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Retrospective voting: An experimental study

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Abstract

This essay reports on some experiments designed to study two candidate electoral competition when voters are 'retrospective' voters. The experiments consist of a sequence of elections in which subjects play the part of both voters and candidates. In each election the incumbent adopts a policy position in a one-dimensional policy space, and voters are paid (on the basis of single peaked utility function over that space) for the position adopted by the incumbent. Neither voters nor candidates are informed of the voter utility functions, and the only information received by the voter is the payoff he has received from the present and previous incumbent administrations. Despite the severely limited information of candidates and voters, we find that, generally, candidates converge toward the median voter ideal point.

1. Introduction

It is well known that most voters are poorly informed about candidates' policy positions and party platforms, about the substantive content and conceptualization of issues, and about how alternative positions on those issues relate to their specific welfares. Confronted with such facts, the classical Downsian spatial model seems an untenable abstraction. Because it is difficult to justify empirically assumptions such as that citizens vote 'for the candidate whose policy position is nearest their ideal point,' or 'for the candidate whose policy position yields the greatest expected utility,' it is tempting to regard models that use such assumptions as irrelevant to understanding democratic processes.

Instead, the empirical data provides more support for a 'retrospective voting' model in which voters have minimal information about contempo-

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rary issues and candidate positions, and where voters base their voting decisions on the performance of past administrations. As V.O. Key (1966) writes:

> [The empirical data] ... graphically reflect the electorate in its great, and perhaps principal, role as an appraiser of past events, past performance, and past actions. It judges retrospectively; it commands prospectively only insofar as it expresses either approval or disapproval of that which has happened before.

According to the retrospective voting hypothesis, then, voters may know nothing of the policy positions adopted during the current campaign by the incumbent and challenging candidates. Indeed, in drawing the distinction between the 'traditional' and 'Downsian' views of retrospection, Fiorina (1981) notes that in the traditional version a voter need not even know the policy positions of past administrations, or have any conceptualization of issues. Instead, voters need only know how well off they were during previous administrations.

This essay does not explore the extent to which the retrospective voting hypothesis explains citizens' decisions, or which view of restrospection is more consonant with those decisions. We are concerned, instead, with the implications of retrospective voting for candidates, and for the policies they are likely to implement if elected. Specifically, we are concerned with how well the political process works *vis-à-vis* the spatial positions adopted by incumbents if voters are forced to choose retrospectively.

In this essay, then, we report on some experiments in which we give voters only the information that they are assumed to use under an extreme version of the traditional definition of retrospection, and we test whether outcomes and the decisions made by voters and candidates are different from the outcomes and decisions that would occur if everyone had the complete information commonly assumed in spatial models of elections. In our analysis we also examine how voters form their evaluations of incumbents and challengers if they are given information only about their utility from past incumbents. Second, we look at how incumbents choose policy positions in the incomplete information setting generated by retrospective voting.

Elsewhere, we examine two types of incomplete information election models, and we show theoretically and experimentally that in both of those models, elections will achieve the same outcome as their complete information counterparts. Those papers differ from this work in several ways. The first model (McKelvey and Ordeshook, 1985a) focuses on a single election, and contrary to the extreme form of the retrospective voting hypothesis, it assumes that voters use contemporaneous information from interest group endorsements, public opinion polls, and the advice of friends. The second

model (McKelvey and Ordeshook, 1985b) more closely parallels the Downsian perspective on retrospection, and gives voters more information about issues and candidates than the traditional retrospective hypothesis admits. That model assumes that voters observe the actual policy positions of past incumbents, as well as a contemporaneous endorsement that tells voters the left-right orientation of the two candidates on the election issue.

Both our previous papers demonstrate that the political process can function with incomplete information, but we cannot use these models to evaluate the traditional retrospective voting hypothesis. First, if as Key asserts, the electorate 'commands prospectively only insofar as it expresses either approval or disapproval of that which has happened before,' then events of the current campaign are irrelevant to a voter's decision, including the endorsements of interest groups and the candidates' avowed positions on issues. We can interpret a campaign as an opportunity for voters to gather information to 'fine-tune' their retrospective evaluations of an incumbent candidate (*cf.* McKelvey and Ordeshook, 1985a). But in the extreme form of the hypothesis, the only information that a voter has concerns the past performance of incumbents, the current incumbent's performance, or the historical performance of the challenger's party relative to the voter's welfare. Second, while our earlier models suppose that both election candidates have well defined positions on the issues and that voters estimate these positions indirectly, retrospective voting supposes that citizens vote on the basis of answers to question such as: 'Am I better off today than I was four years ago?' Voters do not need to know the actual policy positions of previous incumbents or current challengers. In fact, the challenger's campaign promises are irrelevant. Instead, only the utility or benefit attributed to previous and the current incumbent are relevant to voters. In Fiorina's words: 'What policies politicians follow is their business; what they accomplish is the voter's (p. 13)'.

This paper, then, investigates experimentally elections that concern a single issue, in which voters know only what their welfare has been in previous administrations. In our experiments, only incumbents adopt positions on the issue. Modeling the assumption that voters pay no heed to current promises and campaign rhetoric, a challenger must sit idly by and hope that the incumbent misreads voter desires or that voters otherwise choose to see what the challenger might offer as an incumbent. Thus, for voters, any information about the challenger must come from the past, and the principal decision confronting voters is whether or not to reelect the incumbent on the basis of the current and past performance of the incumbent and the past performance (if any) of the challenger. In fact, some of our experiments do not even inform voters about the existence of a campaign issue.

In the next section, 2, we review the details of our experimental procedures. Section 3 summarizes the outcomes of the experiments in terms of

their convergence to the full information outcome (the median voter ideal point). In Section 4, we estimate a decision rule for voters that is suggested by the retrospective hypothesis, and we examine the extent to which subjects abide by such a rule. Section 5 evaluates a similar rule for the candidates. Section 6 assesses whether these rules can be used to explain the extent to which incumbents converged or failed to converge to median preferences. Section 7 examines three variations in the experiments: (1) voters are told that the election concerns a single issue and that each of them has a single-peaked preference over this issue that determines their payoffs, (2) voters are wholly uninformed about the basis of their payoffs, and (3) electorate's median preference is shifted suddenly, without voters or candidates being told of this shift. Section 8 concludes with observations about how our experiments might be modified to address other issues about retrospective voting and incomplete information in elections.

2. Experimental design

This essay summarizes nineteen multiple-trial experiments in which undergraduates at the University of Texas, acted both as voters and as candidates. These experiments were structured as follows: each voter is assigned a single-peaked utility function on an 'issue', where the issue is a numerical scale between zero and one hundred. Voters, however, are not told their utility function. Two subjects are selected as candidates, and they also are uninformed about voter preferences. Candidates are seated in a separate room, and with a coin toss one of them is selected as the initial incumbent. That incumbent must then choose a position on the issue, but the position is not revealed to the voters. Instead, each voter's payoff, based on his or her assigned utility function evaluated at the position selected by the incumbent, is computed and revealed to the voter (payoffs range from zero to seventy cents per voter per period). Voters must then vote on whether to keep the current incumbent in office or to elect the challenger. The winner becomes the new incumbent, and must choose a position in the next election period. This process is repeated a predetermined number of periods (or until time expires, usually two hours). The experiments varied in length from between 23 and 45 periods, with an average length of 34 periods. Each voter's final payoff equals the total of what is earned across all periods (averaging $14), while candidates are paid $1 for each election that they win and nothing otherwise.

To test various hypotheses about retrospective voting, we look at three variants of this procedure. In the first variant, voters and candidates are told that voter preferences are single peaked, and an illustrative utility function is shown to all subjects. In the second variant, neither voters nor candidates

are told about the shape of voters' preferences on the issue. Indeed, voters are not informed about the existence of an issue. Of course, candidates must be told about the issue since this defines their strategy space (the instructions read to subjects in this experiment are presented in this essay's appendix). The third variant is identical to the second except that in the twenty-first period the ideal points of all voters are increased or decreased 35 units (depending on whether the original median is less than or greater than 50). Neither voters nor candidates are informed of this shift, although it does affect voter payoffs immediately.

The comparison of outcomes between the first two experimental variants tests the hypothesis that information about one's utility function and knowledge of the issue are irrelevant to final outcomes. Theoretically, voters should not require the additional information about the shape of their utility functions since they cannot use this information. The traditional version of the retrospective voting hypothesis maintains that not only is contemporaneous information about the candidates' campaigns irrelevant to voting decisions, but that voters have no knowledge about public policy and the issues being debated in a campaign. The second experimental variant models this situation, and we might even speculate that the additional information provided subjects in the first variant will confuse them as they attempt to make use of essentially irrelevant information.

The third variant tests whether candidates respond appropriately to 'shocks' to the system in the form of abrupt changes in taste. These experiments also permit us to assess better the extent to which candidates discount the past, and adjust their beliefs about appropriate strategies to information that is discordant with previous experience. If candidates respond 'quickly', then we have some confidence that retrospective voting does not preclude the selection of appropriate equilibrium strategies; but if candidates respond 'slowly' or not at all, then retrospective voting may induce appropriate outcomes only if there is considerable long-term constancy to the linkages between policy instruments and voters' welfares.

3. A review of the experimental outcomes

Figures 1 – 4 describe four specific experiments. The horizontal axis in each figure denotes election periods, while the vertical axis denotes candidate positions on the election issue and the actual median preference. Squares denote an election period in which candidate 1 is the incumbent and asterisks denote a period in which 2 is the incumbent. Thus, in Figure 1, for example, the coin toss establishes candidate 1 as the initial incumbent and he chooses 70 as his position; but in the first vote, 1 loses, so 2 becomes the incumbent and he choses 30, and so forth.

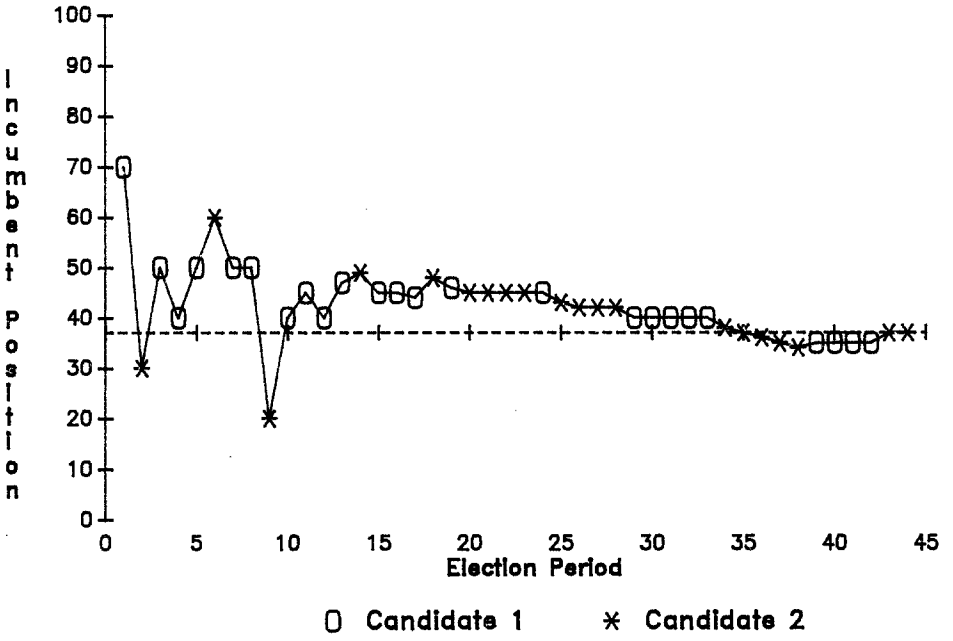

Figure 1.

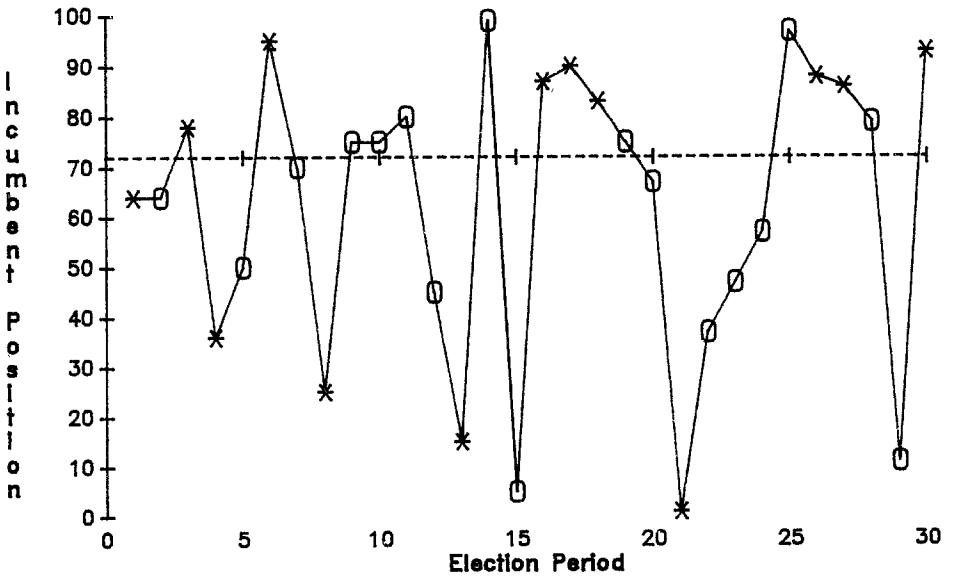

Figure 2.

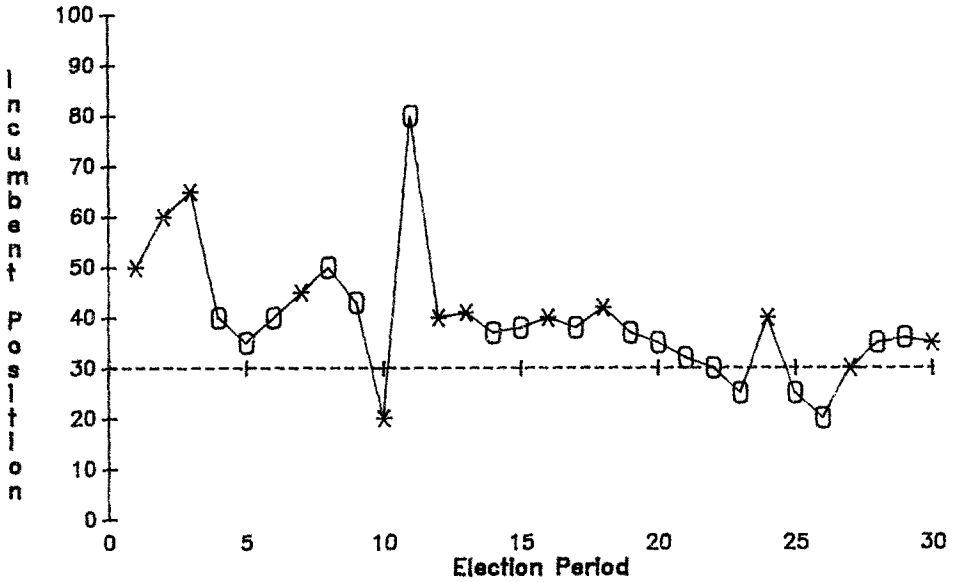

Figure 3.

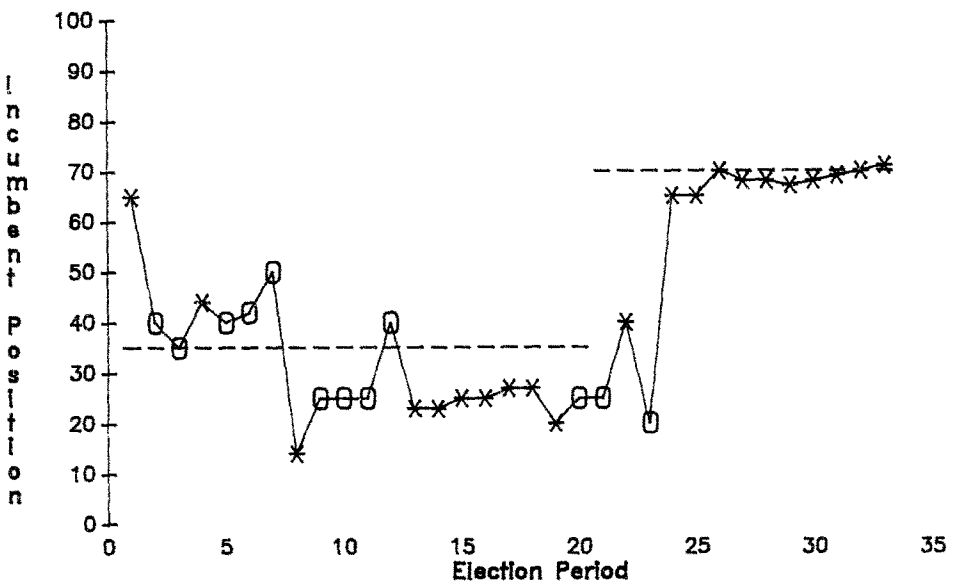

Figure 4.

Figure 1 shows an experiment in which incumbents slowly move towards the median after an initial sequence of sharp fluctuations. Notice how the outcomes of the initial sequence of elections guide the candidates to the general region of the median. Presumably because extreme positions at 70

and 30 lead to the defeat of incumbents, candidate 1 chooses the midpoint 50 in election period 3. A 'voter error' leads to 1's reelection (although we should keep in mind that voters as yet have little on which to base an expectation), and somewhat fortuitously, 1 then shifts towards the median and selects 40. The incumbent, 1, then returns to his initially successful strategy, 50, and is defeated. Candidate 2 fails to read his election as a signal to move down, and moves up instead, which causes him to lose. The new incumbent, 1, returns once again to 50, but is reelected only once. Since strategies in excess of 50 have all been unsuccessful, candidate 2 reads this as a signal to move down, but he over-compensates, and 1 is elected in period 10. Notice, now, that neither candidate ever considers positions outside of the range (30–50). Candidate 1's reelection in period 11 might again be interpreted as voter error, but we should keep in mind that if voters are looking back more than one period, 1's position is better on average for a majority. In period 13, however, 1 moves even further from the median and is replaced by 2 , who once again fails to shift toward the median and is quickly replaced by 1, who moves back toward the median. Hence, while the signals sent by voters in this experiment are not always clear in their interpretation, and while the candidates (especially 2) frequently err, it is evident that the general convergence of the candidates to the median here is not a chance or fortuitous event. Extreme incumbents lose, and as the experiment proceeds voters become more sensitive to small variations in position. Also, errors by one candidate help keep an opponent from making similar errors, since they convey information about what strategies are likely to be successful, and which ones are likely to yield defeat.

In contrast to Figure 1, Figure 2 presents our most obvious 'failure'. Here, the candidates never stabilize about any point. Actually, the signals that voters send are generally clear in terms of what direction they prefer candidates to move, but neither candidate seems able to interpret these signals. Figure 3 shows an experiment that is between the first two, although, again, incumbents that defect sharply from the median are generally punished with a defeat. While the convergence to the median is less precise than in Figure 1, it seems reasonable to suppose that if time had permitted this experiment to run ten or fifteen additional periods, Figures 1 and 3 would not look much different. Finally, Figure 4 illustrates an experiment in which the median is shifted suddenly in the twenty-first period from 35 to 70. Notice that 2 is cautiously moving in the direction of the median from periods 13 to 18. In period 19, however, he chooses a position further from the median, and is defeated. Candidate 2, now the incumbent, moves back towards the median, but is defeated unanimously in period 21, since almost all voter payoffs suddenly decline. Candidate 2 moves sharply up to 40, but voters, presumably remembering earlier payoffs, remain dissatisfied, and 2 loses by a vote of 6 to 1. Candidate 1 moves back to a region

Table 1. Convergence of incumbent's position to median

Periods	1st 10	2nd 10	Last 10
Constant	26.29	17.83	9.99
Slope	.495	.698	.871
Std. error	.059	.051	.056
Std. error of Estimate	15.08	13.19	13.09
R^2	.27	.50	.57
Average dist. from median	13.86	10.36	9.08
Standard dev. of distance	11.06	10.04	10.14

of the issue that had been successful in the past, but he again loses 7 to 0. Convinced, perhaps, that something has changed, or in confusion, the new incumbent successfully tries a radically new strategy, 65.

These figures illustrate some common patterns in the experiments, and they illuminate some of the questions we now ask and answer. Is the experiment that Figure 2 reports truly an aberration? Which experiment, the one that Figure 2 reports, or the one that Figure 1 reports, provides the more reasonable characterization of incomplete information elections with retrospective voting? Might incumbents have moved closer to the median in Figure 3 if the experiment had been run longer?

First, to answer one question, we can safely reject the hypothesis that convergence to the median is a fortuitous event. Indeed, convergence is the most general pattern that emerges in our experiments. Pooling our data across all 19 experiments, let us look first at some simple descriptive statistics that summarize these outcomes. For example, for periods 1 through 10, we find that the payoffs to the median voter average \$.49; for periods 11 through 20 this average increases to \$.55; and for the last ten periods it becomes \$.56 (out of a possible maximum of \$.70), even though we have included the six median shift experiments that might not permit candidates sufficient time to fully adjust to new conditions.

Table 1 presents this data differently. This table summarizes three regressions in which the actual median is the independent variable, and in which the dependent variable is the incumbent candidate's positions in the first ten periods, periods 11 through 20, and the last ten periods. This table also presents the mean and variance of the distance of the incumbent from the median in each range of periods.

We can apply two null models to the estimated coefficients in Table 1. The first is that there is no relationship between an incumbent's strategy and

the electorate's median, in which case the constant is 50 and the slope coefficient is 0. The second null hypothesis is that the candidates have converged to the median, so that the constant is 0 and the slope 1. While we can reject both hypotheses, notice that as the experiments proceed, the slope coefficient increases from .50 to .87, while the estimated intercept decreases as predicted from 26 to 10. The average distance of the candidates from the median, moreover, is less than ten units in the last ten periods. Furthermore, the fit of each regression improves monotonically as the experiment proceeds (R^2 increases from .27 to .57). Thus, while it did not happen in every experiment, these regressions document a general convergence to the median.

The data in Table 1 suggests that incumbents will learn to choose appropriate strategies in stable environments (that is, if the median preference is stable). It is also interesting to note, however, that if we look solely at the six median shift experiments, the average distance of the incumbent from the median in the last ten election periods is not significantly different from the overall average. That is, candidates can learn to track a changing median. Figure 4 illustrates this tracking, but the experiment in Figure 5 provides a more dramatic example of the process. Notice, first, that prior to the shift, the voters (actually, one voter) have allowed candidate 2 to drift away from the median. One voter votes 'incorrectly' in period 21, which allows candidate 1 to remain in office, but when 1 attempts to drift further (now in the direction of the shifted median) he loses, since voter payoffs have suddenly declined. Candidate 2, now the incumbent, wins reelection after moving slightly closer to the new median, but when he returns to the region of 1's earlier successful positions he loses. At this point, the candidates seem confused, as well they might be, since positions that were successful in the past are no longer successful. And while the reelection of candidate 1 in period 28 might reflect a voter error, we should keep in mind that for a majority of voters, 1 might appear to be the better of two bad candidates. In period 29, the incumbent chooses a position approximately midway between the previous four positions, which takes him near the new median, and which secures for him a string of reelection victories until period 42. But, the more extreme positions of 2 lead to his eventual replacement by 1 in the last period of the experiment.

The previous examples should not be interpreted to mean that when convergence occurs, it occurs smoothly or quickly, or that when the candidates move in the 'wrong' direction, it is because of voter errors. Figure 6 illustrates an experiment in which, despite seemingly correct signals from voters, the candidates confuse themselves for a while. Notice, first, that after candidate 1 moves past the median in period 5 and is replaced by 2, 2 is defeated after only a slight (one unit) move away from the median. The new incumbent, 1, reasonably reads this as a signal to move to a lower

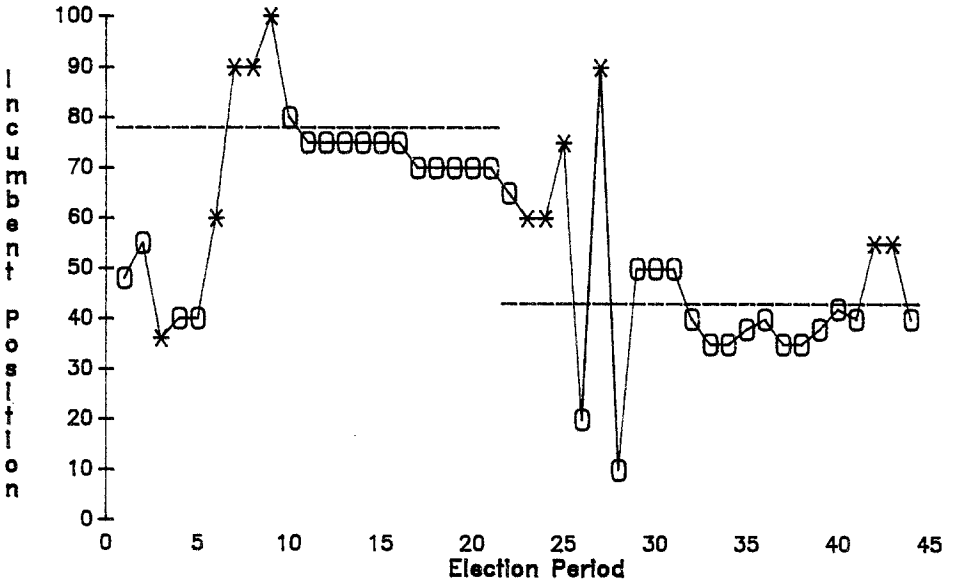

Figure 5.

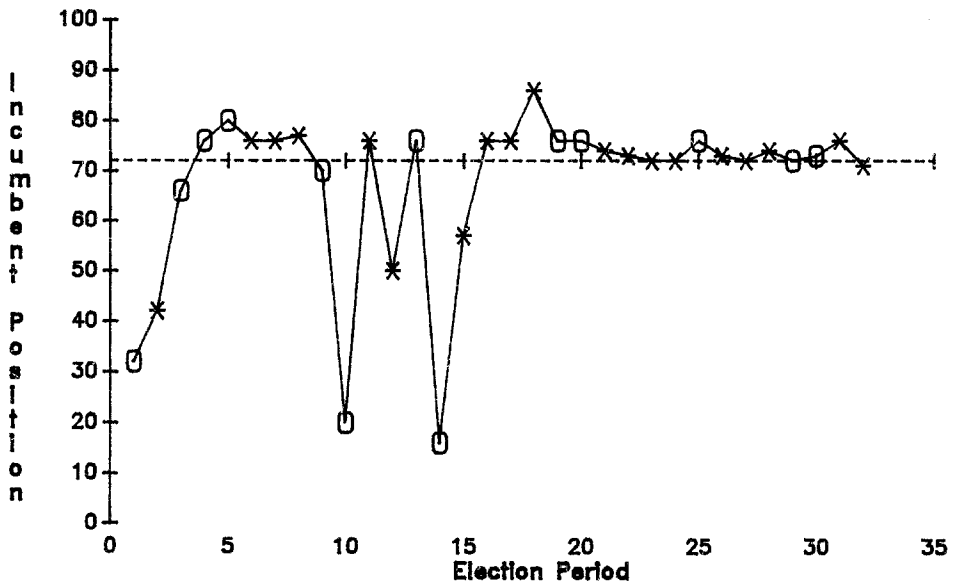

Figure 6.

position, is reelected in period 9, then inexplicably shifts to 20. Candidate 2 moves back to the region of previously successful strategies, and then, he too shifts too low, whereupon the voters elect 1, who gains reelection by moving back to the median in period 13. But again, 1 chooses a radical

position and is defeated. Candidate 2 is then able to secure a string of victories by moving towards the median, until he moves too high in period 18. Hereafter, the candidates settle in to more cautious moves, and on four occasions set their positions identically equal to the median. Why candidate 1 chooses the two radical positions in periods 10 and 14 is unclear, but as we note earlier, it illustrates that convergence does not always follow a smooth path.

The convergence to the median that Table 1 reports gives our earlier questions some focus. Now we must ask: is there a theoretical justification for supposing that, despite the incomplete information in our experiments, incumbents should converge to the median voter ideal point? What decision rule can we attribute to candidates that implies convergence? Second, what explains voter decisions? Why, for example in Figure 5, does the electorate permit candidate 1 to move towards and away from the median in periods 29 through 40, but a slight move off the median in period 41 leads to the election of the challenger?

To shed some light on possible answers to these questions, we now turn to separate analyses of voters and candidates. Aside from showing that retrospective voting and incomplete information do not preclude convergence to complete information outcomes, these analyses should give us some insight into how voters use retrospective information, and how candidates respond to an electorate that votes retrospectively.

4. Voters

To analyze voters we must first introduce some notation. We let $c_t \in \{1,2\}$ denote the incumbent in election period t, and we let $s_t \in X = [0,100]$ denote the policy position adopted by c_t in period t. Each voter has a symmetric single-peaked utility function, $u_i(s)$, over X, with an ideal point at x_i^*, and a voter's payoff in period t is $u_i(s_t)$. In our experiments, voter i observes $u_i(s_t)$, but not u_i or s_t. Thus, in the current period a voter knows his welfare under the current administration, but he does not observe his own utility function or the incumbent's policies or strategy. Finally, in addition to observing $u_i(s_t)$ for the current period, voters also know $u_i(s_{t-1})$, $u_i(s_{t-2})$, and so forth. That is, voters are aware of the stream of benefits that they have received from each previous incumbent.

The question we address, now, is: How do voters use this benefit stream $(u_i(s_t), u_i(s_{t-1}), \ldots)$ in deciding how to vote in the current election? The retrospective voting hypothesis suggests a 'reward and punishment' rule, in which the incumbent is *rewarded* if a voter believes that he has performed 'well', and is *punished* (with a vote for the challenger) if the voter believes that the incumbent has performed 'poorly'. In our experimental context, we

can consider several ways to identify what 'well' and 'poorly' might mean. First, a voter might simply compare the incumbent against the performance of the previous administration. That is:

$$\text{if } u_i(s_t) > u_i(s_{t-1}), \text{ then vote for the incumbent, } c_t; \text{ otherwise vote for the challenger.} \tag{4.1}$$

In Presidential elections this voter asks the question:'Am I at least as well off today as I was four years ago?', and if he answers 'yes', then he votes for the incumbent, otherwise he votes for the incumbent's opponent. But this decision rule is merely a special case of a more general rule. Suppose voter i discounts the past at the rate r_i in establishing an evaluation of what he can expect to receive from incumbents. Beginning at some initial period, say j = 1, and counting up to periods j = t−1, this voter computes,

$$\begin{aligned} EV_i(t) &= r_i \sum_{j=1}^{t} (1-r_i)^{j-1} u_i(s_{t-j}) + (1-r_i)^t EV_i(0) \\ &= r_i\, u_i(s_{t-1}) + (1-r_i) EV_i(t-1) \end{aligned} \tag{4.2}$$

If $u_i(s_t) > EV_i(t)$, then i votes for the incumbent, otherwise i votes for the challenger. Thus, if $r_i = 1$, then this voter compares only the current and previous election periods, whereas if $r_i = 0$, then he weights all past outcomes equally when making this comparison.

There is, however, another model of voter decisions that we should consider: a model in which voters discriminate between the candidates' performances. In this instance, the voter computes two discounted values – one for each candidate. Unlike expression (4.2), however, the discounted value, $EV_i^j(t)$, for the current incumbent, j, looks only at those periods in which j is the incumbent; similarly, the discounted value, $EV_i^k(t)$, for $k \neq j$ looks at those periods in which k is the incumbent. More formally, suppose candidate 1 is the incumbent in the current period t, in which case voter i should use the following formula to update discounted values:

$$\begin{aligned} EV_i^1(t) &= (1-r_i)^k\, EV_i^1(t-1) + [1-(1-r_i)^k]\, u_i(s_t) \\ EV_i^2(t) &= EV_i^2(t-1) \end{aligned} \tag{4.3}$$

where k is the number of periods since 1 was the incumbent last. Hence, i votes for the current incumbent if $EV_i^1(t) > EV_i^2(t)$, otherwise he votes for the challenger (or tosses a coin if equality holds).

Combining all experimental trials, performing a grid search over the value of r and initial expectation, EV(0), that best fits the data for each

voter, we find that 87% of all voter decisions are consistent with the model implied by expression (4.2), and 80% are consistent with the model implied by expression (4.3). Thus, despite the limited information of voters about the structure of the experiments, they act in coherent ways. But, since both models are reasonable, it is possible that different subjects use different criteria. Thus, if we choose the model that best fits each subject in an experiment, we find that 88% of all decisions are consistent with one model or the other. And, of the nearly 200 subject observations, the simple reward-punishment model – the expectations model implied by (4.2) – fits best nearly three-quarters of the time. Overall then, subjects seem to be simply comparing the payoff from the current incumbent with a discounted stream of benefits from the past. If the current payoff exceeds the stream, they vote to reelect the incumbent; if the current payoff falls short of the stream, they vote to unseat the incumbent in favor of the challenger.

Since it provides the overall better fit, we focus on the model implied by expression (4.2). With this focus, we can then let EV(0) be the average payoff each subject receives in some initial number of 'learning' periods, which somewhat arbitrarily, we set equal to six. Nevertheless, one difficulty with evaluating decision rules is that the estimate of r for some voters, depending on the incumbents' strategies, is indeterminate. Some specific cases illustrate this as well as the general patterns we find in our experiments. Figures 7, 8, 9, and 10 plot the payoffs of four voters across all periods in four experiments. Circles denote incumbents for whom the subject voted, x's denote incumbents for whom the subject did not vote, and the dashed line represents the expectation at the estimated discount rate from previous incumbents. Thus, circles above and x's below the dashed line denote votes that are consistent with the model from expression (4.2).

Figure 7 illustrates a voter with a best-fit discount rate of .4, but who could just as easily be said to be satisficing by voting for any incumbent who pays him more than fifty cents. Indeed, if we did not require setting the initial expectation equal to what the voter receives on average in the first six periods, a discount rate of 0 (satisficing) yields no errors. Figure 8, on the other hand, illustrates a voter who seems not to be satisficing, but who instead is forced to adjust his expectations as the experiment proceeds. Notice that at the end of the experiment, the subject, while rewarding incumbents that yield him a higher payoff than the immediate past, must reward incumbents for payoffs that earlier in the experiment he had voted against. Figure 9 shows a voter who most clearly illustrates a subject with a high discount rate. Any payoff increase over the previous period is followed by a vote for the incumbent; any decline is followed by a vote for the challenger. There is no evidence of satisficing here. Finally, Figure 10 shows a voter who seems to be satisficing in the first half of the experiment at $.50, but after a series of low payoffs in trials 21 through 26 (this is one of our

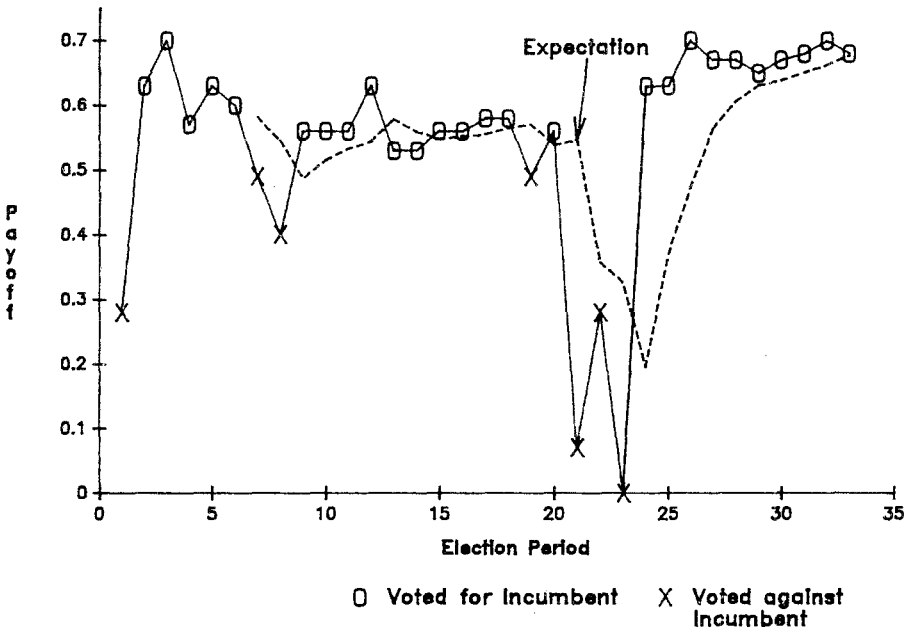

Figure 7. Shift, r = .4, %correct = .93.

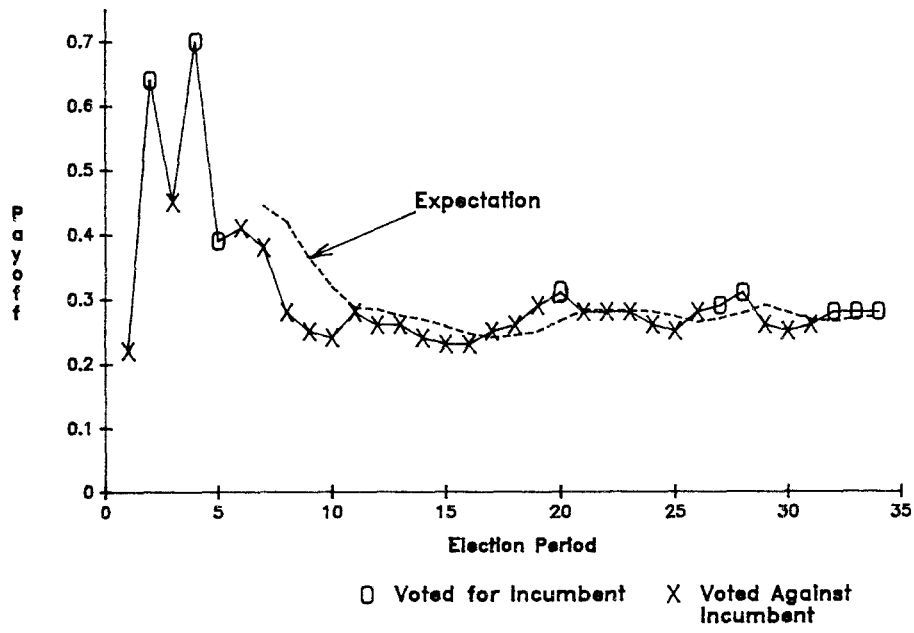

Figure 8. No mod., r = .4, %correct = 86.

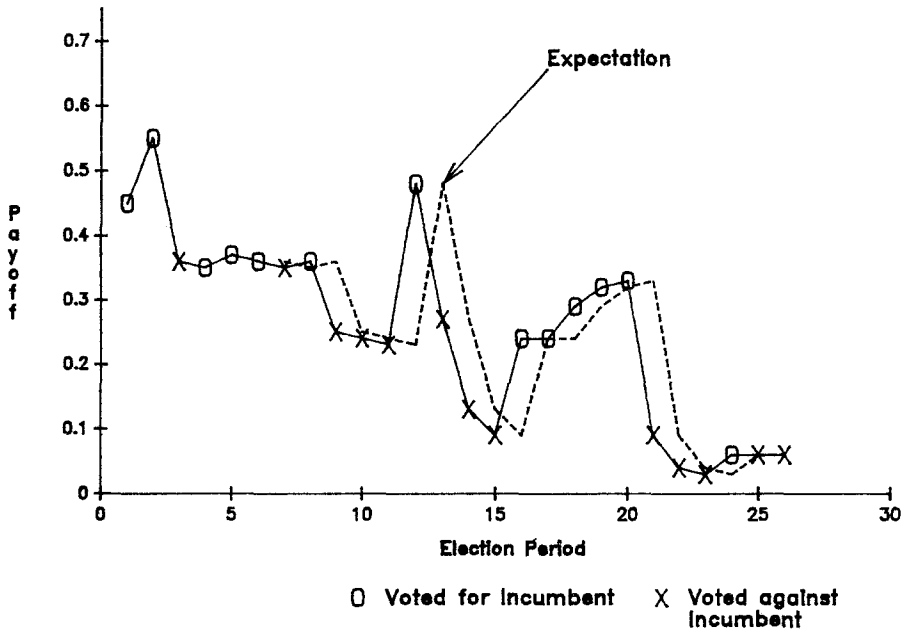

Figure 9. No mod., r = 1.0, %correct = 1.0.

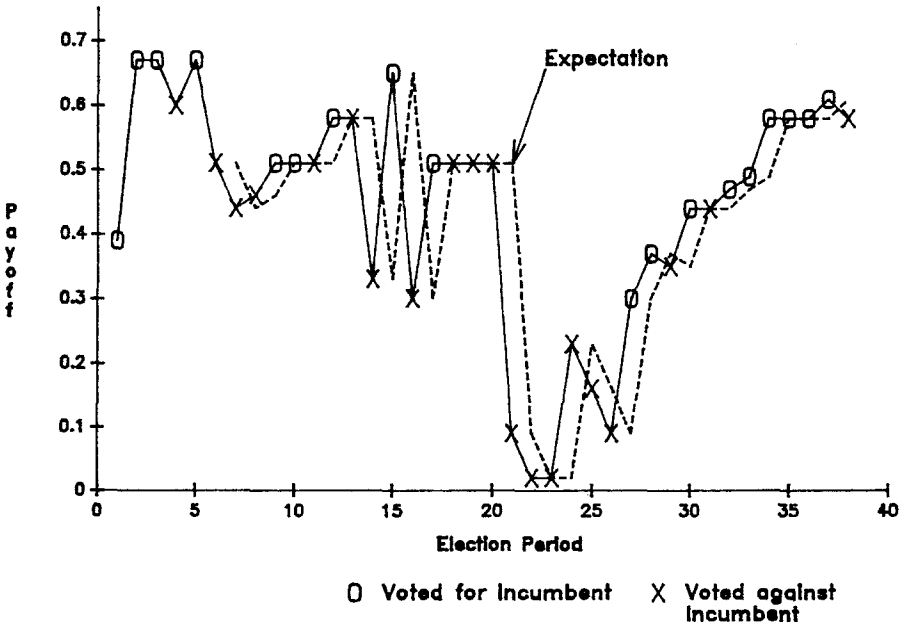

Figure 10. Shift, r = 1.0, %correct = .91.

Table 2. Predicting % correct by voter

Independent var.	Coefficient	Std. error	t	Sig. level
No. of periods	−.0036	.0021	1.698	–
r	−.1542	.0260	5.925	> .001
Pay variance	.0558	.0245	2.273	.05

Constant = .9804 (s.e. = .1053) R^2 = .25 (df. = 111)

median shift experiments), the subject acts as if he is looking back only one period (i.e., r = 1.0) by rewarding any increase in payoff and by punishing any decline, however slight. The implication of these figures, then, is that there appears to be considerable variation among voters in the decision rules they use, although hopefully permitting r to vary captures some of this variation.

Although over 80% of all decisions are consistent with the reward-punishment model, there is considerable variation in the estimated r's and the range of consistent choices among voters varies from 50% to 100%. We have no theory that explains why some voters fit the model well in an experiment and others fit poorly. Certainly, some subjects understood the experiment better than others, and some learned more quickly than others. Table 2 reports a simple regression in which the dependent variable is each voter's fit to the model (%COR), and three independent variables: the number of periods in an experiment, the value of r estimated for a voter, and the variance of the voter's payoffs across periods. These variables yield an adjusted R^2 of only .25, which suggests that voter errors do not follow any clear pattern.

Despite the low R^2, the signs of the coefficients have logical interpretations. First, high values of r reduce %COR. This is consistent with the fact that if a voter satisfices (if r = 0), then that voter is not likely to make many errors, given his or her decision rule. But if subjects abide by some more complex rule approximated by expression (4.2), then we will generally estimate r to be other than zero, and our model is likely to produce some errors. Second, the significant coefficient on pay variance reflects the fact that if candidates present the voters with stark choices, then voters are presented with easy decisions that readily fit the model. However, if the candidates vary their positions only slightly, then voters might consider other criteria, such as choosing a candidate who is perceived as being less risky because his strategies have varied less in the past. Finally, the fact that the coefficient for number of periods is insignificant supports our subjective evaluation that voters learned 'how to vote' in a relatively short period of time, say ten periods, if they learned at all. In general, then, although there is considerable variation in the decision rules used by voters (at least with

respect to r), subjects can make sense out of retrospective information. We cannot determine if a subject voted for the 'right' candidate, because we do not know what position the challenger would have adopted if elected. But a significant percentage of all decisions are consistent with a simple reward-punishment rule suggested by the retrospective hypothesis that uses only one free parameter, r.

5. Candidates

An analysis of candidates is more problematic than the analysis of voters, because the retrospective voting hypothesis does not directly apply to candidates, and thus does not suggest a specific rule for how candidates or political parties act when voters are retrospective. To evaluate the incumbent data, then, we assume that incumbents act as if they believe that the voters are following the model in the previous section, and that they try to make inferences about the preferences of the voters on the basis of their voting behaviour. Since we are not able to work out the mathematical details in general, we consider only the case when $r = 1.0$ for all voters, which corresponds to the situation in which voters make their decisions on the basis of whether the present incumbent is doing better or worse than the previous incumbent.

If the candidates assume that all voters obey the model in Section 4, with $r = 1.0$, then in any election period t, voters vote their true preferences between the position of the incumbent in t, s_t, and the position of the incumbent in period $t - 1$, s_{t-1}. Since preferences are symmetric and single peaked, this means that candidate c_t will win if and only if the median voter ideal point is closer to s_t than it is to s_{t-1}. To make this precise we define the set S_t as follows:

$$S_t = \{x: \| s_t - x \| \leq \| s_{t-1} - x \| \} \text{ if } c_{t+1} = c_t$$

$$S_t = \{x: \| s_t - x \| \geq \| s_{t-1} - x \| \} \text{ if } c_{t+1} \neq c_t$$

So, S_t is always a half interval starting at $(s_t + s_{t-1})/2$ and includes the position of the winning candidate. It follows that from the vote in period t, an incumbent seeking reelection can make the inference that the median voter's ideal point is in the set S_t. (We ought to keep in mind throughout this discussion, of course, that subjects were not trained about spatial models or the equilibrium of the median, so our model actually assumes more knowledge than our subjects possessed.) Extending this reasoning, it follows that if an incumbent were to pool the information available from election periods 1 through t, then he or she should conclude that the median

voter ideal point is in the set $S_t^* = \cap_{j \leq t} S_j$.

Notice, now, that if voters really acted according to the model of Section 4 with a uniform discount rate of r = 1.0, then the sets S_t^*, t = 2,3,..., form a nested decreasing sequence of nonempty sets that always contains the median voter's ideal point. Hence, if voters make no errors, and if r = 1 for all voters, then eventually candidates will be able to identify the electorate's median preference. But the voters do make errors, and only half the estimated r's are greater than .5. Thus, there is no guarantee that this set, in the later stages of an experiment, will be nonempty. To resolve this difficulty, we suppose that the candidates assume that there is as little voter error as possible. Specifically, for any t, we define $g_t(x) = |\{ j \leq t: x \epsilon S_j \}|$, and define

$$R_t = \{x: x \epsilon \arg\max g_t(x) \}.$$

That is, in period t, the weight given to position x equals the number of times x has been in S_t, starting at t = 2 to the current period. The set R_t is then the set of all points that maximize this count. Assuming that the incumbent weighs all previous periods equally, R_t is the incumbent's best estimate of the location of the median voter.

Like voters, however, candidates probably should weigh recent elections more heavily than more distant ones, especially if they assume that voters are learning about the experiment and how to proceed, just as they are, so that errors decrease as the experiment proceeds. Thus, as we add up the number of times a point x has been in S_t we can compute the set R_t for various discount parameters by appropriately discounting the weight given past election periods.

Given a candidate's (set) estimate about the median preference, we now define the following derivative set, which provides us with a prediction about incumbent strategies:

$$G_t = \{x: \|x - y\| \leq \|s_t - y\| \text{ for all } y \epsilon R_t \}$$

Thus, adopting a position in G_t insures reelection (or a tie) regardless of the true position of the median in R_t, since G_t is defined to insure that any point in it is closer to any median in R_t than is the position of the incumbent in the previous election period, s_t.

Notice, now, that if voters and candidates make no errors, then positions in this set should not only yield the continued reelection of the incumbent, but also rapid convergence to the median. Because R_t collapses to the true median, if an incumbent wishes to insure that he or she is reelected, the incumbent should gradually move towards R_t. To the extent, then, that candidates actually choose points in G_t, we have a theoretical justification

Table 3 Predicting candidate positions[a]

	DS	DM	% COR	PREC	R
r = 1	5.35	6.77	.31	.04	.46
r = .5	4.35	7.54	.43	.09	.43
r = 0	4.42	8.82	.44	.12	.39

DS = Average distance to G_t
DM = Average distance to midpoint of set
% COR = Percent candidate positions in set
PREC = Average precision (size relative to issue space)
R = Correlation of candidate position with midpoint of set

[a]Note that r = 1 means that only the last election is considered, while r = 0 means that all elections are weighted equally.

for concluding that the convergence to the median that Table 1 reports is not fortuitous, but the result of a logical interpretation of the information that retrospective voting generates.

There are several measures that we might use to evaluate the candidate's performance with respect to G_t, and thereby estimate an appropriate (best fit) discount rate. In the case of voters, we simply counted the proportion of times they voted for and against incumbents who chose positions respectively above and below their discount line, choosing the discount rate to maximize the percentage of consistent decisions. Here, however, G_t can be small (if an incumbent chooses the same position twice and wins, G_t is a point), and it may be unreasonable to require that an incumbent choose a position in it as against simply near it. On the other hand, G_t can be large, as after an incumbent chooses a radically different position, so we must also take account of its relative size when judging a candidate's performance and the appropriate discount rate. Finally, insofar as estimating discount rates is concerned, we must confront the fact that while we observe a decision by each voter in every election period, we observe decisions only of incumbents.

Rather than estimate a separate discount rate for each candidate, then, Table 3 presents several summary measures of the candidates' aggregate performances for three discount rates, 0, .5 and 1.0.

Notice that, although candidates choose strategies in G_t only about 43% of the time (for r = .5), the average size of this set is about nine units. Thus, by chance alone we would anticipate strategies in G_t only 9% of the time. Similarly, while a 'success rate' of only 31% seems low when r = 0, notice that the size of the predicted set averages only four units. From this perspective, the success rate of G_t is more impressive, given that candidates are subjects who are untrained about medians and equilibria. And although we

Table 4. Explaining reelection frequency

Variable	Coefficient	Std. error	t-statistic
DS	−.019	.007	2.91
% COR	.059	.113	.523
DS Opponent	−.001	.007	.176
% COR Opponent	−.002	.113	.018
Voter r	−.345	.118	2.94
Constant	.879	.077	11.491
	R^2 = .45	s.e. = .128	

aggregate the data across all experiments, different candidates probably use different discount rates, and were we to take account of this possibility, the fit of the model would be improved considerably. Perhaps a better measure of how well the candidates fit the model is the average distance of incumbents from G_t. Although they choose positions in the set less than half the time, incumbents deviate from G_t on average by less than five units (for r = .5 and 1.0).

What we lack is a reason for arguing that the candidates share the rationale of our theoretical model for choosing points in or near G_t. Since voters do make errors even when we allow the estimate of r to differ from 1.0, it is possible that they are following a different decision rule than what we assume here – a rule such that leads candidates away from the median or which implies no specific direction at all. Naturally, the most theoretically satisfying explanation for why incumbents would track G_t is: 'because that is the way to win.' To test this, using estimates based on r = .5, Table 4 presents a regression in which the dependent variable is the frequency of reelection, and the independent variables are two measures of fit to the set (DS = distance to the set, and %COR = percent of the incumbent's positions in the set), two measures of the opponent's fit, as well as the average value of r estimated for voters in the relevant experiment (we include DS but not DM because of collinearity between the variables, and because DS yields a slightly better fit).

The implications of this regression are, first and as hypothesized, the relationship between DS and the frequency of reelection is significant and negative. That is, given the voter behaviour observed in the experiments, the closer an incumbent is to G_t the greater is his or her chance of being reelected. The insignificant coefficient for %COR apparently supports our earlier contention that G_t presents too rigorous a requirement for reelection – getting close or moving in the direction of this set is good enough. The failure of either measure of an opponent's fit to yield a significant coefficient is important. It suggests that an incumbent's fortunes are more a

function of what policies he or she selects than they are of what the challenger did in the past. That is, although an opponent's choice will determine whether a candidate is elected or not, reelection is more a function of the incumbent's performance than anything else. Finally, the significant negative coefficient for r indicates that if voters are satisficing (low voter r), it is easier to be reelected than if they are simply looking back one period. Voters who take the past into consideration are more likely to be more forgiving of deviations from G_t than are voters who look back only one period.

The significant coefficient for DS that Table 4 reports confirms an incumbent's incentive to choose strategies in or near G_t. For example, being five units further from the set, on average, decreases an incumbent's frequency of reelection by nearly 10%. If an experiment runs 40 periods, and if a candidate is the incumbent in half of these, then the opponent becomes the incumbent two additional times, on average. If the average string of victories for an incumbent is, say, three elections, then the five unit increase in the candidate's distance from G_t costs the candidate six elections, or \$6.00. This seems incentive enough to rationalize positions in or near this set.

Before we look at whether the decision rule hypothesized for candidates does in fact account for strategies near the median, it is useful to look at some additional experiments to see why the coefficient for DS that Table 4 reports is significant but the coefficient for %COR is not. Consider Figure 11, which shows an experiment in which the candidates converged close to the median, and in which both candidates enjoyed long successive reelection periods. Notice that in lieu of staying at a winning position (which insures choosing a position in G_t), incumbents vary their positions slightly from one period to the next. When questioned afterwards, both candidates expressed a belief that choosing the same position would bore the voters, and that they would be defeated. With respect to the regression in Table 4, this experiment exhibits a high percentage of reelections (89% as against an overall average of 67% across all elections) and low average distance from the median (1.37 units compared to 4.35 overall), which increases the correlation between DS and frequency of reelection. While the percentage of correct decisions is greater than average here (52% as against an average of 44%), DS is 'credited' with the effect in the regression.

This is not to say that experiments such as the one that Figure 11 summarizes characterize a majority of our experiments. An even more frequently observed pattern is one in which candidates in fact remain at fixed positions for several successive periods. Figure 12 illustrates such an experiment, and the lessons it reveals about retrospective voting are informative. First, notice that keeping a fixed position does not insure indefinite reelection. After candidate 2 has been the incumbent for five periods, the voters 'test the waters' by electing the opponent (election period 14), who then remains

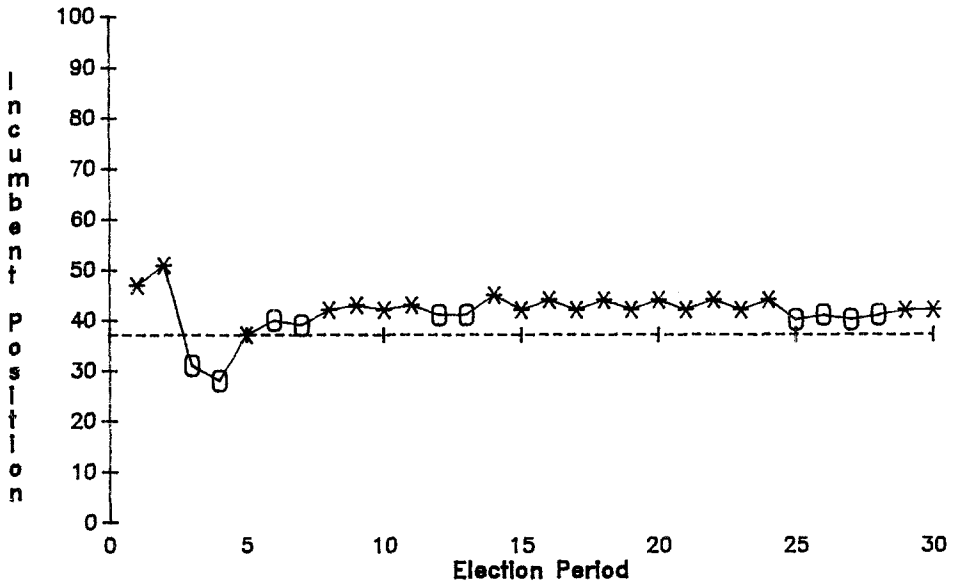

Figure 11.

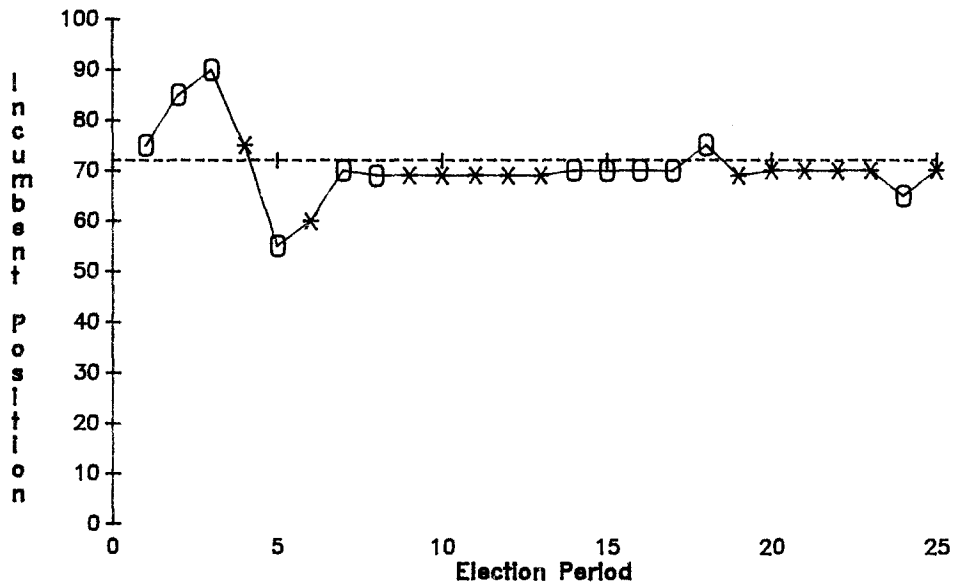

Figure 12.

in office for five periods, until he shifts slightly from the median in period 18. Candidate 2 is then reelected until period 24, at which time the voters again 'test the waters,' but immediately reject 1's new position.

This experiment suggests that it might be legitimate for candidates to

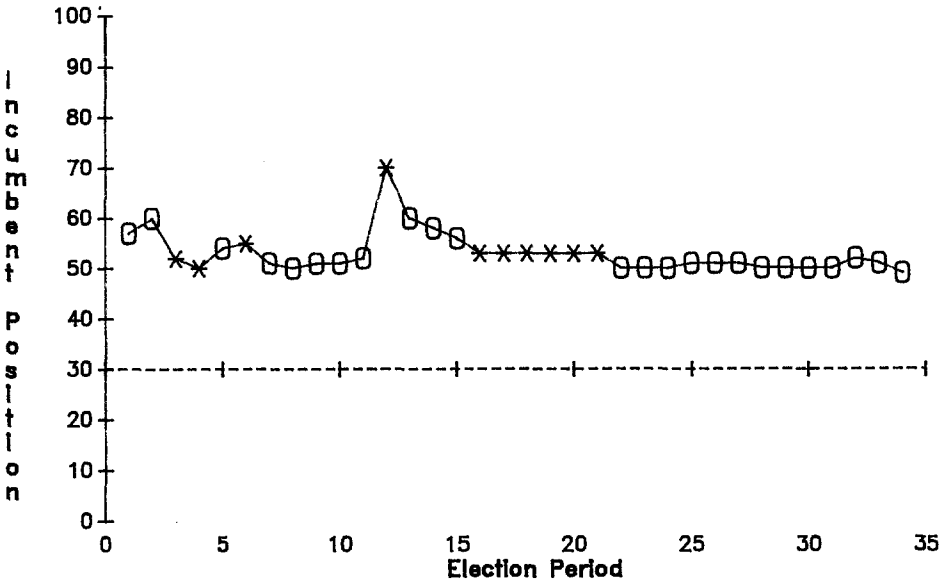

Figure 13.

worry about the boredom of voters. But there is even a better basis for not always wanting to be a 'fixed target'. Specifically, although 'testing the waters' appears as an error in the model, it is not an unreasonable decision for voters, and in fact it is one way to induce positions that are better for a majority. Figure 13 illustrates a second experiment in which the candidates failed to converge to the median. Notice that by testing the waters in period 22, the new incumbent, candidate 1, initially chooses a position closer to the median. But voters reelect 1 every time thereafter, and provide the incumbent with no signals to indicate that the median is elsewhere. Thus, by occasionally voting for the challenger after an incumbent has failed to move for several periods, voters can hope to signal a preferred direction of change at the next election.

Additionally, if voters suppose that candidates are learning from each other's successes and failures, then voters should not anticipate any great supprises when a challenger is elected. That is, if two candidates abide by the same decision rule, then the risks of electing the challenger after a period of stability are not great, since the challenger's strategy will not differ much from the previous incumbent's. Hence, if we apply this lesson to real elections, then the retrospective voting hypothesis should be modified to admit the possibility that some voters switch parties not because they are dissatisfied with an incumbent's performance, but because they wish to see if the opposition can offer anything better, knowing that the oppostion will not change policies radically.

6. Convergence to the median

Table 5. Predicting convergence to the median.

Variable	Coefficient	Std. error	t-statistic
Const.	35.984	16.884	2.13
% COR for voters	−40.855	21.089	1.94
DS	1.588	.412	3.85
	R^2 = .494	s.e. = 5.938	
Const.	70.191	25.032	2.804
% COR for voters	−73.802	27.212	2.712
DS	1.704	.393	4.339
r	−15.876	8.987	1.767
	R^2 = .58	s.e. = 5.580	

The preceding sections detail two models of voter and incumbent candidate choice and, theoretically, if candidates and voters abide by the models, then convergence at the median must occur. It is useful, then, to test whether consistency with these models, in fact, helps explain whether or not we observe convergence. Thus, Table 5 presents the results of a simple two-variable regression in which the dependent variable is the distance of the incumbent from the median in each experiment's last ten periods, and the independent variables are the average distance of the candidates from G_t (DS, using a discount rate of .5 for all candidates), and the percentage of voter decisions that fit expression (4.2). This table also presents the results of a second regression in which we include the average discount rate of voters in each experiment. We include r, since, if r = 0 (if all voters satisfice), then it is possible for the model of voters and candidates to fit perfectly without implying convergence.

The most important fact of this table is that not only do the coefficients of DS and %COR have the right signs, but, with the inclusion of r, the coefficients for both variables are strongly significant. Of course, there may be other models that predict voter and candidate choices as well, or better than the models we postulate for them here, and which also imply convergence. But now we have some confidence that the convergence to the median that Table 1 reports can be understood, in part at least, by the extent to which voters and candidates abide by the models we postulate.

7. Three types of experiments

To this point we have combined all nineteen experiments into a single

Table 6. Some summary data comparing experiment types.

	Type 1	Type 2	Type 3	All
Average r	.50	.59	.38	.49
% Correct for voters	82	79	83	82
% Correct for cand.	44	56	34	44
% Incumbents reelected	60	69	73	67
Med. voter pay, last ten periods	$.51	.59	.60	.56
Med. voter pay, 2nd ten periods	$.51	.60	.56	.55
Med. voter pay, first ten periods	$.46	.56	.47	.49
Avg. distance to median, last 10 periods	12.8	5.92	6.78	9.08
Avg. distance to median, 2nd ten periods	13.4	6.18	9.78	10.37
Avg. distance to median, first ten periods	15.3	8.54	16.40	13.86
Average no. of periods	31.9	31.6	39.2	3.0
n	8	5	6	19

sample. This sample, however, actually contains three types: (1) experiments in which voters as well as candidates know the form of voter preference and the fact that candidates must compete on a single issue; (2) experiments in which voters are not told the basis of their payoffs; and (3) experiments in which the median voter preference is shifted suddenly in period 21. Table 6 presents some simple descriptive statistics that we can use in deciding whether these forms produce any important effects. What we are especially interested in ascertaining is, first, whether the additional information given voters in experiments of the first type aid or hinder subjects; and, second, whether candidates track a shifted median.

Although there are far too few cases for meaningful statistical tests (we should keep in mind that each experiment runs approximately two hours, and costs an average of $125), it is remarkable how, in so many respects, these numbers are alike across experiment types. Focusing first on the Type 1 and Type 2 experiments, the only numbers that seem different concern the average payments to the median voter and the average distance of incumbents from the median. And here the differences suggest that incumbents move closer to the median in the low information experiments than they do in those experiments in which the basis of voter payoffs is revealed to subjects! Closer examination of the numbers in this table suggests an explanation. First, notice that while voters fit the model only slightly better in Type 1 experiments, the average r for voters is higher in the Type 2 trials,

suggesting less satisficing behaviour in the lower information trials. And, while we can only speculate why the additional information might cause candidates to perform less well with respect to our model, that is in fact the case. The combination of candidates that fit the model better, and voters who are more sensitive to recent election periods apparently combine to yield a tighter overall convergence when irrelevant information is excluded. Notice, moreover, that we cannot attribute this difference to the fortuitous fact that candidates on average began the low information experiments closer to the median than they began the Type 1 experiments. The average distance of the candidates from the median in the Type 3 experiments in the first ten periods is actually slightly greater than in the Type 1 experiments; nevertheless, the average distance by periods 11 through 20 is less again in the Type 3 trials than it is for the Type 1 trials. The summary data on the average payoffs to the median voter tell a similar story. Although none of these differences is so great that we can assert that theoretically irrelevant information hurts, such information clearly does not help either.

Examination of the Type 3 experiments, those in which the median is shifted suddenly, reveals that such a shift is tracked by incumbents. Because of the shift, these experiments are run, on average, 8 periods longer than the others. But notice that the distance of incumbents from the median in the last ten periods is not much different from what we find in the low information Type 2 experiments.

Figures 4 and 5 illustrate the general pattern in these shift experiments. After the shift, there is a period in which the candidates appear in disequilibrium, after which they 'settle in' near the new median or are once again carefully approaching it. To see this in aggregate terms, we note that in the first, second, third, and fourth block of five periods, the incumbents' distance from the median averaged, respectively, 19.2, 13.6, 10.4 and 9.2 units. In the first, second, and third blocks of periods after the shift, this distance averaged, respectively, 19.4, 10.0 and 8.5 units. Thus, while it took incumbents approximately fifteen periods in the beginning of the experiment to move within ten units of the median, it took them five fewer periods after the shift to accomplish this. Clearly, our candidates had learned something in the course of the experiment about how to use the available information. And it seems reasonable to speculate that this convergence would be even more rapid if candidates anticipated the possibility of periodic shifts in preferences.

8. Conclusions

Both our theoretical and experimental results should be gratifying to proponents of the retrospective voting hypothesis, and to those who do not see

imperfect information as an opportunity for the failure of democratic systems to measure and to respond to citizens' preferences. Suppose that decisions in accordance with this hypothesis lead to outcomes that differ significantly from what we anticipate under complete information. Then, if voters do in fact act retrospectively, we must assume that they do not know the consequence of their actions, they do not care about the consequences of their actions, or they believe that their individual actions have no consequences. Any one of these possibilities is a disquieting note about the functioning of democracy.

But this essay suggests something quite different. Indeed, it suggests a kind of systemic rationality on the part of the electorate. Given that one's vote counts so little, there is little reason for people to invest in political information. Thus, retrospective voting reduces information costs. But it does more. Retrospective voting also yields the same outcomes here as does voting with complete information, so something is saved with retrospective voting (costs), and nothing is lost (in terms of policy outcomes). And although we observe considerable variation in voter and candidate decision rules, as well as in the ability of subjects to learn appropriate rules, in only three of our nineteen experiments did the candidates fail to 'settle in' at positions near the median.

Our experiments also reveal several patterns that are reminiscent of actual political phenomenona, such as voters 'testing the waters,' and candidates learning from opponents about reasonable strategies. But at this point we should detail the limitations of our analysis. First, our experiments concern a single issue. There is no reason to believe that voters cannot choose appropriately in a multidimensional environment (since we now know that they do not require any knowledge of their own preferences or the policy space), but candidates may confront a different problem. Ultimately, then, we should test whether candidates can find appropriate strategies if multiple issues dictate voters' payoffs.

Second, there is no 'noise' or discordant information in our theory or in our experiments. In reality, however, exogenous factors affect the consequences of an incumbent's policies. Oil embargoes, international conflicts, other nations' tariff policies, and the like, each affect the domestic consequence of an incumbent's program. These factors often are unpredictable, and even after they have occured it may be impossible to ascertain whether different policies might have produced better results. If voters are uninformed, they will not know, of course, whether their welfares have been changed by deliberate policies or by exogenous and uncontrollable factors, and perhaps they will not even know that these factors exist. While we might be able to incorporate such noise into our theoretical analysis and show that the imperatives of convergence to the median still hold, it is less clear how subjects in an experiment will perform. If candidates know how

exogenous factors have affected their positions and thus voters' payoffs, then they may be able to make suitable adjustments. But we can only guess how voters will respond if they deem the candidates 'unpredictable'.

Third, we should reemphasize that our experimental procedures require that subjects vote retrospectively: retrospective information is the only information they possess. If, as Popkin, *et al.* [1976] say, political information is a costly investment, then voting retrospectively may be a rational response to such costs and to the assumption that new incumbents in our political system are not likely to change policies much from the past. It is interesting, then, to speculate what would happen if we permitted subjects to, say, purchase contemporaneous information about an incumbent's position (as well as, perhaps, about their own payoff functions) – that is, if we permitted subjects to choose whether or not to be retrospective voters. It seems reasonable to hypothesize that as the candidates settle into a small range of strategies, presumably near the median, so that the value of contemporaneous information diminishes from what it might be in the early stages of an experiment, subjects will not purchase the information. But we might also speculate that after an abrupt median shift, information will once again be purchased until the candidates once again settle into a narrow range.

Finally, although we can anticipate addressing some of these issues in future research, one limitation that we cannot treat is the fact that we cannot translate the election periods in our experiments into 'real time'. An experimental period is not the same thing as an election every two or four years. The 'gathering of data' for a retrospective vote is a continuous process, and not one that simply occurs prior to a vote. Thus, while it may take five, ten, or fifteen periods for candidates to approach the median in an experiment, this gives us no clue as to how fast equilibrium might be reached in reality.

Despite this last caveat, the results of our experiments give us some confidence that democratic processes are robust. Not only is retrospective voting a means whereby voters can reduce information costs and make sense out of complex political-economic environments, the general empirical finding that voters are poorly informed about contemporaneous issues may not be nearly as relevant to the policies that politicians enact as we might otherwise suppose.

REFERENCES

Fiorina, M.P. (1981). *Retrospective voting in American national elections.* New Haven: Yale University Press.

Key, V.O. (1966). *The responsible electorate.* New York: Vintage Press.

McKelvey, R.D., and Ordeshook, P.C. (1985a). Elections with limited information: A fulfilled expectations model using contemporaneous poll and endorsement data as information sources. *Journal of Economic Theory* 36: 55–85.

McKelvey, R.D., and Ordeshook, P.C. (1985b). Sequential elections with limited information. *American Journal of Political Science* 29: 480–512.

Popkin, S., Gorman, J.W., Phillips, C. and Smith J.A. (1976). What have you done for me lately: Toward an investment theory of voting. *American Political Science Review* 70: 779–805.

APPENDIX

Instruction

This experiment is a study of voting in two-candidate elections. As subjects in the experiment, you will each be assigned to be either a voter or a candidate, and your will each be paid for your participation in the experiment on the basis of the decisions you make. If you are careful and make good decisions, this experiment can be profitable for you.

In this experiment there are two candidates, labeled 1 and 2, while the rest of you are voters. The experiment itself is divided into a number of trials or election periods, and in each period the incumbent candidate, who is whoever won in the previous election, will adopt a policy that will characterize his or her administration. Later, after the two candidates are seated in a separate room, we will provide them with more details about the policies they may select. After the incumbent has chosen his policy, then, on the basis of a predetermined mathematical function, each voter will be told how much this policy is worth to them. Each voter must then decide whether to keep the incumbent in office for another period, or to elect the challenger. At the end of the experiment, each voter will be paid, in cash, an amount equal to the cumulative amount he or she has earned in each election period. Candidates will be paid $1.00 for each election they win, and nothing otherwise.

The experiment will begin by choosing an incumbent candidate, using the toss of a fair coin. The incumbent will then adopt a policy. This will be done in secret, and the specifics of that policy will not be made public. At this point, we will inform each voter of his or her payoff. The computation of payoffs will be made by the computer, using the function detailed in the sealed envelope, which may be opened at the termination of the experiment. At this point, voters will record the incumbent candidate and their payoff in that period on the record sheet that will be provided. After voters have been told their payoffs, they must then vote to keep the incumbent in office for another period or they may vote for the challenger. We will announce the outcome of this vote and ask the new incumbent (which may or may not be the old incumbent) for a new policy. Voters will then be told their payoffs, and be asked again to vote between the current incumbent and the challenger. After a predetermined number of elections have elapsed, the experiment will terminate, and all voters will be paid in accordance with their payoff charts.

We want to emphasize that the candidates are free to change their policy from one election period to the next, or they can adopt the same strategy as the previous incumbent. Let us emphasize that your payoff in each election period is private information and should not be revealed to anyone else.

Reviewing the sequence of events, then, an election period begins with an incumbent adopting a policy. The payoffs from this policy will be revealed to the voters, and they must then vote on whether to keep the current incumbent in office or to elect his opponent. Whoever wins becomes the new incumbent.