence significantly correlate with the observed frequencies of congruence. This implies that our estimation method can be applied to identify politicians who are more or less congruent with the will of the majority of voters from their roll-call votes alone.⁴ The ability to accurately predict the probability of congruence lends validity to the estimated probability of a representative acting as a delegate or a trustee. To give a further example for the application and usage of the estimated probabilities in empirical work, we also use ideology scores for the Swiss MPs – computed using the well-known Poole and Rosenthal's (1997) NOMINATE method – to explore the relationship between the ideology and the probability of acting as a trustee on the individual level.

The remainder of the paper is structured as follows. Our binominal mixture model is

⁴This feature of our method could be appealing for evaluating the degree to which politicians represent their constituents.

presented in Section 2, Section 3 discusses estimation results, the validation of our model and an application. Concluding remarks are offered in Section 4.

2 The model

In an assembly of n legislators, each legislator i , where $i = 1, 2, \dots, n$, may vote according to a private binary signal X_i or a common binary signal M . The choice of legislator i is modeled by a binary random variable L_i . Assume that the $2n + 1$ random variables L_i, X_i, M are independent Bernoulli random variables with the expectations $\mathbf{E}L_i = r_i$, $\mathbf{E}X_i = r_{n+i}$ and $\mathbf{E}M = r_{2n+1}$. The vote V_i is modeled as a mixture:

$$V_i = L_i X_i + (1 - L_i) M. \quad (1)$$

It follows that the distribution of V_i is also Bernoulli, and $\mathbf{E}V_i = r_i r_{n+i} + (1 - r_i) r_{2n+1}$.

The common signal induces positive correlations between the votes, which are independent only conditionally on the common signal M . The Pearson product-moment correlation coefficient for any two votes V_i and V_j , where $j = 1, 2, \dots, n$ and $j \neq i$, is given by

$$\mathbf{Corr}(V_i, V_j) = \frac{\mathbf{E}V_i V_j - p_i p_j}{\sqrt{p_i(1-p_i)p_j(1-p_j)}} = \frac{(1-r_i)(1-r_j)r_{2n+1}(1-r_{2n+1})}{\sqrt{p_i(1-p_i)p_j(1-p_j)}} > 0,$$

where $p_i = \mathbf{E}V_i = r_i r_{n+i} + (1 - r_i) r_{2n+1}$. The votes are also correlated with the common signal

$$\mathbf{Corr}(V_i, M) = \frac{\mathbf{E}V_i M - p_i r_{2n+1}}{\sqrt{p_i(1-p_i)r_{2n+1}(1-r_{2n+1})}} = (1-r_i) \sqrt{\frac{r_{2n+1}(1-r_{2n+1})}{p_i(1-p_i)}} > 0.$$

In the absence of absenteeism and abstentions, the roll-call data would comprise nT observations of random variables V_i , where n is the number of legislators and T the number of ballots, indexed by $t = 1, 2, \dots, T$. In the next section we show how to estimate the vector of model parameters

$$\vec{r} = (r_1, \dots, r_n, r_{n+1}, \dots, r_{2n}, r_{2n+1})$$

from the roll-call votes, without observing the $(2n + 1)T$ realizations of L_i, X_i and M .

Conceptually, trustees exercise discretion by using own judgment and voting according to their conscience. In contrast, delegates follow the (uncertain) will of the majority. To operationalize such behavior in the confines of our stochastic model of votes, we must envision how an impartial external observer would perceive a trustee's votes on a large set of independent and exogenous issues. For an impartial external observer, voting as a trustee would amount to voting *idiosyncratically*. We thus say that legislator i acts as a trustee on the ballot t , if i votes on t according to the t 's realization of i 's private and independent signal X_i . This allows us to interpret $\mathbf{E}L_i$ as the probability (the inclination,

the degree) of acting as a trustee. Our primary objective is to estimate the probability of i acting as a trustee from i 's voting record.

It is important to emphasize that the nature of the common signal M , as a source of stochastic dependence between the votes, has no direct bearing on the identification of the trustee voting. Ideally, we would like to interpret the complementary probability $(1 - \mathbf{E}L_i)$ as the probability of acting as a delegate, so that the mixing equation (1) models the choice between the two classic modes of political behavior. This interpretation is admissible only if M indeed reflects the will of the median voter, an assumption that in most cases cannot be verified if the latter remains unobserved. For a typical indirect democracy, i.e. a parliamentary democracy without referendum decisions, our analysis would end here, because an indirect identification of the common signal is unlikely due to a large number of potential factors. The model tells us only that the realizations of M are binary, that they influence the votes of all legislators and are specific to each ballot, but this information alone will rarely suffice to identify M empirically, i.e. with real world data.

In the case of Swiss referendums, we can verify our assumption of the common signal M being the will of the median voter on issues that were put on a referendum. This allows us to *validate* the assumption that M reflects the will of the median voter by comparing the predicted probabilities of congruence with the observed frequencies of congruent votes. We use the actual outcome of the referendum as an ex ante estimate of the median voter's position.⁵

The assumption that the common signal reflects the median voter's position allows us to predict the probability of congruence of individual politicians with the median voter using the roll-call data. The probability of congruence with the median voter M can be obtained from the following conditional probabilities:

$$\begin{aligned}\pi_{11} &= \mathbf{P}\{V_i = 1 \mid M = 1\} = 1 - r_i(1 - r_{n+i}), \\ \pi_{00} &= \mathbf{P}\{V_i = 0 \mid M = 0\} = 1 - r_i r_{n+i}, \\ \pi_{10} &= \mathbf{P}\{V_i = 1 \mid M = 0\} = r_i r_{n+i}, \\ \pi_{01} &= \mathbf{P}\{V_i = 0 \mid M = 1\} = r_i(1 - r_{n+i}).\end{aligned}$$

The probability of congruence is given by

$$\mathbf{P}\{V_i = M\} = r_{2n+1}\pi_{11} + (1 - r_{2n+1})\pi_{00}. \quad (2)$$

Here, the first term is the probability of congruence of a Yes vote:

$$\mathbf{P}\{V_i = 1 \cap M = 1\} = r_{2n+1}\pi_{11},$$

whereas

$$\mathbf{P}\{V_i = 0 \cap M = 0\} = (1 - r_{2n+1})\pi_{00}$$

⁵Much as empirical tests of the Downsian model of turnout proxy the expected closeness of an election with the actual closeness observed ex post (Geys 2006). For a more direct test of the median voter model with Swiss referendum data, see Portmann and Stadelmann (2017).

is the corresponding probability for a No vote.⁶

The *observational equivalence* regarding trustee or delegate behavior discussed in the introduction follows because the event $V_i = M$ may occur with any L_i , i.e. a representative acting as a trustee or as a delegate may represent the will of the median voter. Put differently, the mere observation of congruence of a legislator's vote (realization of V_i) with the median voter (realization of M) does not imply a certain mode of representation (delegate vs. trustee). A representative may make a popular choice ($V_i = M$) for idiosyncratic reasons ($L_i = 1$). The above model allows overcoming observational equivalence by disentangling the two cases which is a central new contribution of our approach to the existing literature.

2.1 The Maximum Likelihood estimate

We can estimate \vec{r} using Maximum Likelihood from the parliamentary roll-call data, i.e. realizations v_i of the random variables V_i , despite X_i , L_i and M being unobserved. Let $v_i = 1$ if legislator i votes Yes, and $v_i = 0$ if i votes No. Let n be a fixed number of legislators, and let v_i^t be independent (in t) observations of V_i for $t = 1, 2, \dots, T$ ballots. The likelihood function reads

$$F_T(\vec{r}) = \prod_{t=1}^T \left[r_{2n+1} \prod_{i=1}^n F(i, M = 1, t, \vec{r}) + (1 - r_{2n+1}) \prod_{i=1}^n F(i, M = 0, t, \vec{r}) \right], \quad (3)$$

where

$$\begin{aligned} F(i, M = 1, t, \vec{r}) &= v_i^t(1 - r_i(1 - r_{n+i})) + (1 - v_i^t)r_i(1 - r_{n+i}), \\ F(i, M = 0, t, \vec{r}) &= v_i^t r_i r_{n+i} + (1 - v_i^t)(1 - r_i r_{n+i}). \end{aligned}$$

To estimate the vector of parameters \vec{r} , the logarithm of likelihood function $F_T(\vec{r})$ is maximized subject to the following constraints:

$$r_i \in [0, 1], \quad i = 1, 2, \dots, 2n + 1. \quad (4)$$

To improve the fit, we require that the marginal probabilities of affirmative votes equal their observed counterparts. This additionally imposes n constraints:

$$r_i r_{n+i} + (1 - r_i) r_{2n+1} = p_i, \quad i = 1, 2, \dots, n, \quad (5)$$

where the means $p_i = (1/T) \sum_{t=1}^T v_i^t$ are the frequencies of Yes votes. We use the following re-parametrization to simplify the optimization problem: $R_i = r_i$, $R_{n+i} = r_i r_{n+i}$ and $R_{2n+1} = r_{2n+1}$, with $R_i \geq R_{n+i}$ imposed in addition to (4). Further constraints related to the mixed moments of the joint probability distribution can be imposed. The Bahadur (1961) parametrization suggests a large number of moment-based constraints that may

⁶In the case of the Swiss parliament, we use the probability of congruence to validate our interpretation of the common signal M as the preference of the median voter.

be imposed. A natural addition to the first-moment constraints would be those based on the mixed moments $\mathbf{E}V_iV_j$ and the frequency of all ballots in which the legislators i and j both voted Yes. This would introduce $n(n-1)/2$ additional constraints. The trade-off lies in the increased complexity of the optimization problem, and the possible non-existence of a solution.

The above likelihood function implicitly assumes a fixed number of legislators deciding on every ballot, and attaches the index i to the same legislator. While the assumption of a constant composition is suited for small voting bodies such as juries, it is not tenable for large voting assemblies such as parliaments. The actual number of votes cast on any particular legislative ballot is likely to be smaller than the number of seats in the parliament, because some legislators could abstain from voting, be temporarily absent or be permanently replaced by other legislators in the middle of a legislative session due to resignation or demise. Our method is sufficiently flexible to accommodate abstentions and irregular tenures.

To account for absenteeism and abstentions in parliament, we introduce a binary participation parameter a_i^t , such that $a_i^t = 1$ if legislator i voted on the ballot t , and $a_i^t = 0$ if she did not. If $a_i^t = 0$, we set $v_i^t = 1$. This information is collected in an $n \times T$ binary attendance matrix A . The following definitions replace their counterparts in problem (3):

$$F(i, 1, t, A, \vec{r}) = a_i^t[v_i^t(1 - r_i(1 - r_{n+i})) + (1 - v_i^t)r_i(1 - r_{n+i})] + 1 - a_i^t, \quad (6)$$

$$F(i, 0, t, A, \vec{r}) = a_i^t[v_i^t r_i r_{n+i} + (1 - v_i^t)(1 - r_i r_{n+i})] + 1 - a_i^t. \quad (7)$$

This simple modification fully captures absenteeism and abstentions, as well as different tenures of legislators. If i has resigned during a session at time τ , then $a_i^\tau = 0$ for all $\tau \geq t$. If j succeeds i , then $a_j^\tau = 0$ for all $\tau < t$. In this formulation, n denotes the number of legislators that voted at least once. The estimates for the Swiss parliament below were obtained using an adjusted maximum likelihood function (3) with (6) and (7), under the moment restrictions (4) and (5). We also provide the estimation code for the statistical packages MATLAB and R on request.

3 Estimates and application

The Swiss Parliament comprises two houses, a Lower House (National Council, Nationalrat in German) and Upper House (Council of States, Ständerat in German). This study analyzes voting behavior in the Lower House. The Lower House has 200 members, who are elected using a proportional system.

Swiss legislators vote on new laws and amendments just like representatives in other parliamentary democracies around the world. But Swiss direct democracy allows us to directly measure congruence between representatives and the median voter. The proposals accepted by the parliament do not turn directly into law. Parliamentary decisions can be challenged by citizens demanding a referendum. Final votes in the Lower House are recorded by an electronic voting system. We apply the estimation approach detailed in

the previous section to final roll-call data on bills that were subsequently put on a country-wide referendum. In particular, these bills include all constitutional amendments, as they require a confirmatory referendum. A majority of voters and cantons (Stände) suffices to change the constitution.⁷ In addition to these constitutional referendums, a small group of citizens can put forward an initiative to amend the constitution by referendum, or demand a referendum on a simple law already passed by the parliament. In all cases the legislators vote on precisely the same proposals as citizens, allowing us to compare their votes (Portmann 2014, Stadelmann, Portmann and Eichenberger 2018).

3.1 The probability of acting as a trustee

We estimate the model using roll-call data from the Swiss Lower House for three legislative sessions from 1999 to 2011. Table 1 summarizes the distributions of the estimated individual probabilities of acting as a trustee by legislative session, which is given by $EL_i = r_i$, the expected value of the mixing variable.

Depending on the legislative session, the median values (column q50) of the estimates of r_i lie between 0.48 and 0.62, implying that half of the legislators act as trustees slightly more often than half of the time. Although this finding may sound inherently plausible, it hides significant heterogeneity in the estimates. Figure 1 plots the estimated probabilities of acting as a trustee by session, sorted in ascending order. About one third of the estimates equal unity, implying clear idiosyncratic behavior typical of trustees. We call the representatives whose estimated probability of acting as a trustee equals to unity the *perfect trustees*. Who are the perfect trustees and how representative of the electorate are they? We shall use the NOMINATE scores to locate their ideological positioning on the traditional left-right political spectrum, but before that an exploration of the validity of the estimation model would be needed.

Table 1: Estimated Probability of Acting as a Trustee

Session	MPs	Refs	Min	q25	q50	q75	Max
1999 to 2003	212	43	0	0.13	0.54	1	1
2003 to 2007	224	20	0	0.32	0.48	1	1
2007 to 2011	220	30	0	0.21	0.62	1	1

The abbreviations Min, q25, q50, q75, Max denote the minimum, the 25 percent quantile, the 50 percent quantile (median), the 75 percent quantile and the maximum, respectively.

3.2 The probability of congruence – model validation

To validate the model empirically, we estimate the probability of congruence and compare it to the observed frequency of congruence derived from comparing the representative's

⁷A discussion on majority rules in constitutional referendums is provided by Stephan and Cofone (2017).

roll-call vote with the decision of the majority of voters – and hence also that of the median voter – in a referendum. Table 2 summarizes the distributions of the *estimated* individual probabilities of congruence (columns titled ESTIMATES), i.e. $\mathbf{E}(V_i = M)$, by legislative session.

The estimated total probabilities range from 0.37 to 1. Median values between 0.69 and 0.76 suggest that half of the legislators are estimated to disagree with the median voter in about 30 percent of their decisions. This figure is consistent with the observed congruence rates when comparing representatives and voters in referendums (Brunner et al. 2013, Garrett 1999, Stadelmann et al. 2013, Matsusaka 2015). The extreme estimates of one, indicating perfect congruence, occur for legislators with exceptionally short tenures. In our dataset, this applies to four members of the 1999-2003 session and five members of the 2007-2011 session, who voted on fewer than one-tenth of ballots during a session – too seldom for a reliable estimate.

Table 2: Estimated Probability of Congruence

Session	MPs	Refs	DATA	ESTIMATES					VALIDATION		
			Votes	Min	q25	q50	q75	Max	ρ	τ	R^2
1999 to 2003	212	43	All : 7458	0.48	0.49	0.74	0.93	1	0.89	0.61	0.72
			Yes : 3941	0.68	0.82	0.87	0.96	1	0.83	0.68	0.56
			No : 3517	0.48	0.67	0.94	0.99	1	0.96	0.59	0.86
2003 to 2007	224	20	All : 3646	0.37	0.47	0.76	0.83	0.99964	0.69	0.51	0.48
			Yes : 2214	0.78	0.86	0.89	0.97	1	0.76	0.64	0.42
			No : 1432	0.37	0.62	0.81	0.91	1	0.88	0.7	0.72
2007 to 2011	220	30	All : 5391	0.49	0.5	0.69	0.89	1	0.63	0.56	0.36
			Yes : 2830	0.69	0.8	0.84	0.95	1	0.49	0.45	0.18
			No : 2561	0.58	0.71	0.87	0.94	1	0.78	0.54	0.49

We validate the model by comparing the estimated probabilities of congruence by correlation coefficients (Pearson ρ and Kendall τ) with the observed frequencies of congruence. We also employ a pseudo-coefficient of determination for a logistic regression of the frequencies of congruence on the probabilities (Nagelkerke’s $R^2 \in [0, 1]$) for validation.

The model is estimated using the entire voting record of a given session on proposals with subsequent referendums, yet the above probabilities can, of course, be obtained for Yes and No votes separately. The median probability of congruence for the first and third session is higher for No votes than for Yes votes, which is consistent with the view that legislators are more attentive to voters if they are likely to disapprove. The estimates suggest that 46, 24 and 31 legislators in the respective sessions flawlessly anticipated the disapproval of the majority, resulting in absolute congruence. The corresponding numbers for the Yes votes are 17, 36, 17.

We *validate* the estimation model using correlation coefficients between the estimated probability and the observed frequency of congruence as well as with coefficient of determination in a logistic regression. The observed frequency of congruence reflects the actual matches between the vote of a representative and the observed will of the national median voter in referendums. These are the cases in which the representative voted Yes and the subsequent referendum resulted in a Yes, or if the legislator voted No and the referendum

resulted in a No. Recall that this information has not been used in the estimation of the probability of congruence.

In Table 2 (columns titled VALIDATION), ρ denotes the standard Pearson product-moment coefficient and τ denotes the Kendall rank correlation. The input of both correlation coefficients is the estimated probability and the observed frequency of congruence. The Kendall rank correlation coefficient τ is better suited for uncovering dependence in a nonlinear relationship. Both correlation coefficients indicate a strong association between the estimated probability and the observed frequency of congruence. The correlation patterns are broadly consistent, except for the relative strength of the correlation with the No votes during 1999-2003. Nagelkerke's R^2 serves as a measure of fit for a (cross-sectional) logistic regression of the estimated probability of congruence on the observed frequency of congruence; it confirms good cross sectional fits implied by the correlation analysis. The fits are better for No votes than for Yes votes. The model that we propose has thus been able to predict the actual matches between the decisions of individual legislators and the will of the majority of voters. The validation exercise suggests that our empirical model can be used to infer congruence levels of politicians even if the will of the median voter is unknown. Plausible cross-sectional estimates for the probabilities of acting as a trustee or a delegate further lend credibility to the model.

3.3 Ideology and acting as a trustee – an application

The possibility to estimate the degree to which representatives rather act as trustees or delegates opens a number of potential applications. As an example, we take a look at the statistical relationship between the probability of acting as a trustee and the ideological positions of the representatives.

Table 1 shows that over 25 percent of the estimates equal unity (column q75), implying clear idiosyncratic behavior. Who are the perfect trustees? We give an answer to this question by exploring the relationship between the ideology and the probability of acting as a trustee by using the NOMINATE ideology scores of the representatives.⁸ The scores range -10 (left) to +10 (right). Similar to the probabilities of acting as a trustee, the scores were obtained using the roll-call data. Since the score of a representative can change in time, we use its value at the time of voting in the parliament.

Figure 2 plots the estimated probabilities of acting as a trustee against NOMINATE ideology scores, separately for each legislative session. Three clusters appear clearly in each of the three legislative sessions. We observe a leftist block of perfect trustees (crosses), a centrist block whose members mostly act as delegates (empty bullets), and a rightist block (filled bullets) whose members act as delegates about half of the time. The left block mainly comprises Greens (GPS) and Social Democrats (SP). The centrist block is the most diverse of the three. It includes the members of Green Liberals (GLP), Christian

⁸We draw on the NOMINATE scores computed by Michael Hermann from the Sotomo institute. These scores are also used in newspaper articles (see, e.g., 'Die Parteien sprechen mit einer Sprache', Neue Zürcher Zeitung, 25.11.2014).

Democrats (CVP), Conservative Democrats (BDR) and Liberals (FDP). The right block mainly includes the members of the Swiss People’s Party (SVP).

Let us have a closer look at the members comprising the three blocks. Table 3 provides additional details. Our application shows that perfect trustees exist in each block. However, trustees tend to be concentrated in the political left of the ideology spectrum,⁹ while representatives from center parties rather act as delegates.

Table 3: Estimated Probability of Acting as a Trustee by Ideology Blocks

Session	MPs	Block	ESTIMATES					SCORES		
			Min	q25	q50	q75	Max	q50	ρ	R^2
1999 to 2003	66	Left	0.89	1	1	1	1	-8.18		
	88	Center	0	0.06	0.13	0.21	1	1.53	-0.62 (0.26)	0.42 (0.07)
	42	Right	0.19	0.49	0.56	0.63	1	7.97		
2003 to 2007	75	Left	0.82	1	1	1	1	-8.36		
	82	Center	0	0.14	0.29	0.47	1	1.80	-0.74 (-0.2)	0.56 (0.04)
	52	Right	0.23	0.40	0.45	0.48	0.99	8.02		
2007 to 2011	67	Left	0.83	1	1	1	1	-8.48		
	76	Center	0	0.07	0.14	0.28	0.94	1.64	-0.52 (0.17)	0.29 (0.3)
	62	Right	0.17	0.53	0.62	0.68	1	8.12		

The NOMINATE ideology scores range -10 (left) to +10 (right). The total number of representatives by session is lower than in Table 1, because we do not have the scores for 46 MPs. ρ is the Pearson correlation coefficient between the ideology scores and the probability of acting as a trustee and $R^2 \in [0, 1]$ is the Nagelkerke’s pseudo-coefficient of determination for a logistic regression of the probabilities on the scores for all observations belonging to a legislative session. The figures in parenthesis were computed using the sample that excludes the perfect trustees.

The relationship between the ideological position and the probability of acting as a trustee can be further explored using the methods that were used to validate the empirical model. A negative correlation coefficient between the ideology score and the probability of acting as a trustee means that moving to the right of the political spectrum decreases the probability of acting as a trustee. The Pearson product-moment coefficient ρ is negative and rather high in absolute value. The Nagelkerke’s R^2 for the (cross-sectional) logistic regression of the probabilities of acting as a trustee on the NOMINATE scores shows that the scores can explain between 30 and 60 percent of the sample variation in the probability. A potential caveat in this application is that both figures are inflated by the presence of the perfect trustees.¹⁰ Excluding perfect trustees from the sample suggests that overall relationship between the ideological position and the probability of acting as a trustee in the Swiss roll-call data remains ambiguous. A more extensive investigation employing our estimation method could further look at what makes a representative a perfect trustee, such as personal characteristics, political experience, etc.

⁹This is not entirely surprising. Having sufficiently many parliamentary parties that are ideologically distinct increases the likelihood of locating the perfect trustees on the opposite half of the spectrum relative to the median voter.

¹⁰We provide the corresponding figures without perfect trustees for ρ and the R^2 in parenthesis.

4 Conclusions

We propose a new empirical approach for estimating the probability of a political representative acting as a trustee. The underlying modeling assumption is that trustees vote idiosyncratically. Under this assumption, we can estimate the probability of acting from a set of roll-call data only. The fact that the estimates are specific to each political representative opens the venue for investigations that not only address the nature of issues, but also political campaigns, party affiliations and the personal characteristics of representatives. In our empirical application, we find that most of Swiss representatives who act as perfect trustee tend to come from the left of the traditional ideology spectrum.

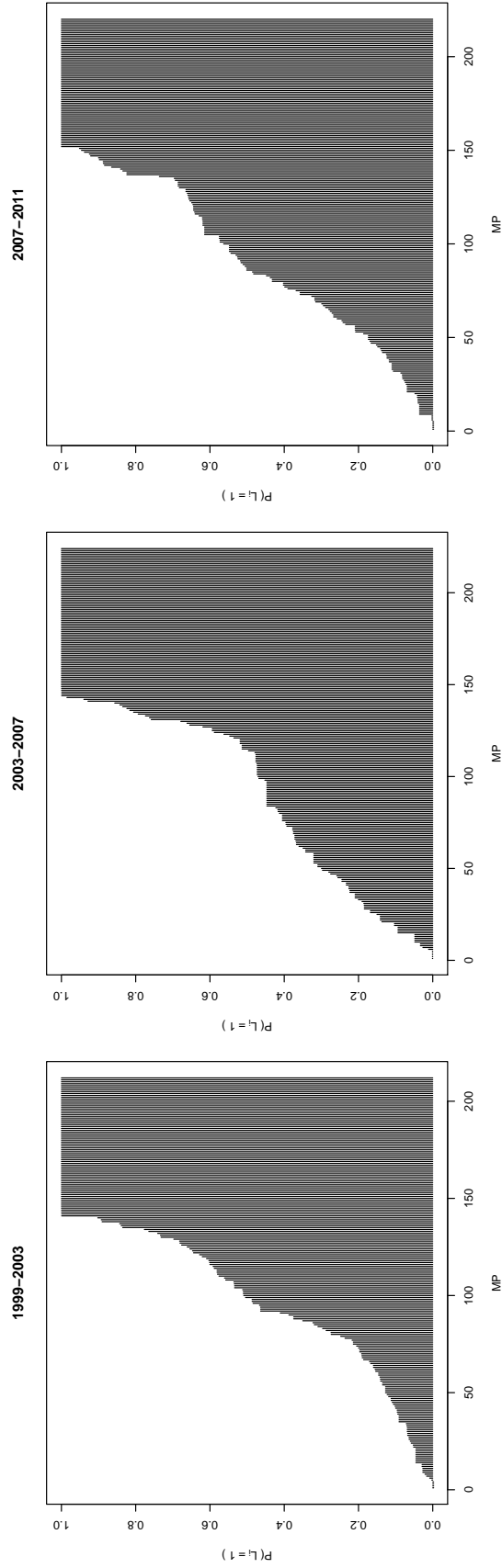
The second quantity of interest from our estimation model is the probability of a representative voting according to an unobserved common signal that influences the votes of all representatives. If the common signal reflects the will of the median voter, this would be the probability of congruence with the median voter. We *validate* our model and the assumption of the common signal representing the will of the Swiss median voter by confronting the predicted probabilities of congruence with the observed frequencies of congruence in a data set that matches the roll-call votes of Swiss legislators and the outcomes of subsequent referendums. Our predicted probabilities of congruence strongly correlate with observed frequencies of congruence. Consequently, our approach can be used to estimate congruence levels for individual political representatives based on the roll-call votes alone. We can then also derive reliable predictions for whether legislators act as delegates or trustees.

Our estimation model has several attractive features: i) it is flexible enough to accommodate abstentions and irregular tenures that are common in parliaments, ii) it generates positive correlation between individual votes that is typically observed, iii) it delivers estimates on an individual level (ranking of politicians) that can be aggregated to the institutional level. Under the assumption that the common signal represents the will of the median voter, this allows us to estimate the fidelity of representation for each legislator and for the parliament as a whole.

Once the relevance of a common factor (signal) in explaining voting patterns has been established, and given sufficient data, the model can be extended to include additional unobserved signals that are common to a subset of the legislators as opposed to all legislators. The subsets would partition the legislators into groups, for example, according to party membership. The approach can thus incorporate a third mode of political behavior known as the mandate model, which stipulates that politicians adhere to the electoral promises made by their party, and bow to the party discipline. The question would then be: ‘To which extent do they bow to party discipline?’ But it could also be other factors that align roll-call votes, such as interest group influence and shared regional interests. For example, future research may include signals specific to each constituency in an attempt to capture the effect of the constituency on voting behavior. Doing this would allow to predict the probability of congruence with the district median voter or even a party-specific voter in addition to predicting the probability of congruence with the country-wide of median voter. The approach presented in this paper allows to successively refine the com-

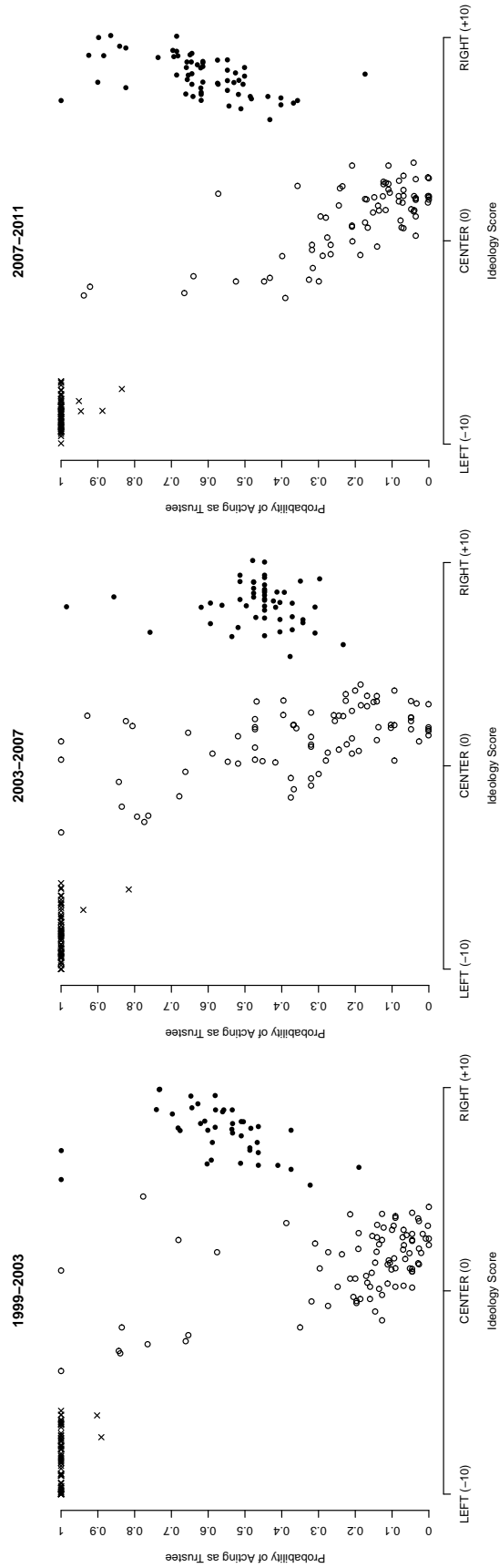
mon signal from a perspective by making it, loosely speaking, successively less common. As the estimation of rich binominal mixture models that contain multiple levels of signals requires extensive mathematical modeling and computing resources, our approach points to promising technical and empirical research avenues.

Figure 1: Estimated Probability of Acting as Trustee



The probability of a legislator acting as a trustee is given by $\mathbf{E}L_i = \tau_i$, the expected value of the mixing variable. The estimates are sorted in ascending order of their magnitude. Roughly one third of the estimates equals unity, implying certain idiosyncratic behavior characteristic of trustees.

Figure 2: Ideology Scores vs. Probability of Acting as Trustee



A plot of estimated probabilities of acting as a trustee against NOMINATE ideology scores reveals three clusters: a leftist block of perfect trustees (x), a centrist block whose members mostly act as delegates (o), and a rightist block (●) whose members act as delegates about half of the time.

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