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An Application to the 2011 Regional Government Election in Zurich

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Abstract:

In several cantons in Switzerland the regional government, i.e. a set of governors who share the executive power in the canton, is elected according to an original voting rule, in which voters can vote for several candidates (up to a maximal number of votes). Up to some details, these elections are instances of what is known in Social Choice Theory as "Committee Approval Voting".

The paper makes use of data from a panel survey collected during the 2011 Zurich cantonal election to check whether a strategic voting theory is consistent with individual behaviour observed during that election. We show that roughly 70% of the individual decisions on candidates are consistent with our model of rational voting.

1. Introduction

In most cantons in Switzerland, the regional government is elected under an original voting rule, according to which voters can vote for several candidates in a multi-member, majority election (Lutz and Strohmann 1998; Vatter 2002). In multi-member districts, elections usually follow some proportional, list-based rule, and majority or plurality elections in multi-member districts are quite rare, although they have earlier been used more frequently in the US and in the UK (Cox 1984). There are only few examples of current national elections held under such a system, and they are mainly limited to two-member districts (Blais and Massicotte 2002). This is for instance the system used at the federal level in Switzerland for the election of the upper chamber (e.g., Lachat 2006). However, the case on which we focus in this article is remarkable by the large magnitude of the district. In the canton of Zurich, on which this paper is based, the seven members of the government are elected in a single district. Up to some details, these elections are instances of what is known in Social Choice Theory as “Committee Approval Voting”.

The contribution of this paper is to use and test the theory of individual rational voting under Committee Approval proposed in a companion paper (Laslier and Van der Straeten 2014) on real election data. For this purpose, we use survey data collected during the election of the canton government in Zurich in 2011, and check whether the theory is consistent with individual behaviour. We compare the observed voting behaviour with the predictions of our model, regarding both aggregate level results (number of votes used, distribution of candidate votes) and individual votes (percentage of correct predictions). The model fares quite well in predicting individual level observations. Roughly 70% of the individual decisions on candidates are consistent with a model of rational voting.

The paper is organized as follows. Section 2 describes the exact electoral formula, as well as the context of the 2011 Zurich regional election. Section 3 describes the predictions of a rational voting model in such elections. Section 4 checks whether these predictions are consistent with both aggregate results and individual behaviour. Section 5 concludes.

2. The electoral context

This study focuses on the election of the regional government in the Swiss canton (the regional unit of the Swiss federal state) of Zurich, held in April 2011. In this canton, the government, composed of seven members, is elected in a single electoral district. The election is based on a two-round system, in which candidates need to reach an “absolute” majority of the votes to be elected in the first round.

On the first round, citizens can cast as many votes as there are seats to be filled (i.e., up to seven votes). However they can also cast fewer votes. "Cumulative voting", that is, giving several votes to the same candidate, is not allowed. Votes can be given to any citizen with the right to vote in that election. In other words, votes are not limited to an official list of candidates that would be determined before the election. Nonetheless, most votes are concentrated on the well-defined set of registered candidates. These are candidates who have been nominated by their respective parties or who have made their candidature public in some other way. The possibility to give a vote to any eligible citizen however means that a significant proportion of the votes go to additional persons. In the April 2011 election, this was the case for 8 per cent of the votes cast.

Candidates are elected in the first round if they reach some minimal majority threshold (and get one of the seven highest numbers of votes). This threshold is equal to the total number of candidate votes cast (that is, individual votes for candidates), divided by twice the number of seats, and rounded up to the next integer. As most citizens partially abstain by using only part of their seven votes, this threshold is substantially lower than one based on the absolute majority of voters. That is, as citizens use only part of their votes, a candidate can be elected in the first round while being supported by less than half of the citizens.[1] In practice, it means that all candidates in Zurich are usually elected in the first round. No second round has been necessary in recent history.[2] In fact, the number of candidates that pass this majority threshold is often larger than the number of seats, in which case those with the highest numbers of votes are elected. This observation will be used to make some simplifying assumptions when building our theory of strategic voting in this election.[3]

In the (largely hypothetical) second round, citizens can cast as many votes as there are seats that remain to be filled (that is, the total number of seats in the government, minus the number of candidates elected in the first round). Like in the first round, votes can be given to any eligible citizen. This implies that parties can put forward new candidates in the second round. The candidates with the highest numbers of votes are elected.

The election in Zurich took place on April 3, 2011. There were 9 registered candidates, competing for the seven seats of the regional executive. They represented six political parties:

[1] In the election on which we focus, the majority threshold corresponded to 31% of voters.

[2] This holds for general elections, which take place every four years. However, in the case of partial elections following a government member's resignation, second rounds are more common.

[3] While most other Swiss cantons use a similar electoral system to elect their government, the way in which the first round majority threshold is set varies between cantons (Vatter 2002). Most common is a more restrictive threshold, equal to the number of valid ballots (and not candidate votes cast), divided by two and rounded up to the next integer. With this alternative system, a second round is usually necessary.

- two left-wing parties: the Social-Democrats (SP) with two candidates and the Greens (GPS) with one candidate,
- two parties in the centre: the Evangelical People's Party (EVP) and the Christian-Democrats (CVP), with one candidate each,
- two right-wing parties: the Liberals (FDP) with two candidates and further on the right the Swiss People's Party (SVP), also with two candidates.

Table 1 indicates the official results, with the party affiliation of the candidates (Candidates are ranked by decreasing scores obtained in the official election). The seven members of the regional executive were elected in the first round. Note that among the nine registered candidates, eight received more votes than the minimal majority threshold (reported in the last line of Table 1, 84 034 votes).

Table 1: Official results of the Zurich governmental election, 3 April 2011

Candidate	Votes (numbers)	Result
Mario Fehr (SP)	137 035	Elected 1st round
Thomas Heiniger (FDP)	134 061	Elected 1st round
Ernst Stocker (SVP)	129 943	Elected 1st round
Ursula Gut (FDP)	129 349	Elected 1st round
Markus Kägi (SVP)	123 159	Elected 1st round
Regine Aeppli (SP)	121 144	Elected 1st round
Martin Graf (GPS)	120 815	Elected 1st round
Hans Hollenstein (CVP)	118 487	
Maja Ingold (EVP)	68 996	
Others	93 485	
Number of candidate votes cast	1 176 474	
Number of voters	273 256	
Majority threshold	84 034	

Note: The total number of voters includes only individuals who casted a valid ballot.
Source: Statistical office of the canton of Zurich.

3. A simple model of rational voting

In a companion paper (Laslier and Van der Straeten 2014), we propose a "trembling hand" theory of strategic voting under "Committee Approval" in the manner of Myerson and Weber (1993) or Laslier (2009). By Committee Approval, we mean a situation where a fixed-sized committee of *M* members is to be elected from a fixed set of K candidates. Voters vote by casting votes for ("approving") candidates; they can give at most one vote to a candidate (no "cumulative voting"); they can approve at most V candidates (in the case of Zurich, $V=M$). The M candidates with the highest numbers of votes are elected. Ties, if any, are randomly broken. We make two main assumptions in our model:

ASSUMPTION 1: Voters' preferences over committees are supposed to be additively separable across candidates in the following sense: each voter has a utility function for candidates, and her utility for any given committee is simply the sum of her utility for the M candidates composing this committee. Besides, when voting, voters are purely instrumental (no expressive motives).

ASSUMPTION 2 ("trembling ballot" assumption): There exists a tiny probability that any vote might be mis-recorded: any YES vote for a candidate can wrongly be recorder as a NO vote, and symmetrically, any NO vote for a candidate can wrongly be recorder as a YES vote. Mistakes are independent across candidates and across voters. This assumption guarantees that whatever the profile of ballots cast by the voters, all electoral outcomes (realized scores of candidates) have a positive probability.

How should a rational voter vote under such assumptions? In rational models of strategic voting, voters cast their votes anticipating their influence on the outcome. The first step of reasoning for a voter is therefore to consider all the events (that is, the distribution of other voters' votes) such that she is in a position to cast a decisive vote. Indeed, whenever she is not pivotal, the same set of candidates is elected whatever her ballot is, and thus all actions yield the same payoff. She then needs to assess the likelihood of these pivot-events, to be able to compute the expected utility associated to each possible ballot. We show that under these assumptions, a rational voter should act as follows (Proposition 11 in Laslier and Van der Straeten 2014):

- *Step 1: Given her anticipations about the behaviour of other voters, the voter identifies the set of candidates she expects to be elected (denoted by c_1 to c_M) or not (denoted by c_{M+1} to c_K), according to the scores she expects for them:*[4]

- *Step 2: For $1 \le k \le M$, define candidate c_K's "main contender" as c_{M+1}, and for $M+1 \le k \le K$, define candidate c_K's "main contender" as c_M.*
- *Step 3: The voter ranks the candidates according to (the inverse of) their distance, in terms of expected votes, to their main contender.*

[4] We use a slight change in notation compared to Laslier and Van der Straeten 2014. Here, we drop the (voter) index indicating that the voter's anticipations take into account the ballots of all the other voters, but not her own. We do not believe it may create any confusion.

- *Step 4: The voter considers all the candidates in turn, according to the priority order defined at Step 3. As long as the voter does not hit the vote-budget constraint (V votes), she votes for a candidate if and only if her utility for this candidate is larger than her utility for its main contender.*

Notice the importance of the two pivotal candidates: the weakest expected winner (c_M) and the strongest expected loser (c_{M+1}). The intuitive content of this rule is the following: the elected committee will probably be $\{c_1..... c_M\}$. But if something different happens due to my vote, what can it be? If one of the expected winners were to be replaced in the set of winners by a losing candidate, this losing candidate is most likely to be c_{M+1}, the one with the largest score. Therefore in order to decide whether I want to approve an expected winner or not, I should compare it to its main contender c_{M+1}. Consider now the expected losers. Who is their "main contender"? Their main contender is the weakest expected winner c_M, and the same reasoning leads me to compare the expected losers to the expected weakest winner c_M. Note that the two types of reasoning concur with respect to c_M and c_{M+1} themselves: I approve the one I prefer, and not the other.
Given the limited number of votes I have, I consider the candidates lexicographically, in the order defined in Step 3. In this order, candidates are ranked according to their distance to their most likely contender (in numbers of expected votes). This is equivalent to ranking them by decreasing probability of them being caught in a tie for election. Indeed, our trembling ballot assumption implies that the most likely pivot-event is a tie between the two candidates who are expected to rank *M*-th and *M*+1-th (here candidates c_M and c_{M+1}). What is the next most likely pivot-event? Note that all the other pivot events imply some order reversals among candidates, compared to the expected order. What is the next pair of candidates between which the voter is most likely to be pivotal? Our assumptions imply that it will be either the pair $\{c_M, c_{M+2}\}$ or the pair $\{c_{M-1}, c_{M+1}\}$, depending on whether the difference in expected scores between c_M *and* c_{M+2} is larger or smaller than the difference in expected scores between c_{M-1} *and* c_{M+1}. Indeed, they are the two pairs which require the less order reversals compared to the expected outcome. Similarly, other pivot-events can be ranked by decreasing probability of occurrence.

Note that the rule used in Zurich differs from "pure" Committee Approval on a number of dimensions:

1. In Zurich, there exists a minimal majority threshold to be elected in the first round. If some seats remain to be filled after the first round, a second round is organized.
2. In Zurich, the candidates include both registered "official" candidates and non-registered candidates.

These points are not taken into account in Laslier and Van der Straeten (2014) but we will see, in view of the data, that they can in fact be safely neglected.

4. An empirical evaluation of the rational model

4.1 Data

Our analysis is based on data collected as part of the research project *Making Electoral Democracy Work* (Blais 2010). A two-wave panel survey was conducted on the occasion of the parliamentary and governmental elections (to be held on April, 3rd 2011). Respondents were interviewed in the last two weeks before the election, and again in the week following the election. 1192 respondents completed the pre-electoral wave and among these, 842 also completed the second questionnaire.[5] These surveys were conducted online by Harris International, relying on a panel of respondents from the Swiss polling firm Link. The sampling was based on a stratified, quota-based approach. Quotas were set by controlling for age, gender and education status. The participation rate was 36% in the pre-electoral wave and 71% in the post-electoral wave.

In order to test our strategic voting model, we need information about citizens' candidate preferences, on their anticipations about the scores of the candidates, and on their actual vote choice. Vote choice was measured either in the pre-electoral wave or in the post-electoral wave, depending on when respondents cast their vote. Advance postal voting is widespread and about half of the respondents in the pre-electoral wave had already voted. We assess respondents' voting choices using the following question:

> *For the cantonal government election you had up to 7 votes. Which candidates did you vote for? (up to 7 answers possible)*
>
> - *Regine Aeppli (SP)*
> - *Ursula Gut (FDP)*
> - *Thomas Heiniger (FDP)*
> - *Ernst Stocker (SVP)*
> - *Markus Kägi (SVP)*
> - *Hans Hollenstein (CVP)*
> - *Mario Fehr (SP)*
> - *Maja Ingold (EVP)*
> - *Martin Graf (Greens)*
> - *Other candidate*
> - *Don't know*

[5] These figures exclude respondents who started but did not complete the corresponding wave(s). They also exclude respondents who were disqualified on the basis of quality measures, seeking to identify those respondents who appear unengaged, for example by giving illogical responses or by completing the survey too quickly.

To construct individual preferences over the candidates, we use the following battery of questions from the pre-electoral wave:

Please rate each of the following candidates on a scale from 0 to 10, where 0 means you strongly dislike that candidate and 10 means that you strongly like that candidate.

There was no question in the survey on the respondents' anticipations about the electoral outcomes. We will explain in section 4.2 the assumptions we make about these anticipations. Given that some respondents had already voted at the time of the first interview, our sample is not limited to respondents who participated in both panel waves. Out of the 1192 respondents, 502 can be included in the analysis. 451 respondents are excluded because they did not vote and 239 (among voters) because they did not evaluate one or several candidates. Table 2 compares the electoral scores of the registered candidates in the official election and in our sample.

Table 2: Distribution of votes for the registered candidates in the official election and in the sample

	Official election Scores		Sample Scores		Sample relative bias
Candidates	Nb of votes	% of voters	Nb of votes	% of voters	in %**
Mario Fehr (SP)	137 035	**50.15**	298	**59.36**	+18%
Thomas Heiniger (FDP)	134 061	**49.06**	268	**53.39**	+9%
Ernst Stocker (SVP)	129 943	**47.55**	221	**44.02**	-7%
Ursula Gut (FDP)	129 349	**47.34**	257	**51.20**	+8%
Markus Kägi (SVP)	123 159	**45.07**	202	**40.24**	-11%
Regine Aeppli (SP)	121 144	**44.33**	272	**54.18**	+22%
Martin Graf (GPS)	120 815	**44.21**	269	**53.59**	+21%
Hans Hollenstein (CVP)	118 487	**43.36**	263	**52.39**	+21%
Maja Ingold (EVP)	68 996	**25.25**	154	**30.68**	+22%
Average nb of votes per ballot*	3.96		4.39		
Number of voters	273 256		502		

* The average number of votes per ballot is computed restricting attention to the nine registered candidates.
** The sample relative bias of a candidate is the difference between the score of the candidate in the sample and the score of the candidate in the official election, divided by the score of the candidate in the official election.

When comparing the scores of the candidates in the official election and in our sample, we observe that, in our sample, all candidates except the ones from the SVP (the mot right-wing party) get higher scores than in the official elections. As shown in the last column of Table 2, the bias is moderate for the two FDP (moderate right) candidates (about 8 or 9%), and is larger for the remaining centre and left wing candidates (around 20%). The fact that there exists a left-wing bias in our sample will not be problematic when testing our model, since, as will become clear in the empirical strategy section, all our analyses will be conducted at the individual level: the objective is to check whether each individual in our sample casts votes which are consistent with the recommendation of the rational model.

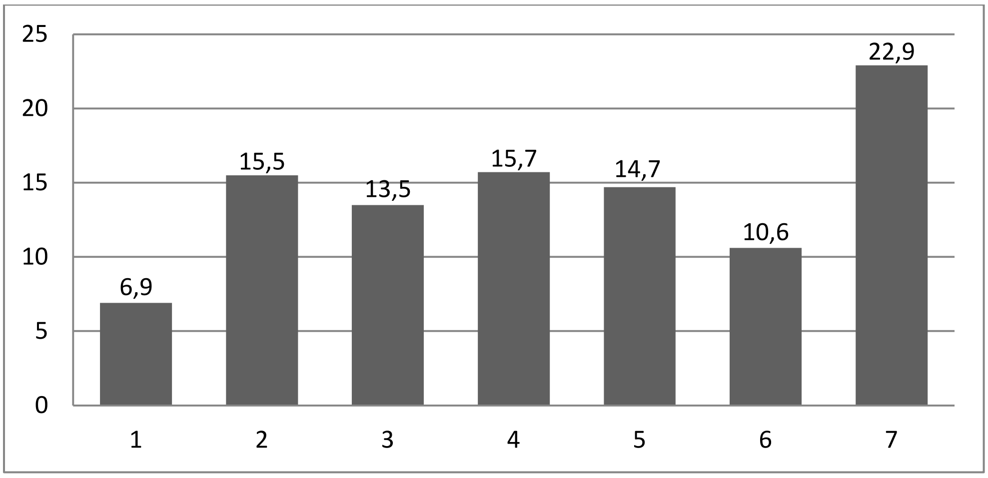
Our analysis will focus on explaining the votes for the registered candidates. Indeed, we have very little information about non registered citizens who receive votes. We do not have voters' evaluations of these persons, and their nominal vote counts are not even recorded in the official election results. This is why in Table 2 we ignore the non-registered candidates. In particular, when computing the average number of votes per ballot, we only consider the votes cast for registered candidates. The number for the official election is computed using the figures in Table 1 and is equal to 3.96 votes per ballot.[6] In our sample, the average number of votes for registered candidates per ballot is 4.39, which is larger than what is observed in the official election (3.96). Therefore our sample slightly overestimates the number of votes per ballot (+11%). The most plausible explanation for this higher number of votes is that we only keep voters who were able to evaluate all 9 candidates, thus restricting attention to well informed voters. Since there is some evidence suggesting that lack of information about the candidates is correlated with casting fewer votes (see Lachat and Kriesi, 2013), selecting the more informed voters may be responsible for this bias.

We will explain when describing our empirical strategy why ignoring the non-registered persons will not bias the way we study the votes for the registered candidates (simply denoted hereafter by "the candidates").

Figure 1 provides more information about the number of votes cast by respondents in our sample, by showing the distribution of the numbers of votes per ballot (still restricting attention to the nine registered candidates).

[6] There were 273 256 voters, casting 1 176 474 votes, 93 485 of which for non-registered candidates (see Table 1). Not taking into account the votes for non-registered candidates, the number of votes per ballot is equal to *(1 176 474-93 485)/273 256=3.96*. If non-registered candidates were included, this number would be 4.31 *(1 176 474/273 256)*.

Figure 1: Distribution of the number of votes per ballot (in % of ballots)



Note that the modal number of votes per ballot is 7 (23% of the ballots). Ballots with a single name are the least frequent (7%).

Lastly, Table 3 provides the means and the standard deviations of the evaluations received by the candidates (on a 0-10 scale).

Table 3: Evaluations and scores of the registered candidates in the sample

	Sample Evaluations		Sample Electoral scores
Candidates	Mean	Standard deviation	% of voters
Mario Fehr (SP)	5.54	3.27	59.36
Thomas Heiniger (FDP)	5.39	2.64	53.39
Ernst Stocker (SVP)	4.48	3.40	44.02
Ursula Gut (FDP)	5.12	2.74	51.20
Markus Kägi (SVP)	4.33	3.35	40.24
Regine Aeppli (SP)	5.11	3.09	54.18
Martin Graf (GPS)	5.31	3.17	53.59
Hans Hollenstein (CVP)	5.16	2.66	52.39
Maja Ingold (EVP)	4.38	2.86	30.68

We observe a strong correlation (coefficient 0.92) between the electoral score and the mean evaluation of the candidates.

4.2 Empirical method

For each voter, we will compute the strategic recommendation as defined in Section 3, and compare it to his/her actual vote. For the time being, we restrict our attention to the registered candidates (we will explain below why we can safely do so). As explained above, to vote strategically, voters must start by anticipating the expected scores of the different candidates in order to evaluate the likelihood that they might get involved in a tie (or a near tie). We assume that they form anticipations which are on average perfect. That is, their anticipations are such that the average expected scores of the candidates coincide with the official scores. (In the Appendix we present results from a series of replications, in which expectations about candidate chances are based on poll results instead).

Table 4 presents all the information needed to establish the strategic recommendation for each voter, in particular:

- Step 1: It establishes the set of expected winners (shaded in light grey) and of expected losers (shaded in darker grey), based on the number of votes they received in the official election (Column 2) and the associated rank (Column 3). Recall that all the first 7 candidates were elected in the first round (See Table 1). In particular, the names of the two critical candidates: the weakest expected winner (Martin Graf) and the strongest expected winner (Hans Hollenstein) are written in bold characters and underlined.
- Step 2: For each candidate, Column 4 identifies his/her main contender. If the candidate is expected to be a winner, its main contender is the strongest expected loser (here Hans Hollenstein), whereas if a candidate is expected to be a loser, its main contender is the weakest expected winner (here Martin Graf).
- Step 3: Using the distance (in expected scores) between each candidate and his/her main contender (Column 5), one can derive the priority order in which order the voters should consider the candidates (Column 6).

Note that in Section 3, a voter's anticipations are defined taking all other voters' votes into account, but not taking into account her own vote. Therefore, in full rigor, each voter should form a similar table, where the computations are made excluding her own vote. Given the scores obtained by the candidates, this would not change the ordering of candidates, nor the strategic recommendation. We therefore reason for all voters on the basis of the figures given in Table 4.

Table 4: information needed to establish the strategic recommendation

(1)	(2)	(3)	(4)	(5)	(6)
Candidates	Number of votes	Rank in official election	Main contender	Distance to main contender (nb of votes)	Priority order
Mario Fehr (SP)	137 035	1	H. Hollenstein	18 548	7
Thomas Heiniger (FDP)	134 061	2	H. Hollenstein	15 574	6
Ernst Stocker (SVP)	129 943	3	H.Hollenstein	11 456	5
Ursula Gut (FDP)	129 349	4	H.Hollenstein	10 862	4
Markus Kägi (SVP)	123 159	5	H.Hollenstein	4 672	3
Regine Aeppli (SP)	121 144	6	H. Hollenstein	2 657	2
Martin Graf (GPS)	120 815	7	H. Hollenstein	2 328	1
Hans Hollenstein (CVP)	118 487	8	M. Graf	2 328	1
Maja Ingold (EVP)	68 996	9	M. Graf	51 819	8
Others	93 485				

Once the main contender and the priority order of each candidate have been established, Step 4 of the strategic recommendation easily follows: The voter considers all the candidates in turn, according to the priority order defined in Column 6. As long as the voter does not hit the vote-budget constraint (*7* votes at most), she votes for a candidate if and only if her utility for this candidate is larger than her utility for its main contender.

So far, we have neglected non-registered citizens who received votes. Although non-registered names receive a substantial number of votes (93 485 votes, see last line of Table 4), these votes are dispersed on many different names. It is not possible to know how many votes the strongest "other" candidate received, as these votes are not broken down by individual candidates in the vote counting process. Yet, given that there was no other serious candidate besides the nine official ones, we can be confident that the distance between any of these persons and their main contender (in their case the weakest expected winner Martin Graf) is much larger than all the distances computed for registered candidates. Therefore, their probability to be part of a pivot-event is negligible compared to those of the registered candidates. Introducing these candidates in the above analysis would not alter the strategic recommendation regarding the vote for (or against) the registered candidates.

In the above analysis, we have also neglected the minimal majority threshold that a candidate needs to reach in order to be elected at the first round. What happens to the strategic reasoning described so far if one explicitly takes into account this majority requirement? There are now two types of pivot-event featuring candidate *c*:

(i) There exists another candidate *c'* such that candidates *c* and *c'* are caught in a tie (or a near tie) for the *M=7*th rank, and both of them are above the majority threshold. In this case, the voter is pivotal in changing the chances of candidates *c* and *c'* to be elected at the first round;

(ii) Candidate *c* is ranked *M=7*th or above, and he gets a number of votes (from other voters) equal to the threshold majority minus one vote. In that case, by voting for this candidate, the voter is able to make him a first round winner rather than having him being a first round loser (who might still be elected on the second round though).

So far, we have neglected type (ii) events. We defend this simplification by noting that the first 8 candidates are all well above this threshold, and that their distance to the threshold is much larger than the distance to their main contender (See Table 1). The exception is the candidate ranked 9th (Maja Ingold). She is below the majority threshold and the distance to the majority threshold is larger than her distance to her main contender (who is above the threshold). For this candidate, the most likely type (i) event is that there is a tie (or almost tie) with the candidate ranked 7^{th} (Martin Graf). And the most likely events where she ties (or almost ties) with candidate Martin Graf entails that she receives more votes that Hans Hollenstein, in which case she will be above the majority threshold. For a type (ii) event to happen, both candidates 7 and 8 need to fall below the majority threshold, which requires many more mistakes. The latter is therefore much less likely than the former. [7]

Finally, we need to explain how we deal with the case of a respondent who gives the same evaluation (on a 0 to 10 scale) to a candidate and to his main contender (see section 4.1 for the definition of these evaluations). Consider a voter who has not used all her seven votes yet, and still have some (registered) candidates to consider according to the algorithm described above. Suppose that she now has to compare candidate *c* to his most likely contender, and that, in the survey, the

[7] We only provide quite informal arguments in this paragraph. Developing more formal arguments would be complicated by the fact that any mistake (mis-recorded vote) on a candidate impacts both the individual score of this candidate and the majority threshold. More precisely, if a YES vote for a candidate is wrongly recorder as a NO vote, it decreases by one vote the score of this candidate, and it decreases the majority threshold by about 1/14 (see the definition of the majority threshold in Section 2). We will simply consider that voters neglect the possibility of a second round.

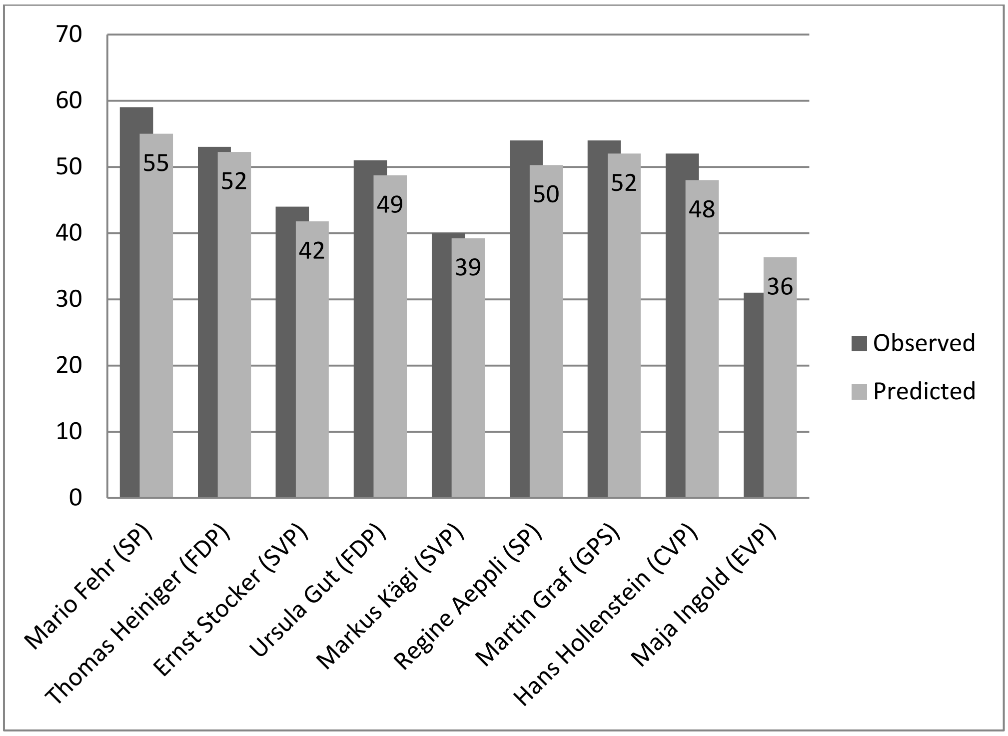
voter gives the same evaluation to both candidates. This situation has two possible interpretations: either the voter is perfectly and exactly indifferent between the two candidates, or she actually prefers one candidate over the other, but given the finite 11-point scale, she is bound to give them the same evaluation. We consider the latter explanation as being more plausible, and we decide to treat that case in the following way. Each voter in the sample is duplicated 99 times. For each of these 100 observations corresponding to a single voter, if she happens to give the same evaluation to any two candidates c and c', the reported indifferences between candidates c and c' are broken randomly, where each strict preference is assigned the same probability.

4.3 Results

Our aim is to assess to which degree the votes cast in the 2011 Zurich elections fit with the predictions of our rational voting model. We look at the model predictions from two different angles: aggregate level predictions, and individual-level predictions.

Aggregate predictions of the model We first study the aggregate predictions of the rational model. Figure 2 indicates for each candidate the observed and predicted scores, in our sample.

Figure 2: Candidate scores, observed and predicted (% of voters)

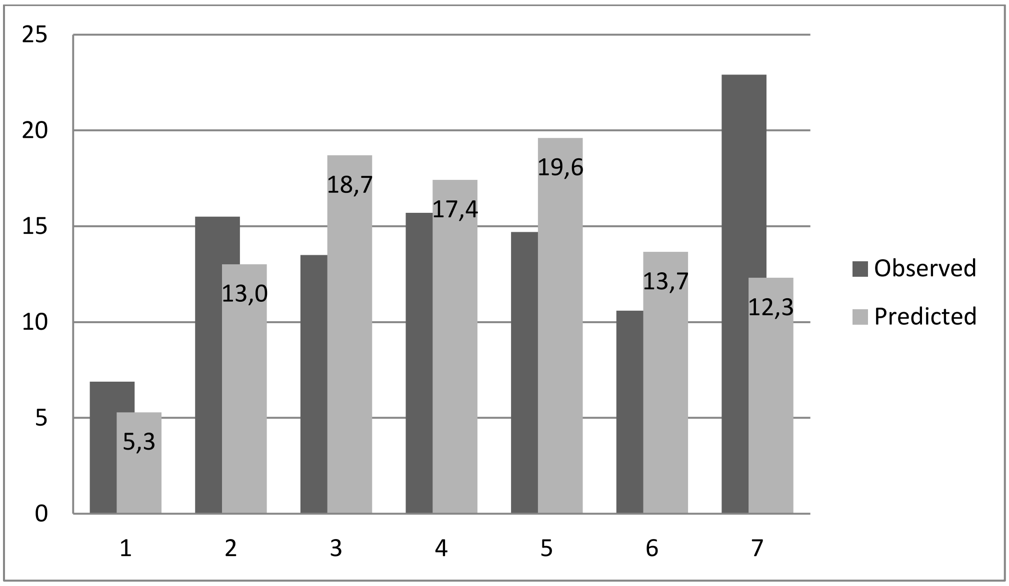


Observe in Figure 2 that the strategic model performs quite well in explaining the electoral scores in the sample. The largest relative error is observed for the last candidate, Maja Ingold, where the strategic model over-predicts her score.

It is noteworthy that the “*M+1* rule”, according to which voters should concentrate on a group of top candidates, the size of which is equal to the district magnitude (*M*) plus one (Cox 1997), does not apply here. All candidates including the ninth candidate can get a significant number of votes.

Regarding the predictions about the number of votes per ballot, the average predicted number of votes per ballot is 4.23, against 4.39 in the sample; there is thus a slight under-prediction of the average number of votes. As can be seen in Figure 3, the predicted distribution is hump-shaped and fails to predict the mode of the observed distribution at 7 votes per ballot: compared to the rational recommendation, too many full ballots are cast in the sample.

Figure 3: Number of votes per ballot (in %)



Individual level analysis In the survey, we have 502 respondents who have answered all the evaluation questions and the vote question. Given that nine candidates are registered, we have 502*9= 4 518 voter*candidate observations.

Table 5 provides (last column) the percentage of correct prediction for each candidate, and on average (last line). One sees that the overall average percentage of correct prediction is 69%

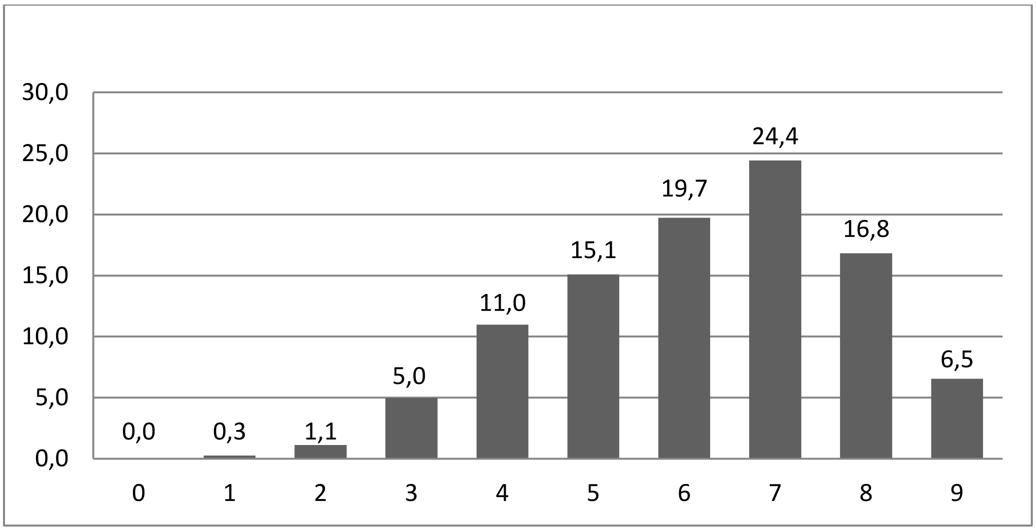
Table 5: Percentage of correct predictions, per candidate

(1)	(2)	(3)	(4)	(5)	(6)
	% of positive predictions	% of correct predictions among positive predictions	% of negative predictions	% of correct predictions among negative predictions	Average % of correct predictions
Mario Fehr (SP)	55	84	45	70	78
Thomas Heiniger (FDP)	52	64	48	59	62
Ernst Stocker (SVP)	42	73	58	77	75
Ursula Gut (FDP)	49	63	51	60	61
Markus Kägi (SVP)	39	70	61	79	75
Regine Aeppli (SP)	50	78	50	70	74
Martin Graf (GPS)	52	78	48	73	76
Hans Hollenstein (CVP)	48	63	52	58	60
Maja Ingold (EVP)	36	36	64	72	59
Average	47	69	53	69	69

This overall average number can be decomposed by candidate and by the sign of the strategic recommendation (positive: "Vote for the candidate", or negative: "Don't vote for this candidate"). Table 5 also provides such decompositions. Column 2 indicates the number of positive predictions for each candidate, and column 3 indicates the percentage of correct predictions among such positive predictions. Column 4 indicates the number of negative predictions for each candidate, and column 5 indicates the percentage of correct predictions among such negative predictions. We observe that on average (see the last line in the table), the percentage of correct predictions is the same whether the strategic recommendation was to vote NO (negative prediction) or to vote YES (positive prediction) for a candidate. Consistently with the observation made on Figure 2 that the rational model over-predicts the score of the EVP candidate Maja Ingold, we observe in Table 5 that in cases where a voter was predicted to vote for her, only 36% were observed to do so. This is the only cell in Table 5 where the percentage of correct predictions falls below 50%.

Last, we construct a general indicator of individual rationality by counting, for each individual, the number of votes correctly predicted in his/her ballot. Figure 4 below depicts the distribution of this indicator.

Figure 4: Number of correct predictions in the ballot (% of ballots



Although we observe that only 6.5% of the ballots are fully consistent with the nine rational recommendations, we see than in almost half of the ballots (47.7%) the number of correct predictions is at least 7 (out of 9 votes).

In view of these results, we conclude that the rational model performs fairly well in explaining individual voting decisions.

Discussion: Strategic versus sincere voting? As noticed in Laslier and Van der Straeten 2014, in theory, strategic voting may entail casting non-sincere ballots (Proposition 4). How often does it happen in this specific election? According to the usual definition in the Approval Voting literature (Brams 1982), define a ballot as sincere if it satisfies the following condition: if a voter votes for a candidate she also votes for all the candidates to which she gives a strictly higher evaluation.
We are going to show that in this election, in most cases, the strategic recommendation satisfies this notion of sincerity.

Consider first the first eight candidates (the seven expected winners plus the strongest expected loser). All these candidates have a priority order of at most 7 (Table 4, Column 6), which means that the constraint on the number of votes (the voter is allowed to cast at most *M=7* votes) is not binding when the voter decides whether to vote for these candidates or not. It is straightforward to check that if the strategic recommendation implies voting for one of these eight candidates, it also implies voting for all the candidates with higher evaluation. Indeed, if the voter prefers Hans Hollenstein (the strongest expected loser) to Martin Graf (the weakest expected winner), she should vote (among those eight candidates) for all candidates she prefers to Hollenstein plus Hollenstein, whereas if she prefers Martin Graf to Hans Hollenstein, she should vote (among those eight candidates) for all candidates she prefers to Hollenstein (but not for Hollenstein). In both cases, it implies sincere voting among the set of the top eight candidates.

Now consider the last candidate, Maja Ingold. There are only two types of situations where sincerity can be violated:

(1) The voter has used her seven votes when considering the first 8 candidates, and she has no vote left to vote for Maja Ingold, even if she likes her better than Martin Graf (her main contender) and some of the expected winner she has already voted for.

(2) The voter still has (at least) one vote left, and there exists an expected winner *c* other than Martin Graf such that the voter has the following ranking in her utility for the candidates: u(Hollenstein)>u(c)>u(Ingold)>u(Graf); in that case, the voter should vote for Ingold (since she prefers Ingold to her main contender Graf), but not vote for the expected winner *c* (since she likes *c* less than its main contender Hollenstein).

This example is useful in that it illustrates the two potential causes as to why the strategic recommendation might not be sincere in general:

(1) The constraint on the number of votes is binding,

(2) The expected winners are compared to the strongest expected losers, whereas the expected losers are compared to the weakest expected winner (note that is all candidates where compared to the same benchmark, sincere voting would result – neglecting the constraint on the number of votes).

It turns out that in our data, the strategic recommendation quite often leads to a sincere ballot. We computed that in over 90% of our voters in the sample, the strategic model predicts that the voter should cast a sincere ballot.

In case the strategic model predicts a violation of sincerity, it is interesting, to get a more precise quantification of this violation, to compute the number of pairs of candidates on which sincerity is violated, where we say that sincerity is violated on a set {*c,c'*} of any two candidates if and only if the voter votes for one candidate and does not vote for the other, although she prefers the latter to the former. Table 6 below reports the distribution of the number of pairs which violates sincerity.

Table 6: Distribution of the number of pairs violating sincerity per ballot (in % of ballots)

Number of pairs in a ballot which violate sincerity	0	1	2	3	4	5	Total
% of ballots	90.2	3.2	3.6	2.0	0.6	0.4	100

Table 6 reads as follows: 90.2% of the strategic ballots display no violation of sincerity. 3.2% of the strategic ballots are such that in these ballots, sincerity is violated for one and only one pair of candidates… When one computes the percentage of pairs (and not ballots) which violate sincerity, one gets 0.57%.

Contrary to what happens in a uni-nominal single-member district elections (*M=1*) where strategic voting contradicts sincerity whenever a voter's preferred candidate is not one of the two main front-runners, we observe that in this election in a multi-member district with multiple votes, the strategic recommendation does not violate in practice a basic notion of sincerity. Note that this low number is related to the fact that the number of candidates (9) is very close to the number of seats (*M=7*).

5. Conclusion

The way canton governments are elected in Switzerland provides an interesting case study of multi-nominal, approval-type, voting. We concentrated on the Zurich cantonal election, where 7 candidates have to be elected, and voters are allowed to cast a vote in favor of up to 7 candidates.

For the 2011 election, a pre-electoral survey was conducted, which allows linking individual level votes and preferences. We took advantage of these data to study the predictions of the rational voting paradigm, in this context. We proved that rational optimization often suggest the voter to approve of many candidates, a theoretical conclusion that matches the observation. In the details of the individual approvals, the explanatory power of the rational model that we tested is of the order of 70%.

These results are encouraging in the sense that a purely theoretical model was able to render a good part of non-trivial facts. But we would like to stress here that the election under study had some distinguished and original features, which call for caution when generalizing our findings about the good performance of the strategic model to other contexts.

The first point is that the number of candidates in 2011 was such that most of them were to be elected: 7 out of 9. As seen above, this fact led to a noticeable feature of the strategic model in that specific election: its predictions rarely contradict some basic notion of sincerity. The second point is that no candidate was clearly sure to be elected: the final score of the best-elected candidate was not so different from the score of the 8-th ranked candidate. These specific features are such that more applied analysis of the same kind would be welcome.

APPENDIX: Alternative assumptions about the anticipations

In the strategic model, two candidates play a key role: the weakest expected winner and the strongest expected loser. The voter's decision is based on a comparison of the expected winners with the strongest expected loser, and of the expected losers with the weakest expected winner. In the official results of the 2011 Zurich election, the scores received by the different candidates were very close. In particular, the weakest winner (Martin Graf) receives the vote of 44% of the voters, while the strongest loser (Hans Hollenstein) receives the votes of 43% of the voters, the vote gap being of only 2 328 votes (see Table 2). Moreover, the scores of the other candidates are also quite close, since the candidate receiving the highest score (Mario Fehr) receives the votes of 50% of the voters. Only the weakest candidate of all (Maja Ingold) receives substantially fewer votes (25%). So it might have been very difficult for voters to correctly predict the expected scores of the different candidates. Indeed, some evidence for this difficulty is provided by the results of a poll, which was conducted by IsoPublic on March 22 2011, that is, two weeks before the first round of the election (April 3). Table A1 below reports the results of this poll, together with the official results.

Table A1: Score, Rank, Main contender, Distance from main contender and resulting priority rank, for each candidate, using as the basis for anticipations the official results and the poll results

	Official					**Poll**				
Candidates	**%**	Rank	Main contender	Distance to main contender (% points)	Priority Order	**%**	Rank	Main contender	Distance to main contender (% points)	Priority Order
Mario Fehr (SP)	**50**	1	H. Hollenstein	7	7	**46**	3	M. Kägi	11	5
Thomas Heiniger (FDP)	**49**	2	H. Hollenstein	6	6	**43**	4	M. Kägi	8	4
Ernst Stocker (SVP)	**48**	3	H. Hollenstein	5	5	**40**	6	M. Kägi	5	2
Ursula Gut (FDP)	**48**	4	H. Hollenstein	5	4	**41**	5	M. Kägi	6	3
Markus Kägi (SVP)	**45**	5	H. Hollenstein	2	3	**35**	8	M. Graf	4	1
Regine Aeppli (SP)	**44**	6	H. Hollenstein	1	2	**49**	1	M. Kägi	14	7
Martin Graf (GPS)	**44**	7	H. Hollenstein	1	1	**39**	7	M. Kägi	4	1
H. Hollenstein (CVP)	**43**	8	M. Graf	1	1	**48**	2	M. Kägi	13	6
Maja Ingold (EVP)	**25**	9	M. Graf	19	8	**19**	9	M. Graf	20	8

The poll correctly predicts the low score of Maja Ingold, who is ranked last. It also put Martin Graf as the weakest winner, which is correct. However, the poll suggests that Markus Kägi should be the strongest loser (although he was elected and finished at rank 5). These poll results show that it was probably a complicated task for the voters to correctly predict the scores of the candidates, and the resulting priority order used to derive the strategic recommendation. Table A1 also provides, for each candidate, the identity of its main contender, as well as its priority rank, based on both the official results and the poll results.

We have replicated the main analysis with these poll results instead of the official results as the basis for the anticipations (Detailed results available upon request).

In terms of the overall number of correct predictions at the individual level, the results based on polls are similar to those based on official results. The overall average percentage of correct predictions with the polls is 68% (69% with official results, see Table 5).

One of the most noticeable differences, however, is the predicted number of votes per ballot. Using the official results, we predicted an average of 4.23 votes, which is only slightly below the observed average of 4.39 votes. Using poll results, in contrast, the model predicts more candidate votes by citizen, with an average of 4.9. The predicted number of full or almost full ballots (with 6 or 7 votes) is substantially larger compared to the main model. This is a consequence of having a far-right candidate as the strongest expected loser (i.e., Markus Kägi from the SVP), instead of a centrist candidate with the official results (Hans Hollenstein). The strongest expected winner is the main contender for most candidates. Since Markus Kägi enjoys a relatively low level of sympathy in our sample compared to Hans Hollenstein (see Table 3), the rational voting model predicts more votes on average for the other candidates, and thus more votes per ballot. These remarks highlight the facts that the precise consequences of the strategic recommendations (e.g. number of votes per ballot) are quite sensitive to the identity of the two critical candidates (the weakest expected winner and the strongest expected loser).

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