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Center for Research in Economics, Management and the Arts

# The Probability of Legislative Shirking: Estimation and Validation

Working Paper No. 2015-17

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# The Probability of Legislative Shirking: Estimation and Validation

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## Abstract

We introduce a binomial mixture model for estimating the probability of legislative shirking. The estimated probability strongly correlates with the observed frequency of shirking obtained by matching parliamentary roll-call votes with the will of the median voter revealed in national referenda on identical legislative proposals. Since our estimation method requires the roll-call votes as sole input, it can be used even if the will of the median voter is unknown.

*JEL-Codes:* C13, D72

*Keywords:* binomial mixture model, legislative shirking, referenda.

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# 1 Introduction

The ability to assess legislative shirking is essential to fostering political accountability. Legislators shirk when they vote their own preferences on legislative issues rather than the preferences of voters. The extent of legislative shirking has direct policy implications, as well as theoretical bearings in the two mainstay paradigms of political competition, the citizen-candidate (Besley and Coate 1997) and the re-election pressure (Maskin and Tirole 2004). Empirical studies show that legislative shirking is common (Brunner, Ross and Washington 2013, Gerber and Lewis 2004, Grofman 2004). While the voting behavior of legislators in a parliament is usually observable, the will of the voter majority is rarely so. Scholars therefore rely on indirect methods of comparing legislator votes with voter preferences, for example by comparing estimates of ideological positions of legislators and the median voter (Poole and Rosenthal 1997, Matsusaka 2010).

We propose a novel approach for measuring the extent of legislative shirking. We estimate a binomial mixture model of legislative votes and compute the probability of a legislator voting according to an unobserved common factor influencing the votes of all legislators. If the common factor reflects the will of the national median voter, then this is the probability of legislative shirking. We can thus estimate the extent of legislative shirking from roll-call votes *alone*. Our approach is inspired by the analysis of voting in the US Supreme Court (Iaryczower and Shum 2012). The quality of the jurisdiction by a Supreme Court cannot be verified for a lack of higher judicial authority. How can we judge the judges? 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 factor such as personal ideology, we can be confident that the decision was a good one. Translating this reasoning to the political arena: If a legislator votes in parliament according to a factor that influences the votes of *all* legislators, then we may be confident that her decision coincides with the countrywide sentiment expressed by the will of the median voter.

Our method 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. The latter allows us to estimate the probability of shirking for each legislator and for the parliament as a whole.

The cornerstone assumption of the common factor representing the will of median voter cannot be tested if the latter is not observed. Swiss data offers a quasi-experimental opportunity to validate our method. The Swiss political system feeds the preferences of the voter majority to the legislative process by requiring legislators to vote 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, Portmann and Eichenberger 2013). These elements of direct democracy make Switzerland exemplary and widely-studied. We confront our estimation results for the probability of legislative shirking with actual deviations of legislators from voter preferences. We validate our method by showing that the estimated probability of legislative shirking strongly correlates with the observed frequency of shirking.

## 2 The model

Consider a political assembly comprising  $n$  legislators. Each legislator  $i = 1, 2, \dots, n$ , may vote according to the will of majority  $M$ , or she may follow her own opinion  $X_i$  and shirk. Whether

or not the legislator shirks is controlled by a variable  $L_i$ , which is specific to each legislator. The vote of a legislator is modeled as a mixture involving three Bernoulli random variables:

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

Assume that the  $2n+1$  random variables  $L_i$ ,  $X_i$  and  $M$  are mutually independent, with  $\mathbf{E}L_i = r_i$ ,  $\mathbf{E}X_i = r_{n+i}$ ,  $\mathbf{E}M = r_{2n+1}$  collected in a vector  $\vec{r} = (r_1, \dots, r_n, r_{n+1}, \dots, r_{2n}, r_{2n+1})$ . The common factor  $M$  induces positive correlation between any two votes defined by (1), but the independence of  $L_i$  and  $X_i$  implies the independence of votes *conditional* on  $M$ . The distribution of  $V_i$  is Bernoulli, with  $\mathbf{E}V_i = r_i r_{n+i} + (1 - r_i)r_{2n+1}$ . Since the distribution of a Bernoulli random variable is completely specified by its mean, the vector  $\vec{r}$  specifies the model. This vector can be estimated from the parliamentary roll-call data alone, or realizations  $v_i$  of the random variables  $V_i$ . Realizations of the random variables  $X_i$ ,  $L_i$  and  $M$  are unobserved. We will validate the main contextual assumption that  $M$  corresponds to the will of the median voter using the voting data of the Swiss parliament, for which the will of median voter is revealed in referenda.

Let  $v_i = 1$  if legislator  $i$  votes Yes, and  $v_i = 0$  if  $i$  votes No. In view of 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 that legislator  $i$  votes according to  $M$  equals  $\mathbf{P}\{V_i = 1 \cap M = 1\} = r_{2n+1}\pi_{11}$  when  $i$  votes Yes, and  $\mathbf{P}\{V_i = 0 \cap M = 0\} = (1 - r_{2n+1})\pi_{00}$  when  $i$  votes No. The corresponding probabilities of legislative shirking are given by

$$\mathbf{P}\{V_i = 1 \cap M = 0\} = (1 - r_{2n+1})\pi_{10} \quad \text{and} \quad \mathbf{P}\{V_i = 0 \cap M = 1\} = r_{2n+1}\pi_{01}.$$

The total probability of shirking is

$$\mathbf{P}\{V_i \neq M\} = 1 - \mathbf{P}\{V_i = M\} = r_{2n+1}\pi_{01} + (1 - r_{2n+1})\pi_{10}.$$

We can estimate the vector of parameters  $\vec{r}$  from roll-call data by Constrained Maximum Likelihood, with constraints based on the first moments of  $V_i$ . Let us assume a fixed number of legislators  $n$ , and let  $v_i^t$  be independent (in  $t$ ) observations of  $V_i$  for  $t = 1, 2, \dots, T$  legislative proposals. The likelihood function reads

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

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:

$$r_i \in [0, 1], \quad i = 1, 2, \dots, 2n + 1. \quad (3)$$

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

$$r_i r_{n+i} + (1 - r_i) r_{2n+1} = p_i, \quad i = 1, 2, \dots, n, \quad (4)$$

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  $R_{2n+1} = r_{2n+1}$ . In this case,  $R_i \geq R_{n+i}$  should be imposed in addition to (3).

The above likelihood function implicitly assumes a fixed number of legislators deciding on every issue, 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 issue 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 another legislator in the middle of a legislative session due to resignation or demise. Our method is sufficiently flexible to accommodate abstentions and irregular tenures that are common in parliaments.

To account for abstentions and absenteeism 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 (2):

$$F(i, 1, t, A, \vec{r}) = a_i^t [v_i^t (1 - r_i (1 - r_{n+i})) + (1 - v_i^t) r_i (1 - r_{n+i})] + 1 - a_i^t, \quad (5)$$

$$F(i, 0, t, A, \vec{r}) = a_i^t [v_i^t r_i r_{n+i} + (1 - v_i^t) (1 - r_i r_{n+i})] + 1 - a_i^t. \quad (6)$$

This simple modification fully captures abstentions or absenteeism, as well as different tenures of legislators in the estimation procedure. If  $i$  has resigned during a session at time  $\tau$ , then  $a_i^\tau = 0$  for all  $\tau \geq t$ . If  $j$  succeed  $i$ , then  $a_j^\tau = 0$  for all  $\tau < t$ . In this formulation,  $n$  denotes the number of legislators that ever voted during a session. The estimates for the Swiss parliament below were obtained using an adjusted maximum likelihood function (2) with (5) and (6), under the moment restrictions (3) and (4).

### 3 Estimates

We apply the above estimation approach to roll-call data from the Swiss Lower House of Parliament for three legislative periods from 1999 to 2011. Table 1 summarizes the distributions of the estimated individual probabilities of shirking by legislative sessions. The estimated total probabilities of legislative shirking range from 0 to 0.63. Median values between 0.24 and 0.31 suggest that half of legislators shirk in about 30% of their decisions. This figure is consistent with evidence of shirking derived from referenda (Garrett 1999, Stadelmann, Portmann and Eichenberger 2012). The extreme estimates of zero, indicating no shirking, occur for legislators with exceptionally short tenures. This applies to four members of the 1999-2003 session and five members of the 2007-2011 session, who voted on fewer than 10% of total ballots during these sessions – too seldom for a reliable estimate.

The model is estimated using the voting record of a given session on proposals with subsequent referenda, yet probabilities of shirking can be obtained for Yes and No votes separately. The median probability of shirking for the first and the third sessions is lower 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 majority, resulting in a zero probability of shirking. The corresponding numbers for the Yes votes are 17, 36 and 17.

Table 1: Estimated Probability of Legislative Shirking by Session

Session	MPs	Refs	DATA	ESTIMATES					VALIDATION		
			Votes	Min	q25	q50	q75	Max	$\rho$	$\tau$	$R^2$
1999-2003	212	43	All : 7458	0	0.07	0.26	0.51	0.52	0.89	0.61	0.72
			Yes : 3941	0	0.04	0.13	0.18	0.32	0.83	0.68	0.56
			No : 3517	0	0.01	0.06	0.33	0.52	0.96	0.59	0.86
2003-2007	224	20	All : 3646	3.6E-04	0.17	0.24	0.53	0.63	0.69	0.51	0.48
			Yes : 2214	0	0.03	0.11	0.14	0.22	0.76	0.64	0.42
			No : 1432	0	0.09	0.19	0.38	0.63	0.88	0.7	0.72
2007-2011	220	30	All : 5391	0	0.11	0.31	0.5	0.51	0.63	0.56	0.36
			Yes : 2830	0	0.05	0.16	0.2	0.31	0.49	0.45	0.18
			No : 2561	0	0.06	0.13	0.29	0.42	0.78	0.54	0.49

We validate the estimated probabilities of shirking by correlation coefficients (Pearson  $\rho$  and Kendall  $\tau$ ) with the observed frequencies of shirking and a pseudo-coefficient of determination for a logistic regression of the frequencies of shirking on the probabilities (Nagelkerke's  $R^2 \in [0, 1]$ ).

The above discussion summarizes the estimates. For a typical indirect democracy our analysis would end here. The nature of the estimated common factor cannot be verified if the actual will of the median voter is unobserved. In Switzerland, we can verify our contextual assumption of the common factor influencing the votes of all legislators being the will of the median voter, at least on issues for which the mismatch between the vote of a legislator and the will of the median voter is revealed in a referendum. We validate the model using correlation coefficients between the estimated probability and the observed frequency of legislative shirking, and the coefficient of determination in a logistic regression. The observed frequency of legislative shirking is defined as the actual mismatch between the vote of a legislator and the observed will of the national median voter. A mismatch occurs if a legislator votes Yes, whereas the subsequent referendum results is a No, or vice versa. Recall that this information has not been used in the estimation.

In the above table,  $\rho$  denotes the standard Pearson product-moment coefficient. The Kendall rank correlation coefficient  $\tau$  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 legislative shirking. 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 logistic regression of the estimated shirking probability on the observed frequency of shirking; it confirms good cross sectional fits implied by the correlation analysis. The fits are better for No votes than for Yes votes. The proposed estimation method is able to detect the propensity of individual legislators in parliament to deviate from the will of the median voter.

## 4 Conclusions

We propose a new empirical approach for estimating the probability of legislative shirking based solely on parliamentary roll-call data. A comparison to the observed frequencies of shirking of

Swiss legislators allows us to validate our approach. Our analysis demonstrates the usefulness of the estimation method for measuring the extent of legislative shirking in countries in which only elements of indirect democracy are in place. The fact that the estimates are specific to each legislator opens the venue for further investigations that not only address the nature of issues, but also political campaigns, party affiliations and the personal characteristics of legislators. The results can be used to rank the politicians according to fidelity of political representation.

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