Follow the Leader: Theory and Evidence on Political Participation

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Using state-by-state voting data for U.S. presidential elections, we observe that voter turnout is a positive function of predicted closeness. To explain the strategic component of political participation, we develop a follow-the-leader model. Political leaders expend effort according to their chance of being pivotal, which depends on the expected closeness of the race (at both state and national levels) and how voters respond to their effort. Structural estimation supports this model. For example, a 1-percent increase in the predicted closeness at the state level stimulates leaders' efforts, which increases turnout by 0.34 percent. (JEL D72, C33, C72, H41)

People on whom I do not bother to dote
Are people who do not bother to vote
"Election Day Is a Holiday"
                    by Ogden Nash (1975)

There are two widely discussed and debated explanations of political participation. Neither is satisfactory. One approach assumes that voters engage in a strategic cost-benefit calculation—people vote because their vote might decide the election (William Riker and Peter C. Ordeshook, 1968). The participation decision is based on whether $B + \pi V$ exceeds C, where B is the private benefit of voting, V is the value of winning versus losing, C is the private cost of voting, and π is the probability of a vote being pivotal. The problem with this explanation is with the π variable.

In a national election, the probability that someone's vote will change the outcome is essentially zero, and so if voting is costly, the strategic model should imply essentially zero

participation.[1] The implausibility of the pivotal-voter model has led some to question the entire rational-choice approach to politics (Donald P. Green and Ian Shapiro, 1994).

An alternative explanation, also suggested by Riker and Ordeshook (1968), is that people vote because it is a consumption activity—they vote because they enjoy it, not because they are concerned with affecting the outcome. For example, people vote because of a feeling of civic responsibility. While this approach can explain voting, it can not explain why turnout is higher when the election is predicted to be close. And one is always suspicious of trying to explain behavior simply by labeling it as a good.

As economists, our objective is to reconstruct a strategic model of voting, one that can explain both large voter turnouts and increased turnout in close elections. The pivotal-voter model is also important in other strategic voting contexts, such as takeover contests, in which stockholders vote by tendering their shares (Bengt Holmström and Nalebuff, 1992) and jury voting (Timothy Feddersen and Wolfgang Pessendorfer, 1996). While the idea of being pivotal

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[1] A person's vote has two effects: it is either pivotal or it is a voice in a crowd. Almost all of the literature focuses on the test of a pivotal-voter theory. The voice in the crowd theory is also problematic. Winning an election with a large majority gives the candidate a bigger mandate than winning with a small majority, but it is hard to see how one additional vote increases the mandate. Hence, our focus is on the small probability of a large change (rather than the large probability of a small change).

seems right, we need to change the model of voting—to move away from a model where individual votes are determined like a weighted coin toss—and develop a more sophisticated equilibrium model of voting and pivotalness. In building this model, we came to understand that the model makes very specific predictions, and these are not the predictions that have historically been tested.

Previous empirical studies of the pivotal-voter theory are incomplete at best. While several of them have found a correlation between *ex post* closeness and turnout, this is not proof for the role of strategic participation decisions.[2] Instead of using *predicted* closeness—as suggested by the theory—they all use the *ex post* outcome. This approach leads to biased results since *ex post* closeness is typically a function of the dependent variable, namely participation.[3]

Furthermore, almost all of the previous studies run *linear* regressions of turnout on closeness (along with other variables) and consider this a test of the pivotal-voter model. The pivotal-voter model, unadulterated, requires using the probability of a tie vote, not closeness. The relationship between closeness and the probability of a tie vote is far from linear. In Table 1, we give the predicted probability of a tie vote for each state in the 11 presidential elections spanning 1948 to 1988. We do this using a coin-toss model in which each voter acts independently and votes for the Democratic candidate with a chance equal to the Democratic

vote share.[4] The chance of a tie is a meaningful number in only two cases: Hawaii in 1960 and Rhode Island in 1956. Outside of these two cases, the probability of a tie vote falls off dramatically. Whereas the tenth most likely case (Idaho in 1948) was less than one in 3 billion, the seventeenth case (Delaware in 1960) was roughly two in a trillion trillion billion. For over 520 of our observations, the chance of a tie vote was indistinguishable from zero. Thus testing closeness is not the same as testing pivotalness. Although testing pivotalness seems doomed since it is nearly always zero, we will see that by eliminating the coin-toss model and replacing it with uncertainty over voter preferences, pivotal probabilities are no longer near zero.

Finally, most previous studies focus on the role of closeness, but ignore other strategic variables suggested by the traditional pivotal-voter theory—uncertainty, electoral votes, and the size of the voting population. Only a few studies (John E. Filer et al., 1993) use state-by-state data on presidential elections in the United States.

This paper begins with an exploration of the data. We first offer some simple linear regressions to give the reader a feel for the data and for the relevance of our new explanatory variables. The linear regressions in Section I are the first empirical study of political participation as a function of the size of the voting population, electoral votes, and the *predicted* closeness of the race. Using state-by-state voting data for the 11 U.S. presidential elections from 1948 through 1988, we show that the participation rate increases with predicted closeness and electoral votes and falls with the voting population size. This result supports the view that strategic considerations enter into political participation decisions.

But whose strategic considerations? Political parties and their leaders will be the most keenly aware of any strategic cost-benefit calculations. Increases in turnout could be the result of an

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[2] Carrol B. Foster (1984) and John G. Matsusaka and Filip Palda (1993) offer extensive surveys of the literature on voter participation.

[3] This is obvious if closeness is measured by the absolute number of votes needed to change the election. But, as the following simple example shows, there is a problem even when closeness is measured in percentage terms. Assume that political preferences split the population 50:50 between the Republican and Democratic candidates. If individuals who prefer the Republican candidate are more likely to participate, then the Republican candidate will have the predicted lead. As turnout increases, however, more people with a smaller propensity to vote will participate: in this case, these are people who prefer the Democratic candidate. Thus, higher turnout leads to a closer race. This is just one example. The larger point is that closeness affects participation, and participation affects closeness.

[4] The probability of a tie can be approximated by $(1/N)\phi((\hat{d}_{jt} - 0.5)/\sigma)$, where N is the voting population, ϕ is the standard normal density, $\hat{d}_{jt}$ is the predicted chance a random voter from state j in election t will vote for the Democratic candidate, and σ is the standard deviation of the Democrats' vote share.

TABLE 1—PROBABILITY OF A PIVOTAL VOTE WITH NO UNCERTAINTY
ABOUT UNDERLYING PREFERENCES

State	Year	Probability that 1 vote will swing the election
Hawaii	1960	0.0008724
Rhode Island	1956	0.000596
Vermont	1976	0.00000373
Delaware	1948	0.0000024
New Hampshire	1960	0.00000196
West Virginia	1988	0.00000193
Alaska	1968	0.00000183
Delaware	1976	0.0000000716
Louisiana	1956	0.000000000427
Idaho	1948	0.000000000177
Alaska	1960	0.000000000167
Oklahoma	1960	0.0000000000441
Minnesota	1960	0.0000000000227
North Carolina	1956	0.000000000000281
New Hampshire	1948	0.0000000000000885
New Jersey	1948	0.00000000000000043
Delaware	1960	0.000000000000000000000000000000000162
Rhode Island	1972	0.000000000000000000000000000000000000053
All other observations		Smaller than 10^{-36}

increased effort by the party to get out the vote. In Section II, using survey data from the 1976 U.S. presidential elections, we find that the parties' efforts to persuade an individual to vote, as measured by contact with voters, depend on predicted closeness and the state's eligible voter population size. A 1-percent increase in a state's predicted closeness yields nearly a 1-percent increase in the probability that a party will contact an individual.

In Section III, we use the empirical results on voter turnout and party effort to develop a new theoretical model of political participation. Our approach has several novel features. First, the pivotal effect is moved up one link in the chain. Instead of voters considering their pivotal effect, leaders make strategic calculations and then choose their effort to influence the actions of followers. Thus, the result of effort gets magnified greatly as the effect of the leaders' effort reverberates throughout the groups. The leaders have two motivations: they care about winning their state for its own sake and for its effect on the national election.

A second innovation concerns the way we introduce uncertainty into the model. We recognize that preferences are volatile and forecasts are often inaccurate. When there is uncertainty about the predicted outcome, the likelihood of any particular individual being a pivotal voter increases greatly. Consider the following example. A predicted outcome of 52:48 might be mistaken, and the correct prediction should have been a 50:50 race. If the population is truly divided 52:48, then the chance that randomness in voting decisions would lead to a tie is essentially zero. However, the prediction could well be wrong—because of either changing preferences or polling error—and if the population is truly divided 50:50, then a tie vote is not impossible.

In fact, given equal turnout rates, we assume that if the participation is truly divided 50:50, the result would *definitely* be a tie. We have abandoned the coin-toss model of voting. If the population preferences are split 50:50, then half the population will vote Democrat (as opposed to each person voting independently by flipping a fair coin). Thus the chance of a tie depends on the chance the true split is 50:50. For this reason, the degree of uncertainty over the predicted outcome (or volatility of preferences) becomes an essential parameter of the model.

In Table 2 we recalculate the chance of being pivotal, taking into account both predicted closeness and our estimates of the variance of this prediction. Now the numbers are small, but not zero. There are 14 instances where the chance of a tie was above 1 in 100,000. Just as in horseshoes and hand grenades, a close vote counts, too. That

TABLE 2—PROBABILITY OF A PIVOTAL VOTE WITH UNCERTAINTY ABOUT PREFERENCES

	State	Year	Probability that 1 vote will swing election	Probability that a 1-percent increase in Democrats' turnout will swing election
1	Alaska	1960	0.0000424	0.0248
2	Alaska	1968	0.0000361	0.0272
3	Nevada	1948	0.0000318	0.0167
4	Wyoming	1948	0.0000234	0.0191
5	Delaware	1948	0.0000191	0.0191
6	Vermont	1968	0.0000155	0.0185
7	Hawaii	1960	0.0000144	0.0236
8	Vermont	1976	0.0000144	0.0243
9	Nevada	1968	0.0000137	0.0170
10	Delaware	1960	0.0000128	0.0164
11	Idaho	1948	0.0000126	0.0207
12	Delaware	1968	0.0000116	0.0168
13	Nevada	1960	0.0000115	0.0089
14	New Hampshire	1948	0.0000114	0.0192
···24	South Dakota	1976	0.0000084	0.0186
···34	Hawaii	1988	0.0000073	0.0296
···44	Vermont	1988	0.0000058	0.0109
···54	Louisiana	1956	0.0000046	0.0388

Note: The smallest 1 percentile is 1.41×10^{-15}.

is because a close vote might be swung by a small lift in one party's turnout. If a political party's effort can increase partisan turnout by even 1 percent, then there is a significant chance that the party's effort will prove pivotal. As Table 2 shows, there are dozens of cases in which a 1-percent lift in turnout (calculated for Democrats) would have between a 1- and 3-percent chance of changing that state's outcomes.

In our model, leaders' efforts depend on their probability of changing the outcome. That probability is based on voters' underlying propensity to vote Democrat versus Republican, the degree of uncertainty concerning voter preferences, effort by leaders in each party, and the resulting participation rates of voters. To capture this, we provide an equilibrium model that allows for simultaneous determination of closeness and participation rates.[5]

Since closeness affects participation and participation affects closeness, the best way to test the pivotal-leader theory is by structural estima-

tion of an equilibrium model.[6] These results, presented in Section IV, show that the elasticity of followers' participation probability with respect to leaders' effort is statistically significant and substantial—a 1-percent increase in closeness at the state level raises turnout by 0.34 percent.

To measure closeness at the national level, we use simulations to calculate the chance that each state is pivotal in each national election. This national closeness effect is also significant in explaining effort and participation. We find that leaders value winning the national election at 13 times the value of winning the state. However, since the average chance of a state

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[5] John O. Ledyard (1981, 1984) conducted the pioneering theoretical work in this area, constructing the first rational-expectations equilibrium model of voter turnout. Ledyard used the model to demonstrate existence and then worked backward to characterize optimal candidate positions.

[6] Various specifications of a partial equilibrium model have been run by Yoram Barzel and Eugene Silberberg (1973), James B. Kau and Paul H. Rubin (1976), Mark W. Crain and Thomas H. Deaton (1977), Steven J. Rosenstone (1983), Foster (1984), Tikvah Darvish and Jacob Rosenberg (1988), and Matsusaka (1993). Howard Rosenthal and Subrata Sen (1973) examine abstention and participation in French elections.

Structural estimation overcomes the difficulty in previous empirical work with finding the right measurement of closeness (see Matsusaka, 1993). Is closeness the percent margin of victory, the winner's percentage minus the loser's, the winner's percentage of the vote, or something else? We let the equilibrium theory determine the correct measure.

being pivotal in the national election is small, in 96 percent of the observations, the direct value of winning the state had a larger net impact on motivating effort.

As a test of the model, we compare our effort variable with data from the National Election Studies on the proportion of individuals contacted by campaign representatives. Although our effort variable is inferred from the equilibrium model and, thus, is estimated without using direct data on campaign effort levels, we find that it is significantly correlated with this measure of party contact.

Structural estimation also allows us to identify and estimate different participation rates for Democratic and Republican voters. We find that Republicans have a 32-percent higher propensity to vote than Democrats do. This suggests that if voting had been mandatory and, hence, the propensities to vote had been equalized, then all of the Republican presidents elected during the last 50 years would have lost their first election.

The works closest to this paper are those of Stephen Hansen et al. (1987) and Gary W. Cox and Michael C. Munger (1989). Hansen et al. used a rational-expectations equilibrium framework to estimate voter turnout in Oregon school referenda. Their paper, the first to use an equilibrium approach to estimate participation, demonstrates that a larger population size leads to lower turnout. It also shows how the pivotal-voter theory can help shape the structural form of the estimation. There are three main differences between our approaches. Hansen et al. exogenously split the voters into two equal camps, pro and con, and then use a coin-toss model to determine pivotal probabilities. In our framework, people vote deterministically, although the true fraction of Democrats in the population is unknown and need not be 50 percent. The predicted outcome is influenced by the population's underlying proclivity to vote Democrat versus Republican, the effort levels of party leaders, and exogenous factors such as the economy and incumbency effects. Because the outcome can vary from its prediction, the degree of uncertainty regarding preferences is important in determining the chance the election will be close, which, in turn, influences turnout. A final difference is that the strategic pivotal-vote calculation is amplified since it is

made by political leaders rather than by each individual.

We believe that the decision to vote is influenced by the actions of leaders. The role of a political elite and the assumption that leadership effort responds to closeness are supported by the work of Cox and Munger (1989). Using the 1982 U.S. House elections, they show that campaign expenditures are higher when elections are close. Direct giving is, of course, only one form of effort. Even after controlling for campaign expenditures, Cox and Munger find that close races still have higher participation. We extend the idea of political elites to the broader notion of leaders. Leaders not only encourage people to participate, but they also help inform voters about the issues and about the importance of participation. Another difference between our approach and that of Cox and Munger is that we do not observe effort directly; instead, we estimate a structural relationship between closeness and turnout that is based on leaders' efforts. An advantage of the structural approach is that it allows us to recognize the simultaneous relationships between closeness and participation. Finally, Cox and Munger (1989) tested the effect of actual rather than predicted closeness and did not consider the effect of voting population size.

I. Empirical Regularities

We begin our empirical work with a simple linear regression. We use this regression to get a feel for the data, to test some of the basic directional implications of the pivotal-voter theory, and to provide a baseline for comparison with the structural approach. The pivotal-voter theory suggests that the participation rate should depend on the probability of a tie, which is a function of the size of the population and the expected closeness. We call these two variables "the strategic variables" since they are the inputs to any strategic calculations. We use a linear estimation and aggregate state-by-state data for the 11 U.S. presidential elections, 1948–1988, to study the empirical correlation between the participation rate and the strategic variables.

How do we measure the likelihood of a close race? The probability of a close race is a complicated nonlinear function of the predicted vote

shares—as we later recognize in the structural estimation. In our simple nonstructural estimation, we proxy the likelihood of a close race by the extent that the *predicted* winner's vote exceeds 50 percent.

The variables that help predict vote shares are taken directly from James E. Campbell (1992) and are presented in Table 3. The data set consists of 539 observations across 50 states in the 11 presidential elections between 1948 and 1988.[7] We effectively reproduce his regression. This regression gives us a state-by-state prediction of the Democrat vote share using data that is publicly available in August, well prior to the November election.[8]

The point of this exercise is that we now have a useful measure of predicted vote shares (R^2 is 87 percent) and, therefore, we do not have to rely on the actual *ex post* closeness as a proxy for the preelection predictions.[9] To transform the predicted Democratic vote share into a predicted closeness, we define the *Predicted closeness* variable as the negative of the difference between the predicted winner's vote share and 50 percent.

Over the 1948–1988 period, on average, a majority of the voters preferred the Republican candidates—the average share of the Demo-

cratic candidate was about 46 percent.[10] In 65 percent of the cases, the Democrat's share was between 40 and 60 percent; expanding the range to between 35 and 60 percent covers 80 percent of the cases. Note that the average Democratic vote share, 46 percent, would suggest a closeness of −4 percent. In our sample, the average predicted closeness is −8 percent. Vote shares average out, but closeness does not. If the Republicans win one state 62:38 and lose another 46:54, the average Democratic vote share is 46 percent, while the average closeness is −8 percent.

A second set of variables, those relevant to participation, is described in Tables 4 and 5. Table 4 shows that the average participation rate is 57 percent. Our participation rate does not include votes for third-party candidates.[11] Most observations have a participation rate between 40 percent and 75 percent. Moving to the explanatory variables, we have the state's eligible voting population, its electoral votes, the percent of the population that is black, a dummy variable for southern states prior to civil-rights legislation (Jim Crow laws), and a dummy variable that indicates the presence of a contemporaneous governor's race.[12] To capture elements of sense of community and registration costs, we use the percent of the population that has moved into the state within the previous year. Another cost variable is the level of precipitation (in inches) in the state's largest city on election day. For states with large and dispersed populations and large geographical areas, a weighted average level of precipitation is used.

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[7] Hawaii and Alaska were not yet states for the 1948–1956 elections. Other complications led us to follow Campbell in dropping a few isolated observations. The Democratic candidate was not on the Alabama ballot in 1948 and 1964, and there was a third-party victory in Alabama in 1968 and in Mississippi in 1960 and 1968. In this manner, the 544 potential observations are reduced to 539. The number of observations in Table 3 is 531, since the complications mentioned above hindered us from calculating the prior vote variables for 8 observations.

[8] In contrast, other estimates of vote shares use economic growth rates that are not available until after the election. A second advantage of Campbell's approach is that it does not require any subjective evaluation of the candidates. In contrast to Rosenstone (1983), who adds a special variable for Kennedy's Catholicism and relies on subjective rankings of the candidates' positions on economic and social policies, the Campbell variables are based on measurable characterizations of the voting population, such as the relative Democratic control of the state legislature.

[9] The prior state vote is one of the factors influencing the prediction. The estimate of this effect may be biased if there is serial correlation. However, since we are using this estimate only for prediction, we are not concerned with this issue.

[10] In our sample, each state in each election year is treated as a separate observation. Thus, the Democrat vote share is not weighted by population and, hence, differs slightly from the actual popular vote.

[11] The denominator of the participation rate is the population of eligible voters (the population over 21 and, later, 18) as opposed to the population of registered voters. We prefer to look at absolute participation for two reasons. There are problems with the voter registration data, such as failure to expunge old records. Secondly, we choose to recognize not registering as another form of failure to participate. Note also that while in Table 4 the average participation rate across states is unweighted by population, in Table 5 it is weighted by population.

[12] This variable serves as a proxy for other reasons to vote. Of course, it would be even better to have the predicted closeness of the governor's race, as well as data on local, congressional, and senatorial races.

TABLE 3—CAMPBELL TABLE

Dependent variable: Democratic vote share in percentage

Variable	Estimate	Standard error
Constant	23.92	1.34
National variables		
Democratic share in the national Gallup poll in early September	0.49	0.03
Second-quarter GNP growth*party incumbent	2.24	0.16
Elected incumbent seeking reelection	1.50	0.32
State variables		
Vice-presidential candidate's home state	2.11	0.85
Presidential candidate's home state	6.63	0.99
State liberalism index (ADA and ACA)	0.03	.005
Prior state vote deviation from previous national vote	0.32	0.03
Prior state vote deviation from twice previous (eight years prior) national vote	0.26	0.03
State legislature party division from the previous off-cycle election	0.04	0.01
Standardized 1st-quarter state economic growth*incumbent party	0.63	0.17
Regional variables		
Deep South (1964)	−17.09	2.73
Southern Democrat presidential candidate's advantage in southern states	7.42	0.99
South (1964)	−8.78	1.70
Rocky Mountain west states (1976 and 1980)	−6.86	0.97
North Central (1972)	5.45	1.34
New England (1960 and 1964)	7.67	1.19

Notes: Number of observations = 531; R^2 = 0.8489.

Source: Americans for Democratic Action (ADA) and Americans for Constitutional Action (ACA) scores used by Campbell are from Thomas Holbrook-Provow and Steven Poe (1987).

Other variables are the state's real median per capita income and the percentage of the population over 25 years of age that have at least four years of high-school education.[13]

Table 5 shows that, although turnout in 1948 was smaller than in 1988, there is a general decline in participation during the last 40 years. It is interesting to note that there has also been a significant decline in the number of gubernatorial races that are concurrent with a presidential election. While about 72 percent of the states had a gubernatorial race concurrent with the 1948 presidential election, only 24 percent had such a coupling in the 1988 elections. A large number of states moved from two-year to four-year governor terms *and* timed the transition to coincide with the mid-term election of the presidential cycle. This is one factor that may help explain the apparent decline in participation.

Table 6 presents the linear regression of the participation rate.[14] Our main concern is the effect of the strategic variables as opposed to the demographic variables. We test their effect while controlling for cost-benefit variables and for regional and period dummies. Since the purpose of this test is not to explain the decline in participation over the last four decades or the heterogeneity among states, but to test the strategic aspect of voting, we are not concerned with time and regional variation.[15]

Table 6 presents strong support for the effect of

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[13] The average state voting population is 2.62 million. During the 40-year period, the population almost doubled, and the percent of blacks rose from 9 percent to 12 percent. Jim Crow laws were in effect in about 10 percent of the observations. On average, 3 percent of the population are new residents, and this varies from 0.75 percent to about 14 percent. In about 25 percent of the observations, it rained on election day. The median per capita income is just above $10,000 (measured in 1972 dollars), and an average of 53 percent have at least four years of high-school education.

[14] We obtain similar results when the dependent variable is ln(participation rate/1 − participation rate). However, we believe the linear regression is easier to interpret. Also, participation is typically between 40 and 75 percent mitigating the distortion of the linear specification.

[15] Our results stay the same when we control for state dummies instead of regional ones. The time-period dummies also control for the closeness of the election at a national, as opposed to state, level. R^2 is equal to 0.69 if we do not include any time dummies.

TABLE 4—SUMMARY STATISTICS

Variables	Mean	Standard deviation	Minimum	Maximum
Participation rate	0.5736	0.1303	0.020	0.835
Predicted closeness	−0.0794	0.0597	−0.371	0
State voting population (millions)	2.622	2.924	0.099	21.063
Proportion of blacks	0.0877	0.0968	0	0.484
Jim Crow laws	0.0965	0.2955	0	1
Rain on election day (in inches)	0.0760	0.2035	0	1.7
Concurrent governor's race	0.4471	0.4977	0	1
Percent moved to the state a year before the election	0.0313	0.0170	0.007	0.139
Income per capita in 1970, 10,000 dollars	1.016	0.1855	0.568	1.703
Percent with at least four years of high-school education	0.5297	0.1526	0.198	0.871

TABLE 5—TIME-SERIES SUMMARY STATISTICS

Year	Participation rate (in percent)	Percent of concurrent governor's race	State voting population (in millions)	Percent of blacks	Percent of people with high-school education	Predicted closeness (in percent)
1988	50.34	24.00	3.596	12.06	0.7373	−7.038
1984	53.57	26.00	3.428	11.80	0.6954	−13.16
1980	48.72	26.00	3.252	11.49	0.6744	−7.257
1976	53.42	28.00	2.988	10.91	0.6114	−5.189
1972	55.95	38.00	2.723	10.80	0.5695	−14.00
1968	54.97	45.83	2.361	10.03	0.5259	−4.032
1964	63.80	53.06	2.227	9.960	0.4833	−11.47
1960	65.28	57.14	2.131	9.774	0.4191	−4.341
1956	61.10	62.50	2.101	9.947	0.4035	−7.289
1952	63.75	62.50	2.002	9.553	0.3616	−6.991
1948	51.07	72.34	1.918	8.999	0.3175	−6.266

the strategic variables. It suggests that smaller population size and closer races are correlated with higher participation. Both predicted closeness and the size of the voting population have estimated effects that are over three times the estimated standard errors. The predicted closeness coefficient implies that a 55:45 race should have a 1-percent higher participation rate than a 60:40 race. An increase of one million people in a state's eligible voting population should decrease the participation rate by 1.5 percent.

An increase of three electoral votes leads to a boost of 1 percent in participation rate. Of course, there is a high positive correlation between electoral votes and voting population (0.95). Therefore, the identification of a positive effect of electoral votes on participation and a negative effect of voting population on participation is especially impressive. The positive effect of electoral votes is consistent with at least two effects: (a) voters in states with few electoral votes may believe that the outcome in their state is unlikely to influence the national election, so they are less motivated than people in states with a large number of electoral votes; (b) national parties allocate more resources to stimulate participation in large electoral votes states (see Steven J. Brams and Morton D. Davis, 1974; Claude S. Colantoni et al., 1975).

Turning to the cost-benefit variables, as expected, Jim Crow laws severely lowered participation, by about 18 percent. Even controlling for this effect, the results suggest that black participation is 48 percent lower. These results control for the effect of median state income and education on turnouts. A gubernatorial race presumably motivates those interested in local politics, increasing turnout by 2.4 percent. Recent movers into a state are 1.2 percent less likely to vote. Finally, each inch of rain on election day decreases turnout by 3.4 percent.

TABLE 6—NONSTRUCTURAL ESTIMATION
OF POLITICAL PARTICIPATION
Dependent variable: Political participation measured
as a fraction of the state voting population

Variable	Estimate	Standard error
Constant***	0.4033	0.0256
Predicted closeness***	0.1656	0.0527
Voting population***	−0.0161	0.0036
Electoral votes***	0.0038	0.0011
Proportion of blacks***	−0.4829	0.0357
Jim Crow laws***	−0.1807	0.0124
Rain on election day***	−0.0349	0.0129
Concurrent governor's race***	0.0245	0.0056
Percent moved to the state a year before the election***	−0.0127	0.0027
Income per capita in 1970 dollars***	0.0969	0.0182
Percent with at least four years of high-school education***	0.2211	0.0372
Noncontinental states***	−0.1036	0.0164
1988	−0.0251	0.0231
1984	0.0222	0.0219
1980	−0.0303	0.0219
1976	0.0202	0.0207
1972***	0.0515	0.0179
1968	−0.0199	0.0148
1964***	0.1234	0.0134
1960***	0.1313	0.0124
1956***	0.0938	0.0121
1952***	0.1258	0.0118

Notes: Number of observation = 539; R^2 = 0.82.
Sources (see definitions of variables in text): Voting population, Proportion of blacks, Income, Education—all from U.S. Bureau of the Census (interpolated for noncensus years). Rainfall—U.S. National Climatic Data Center (1995). Movers into a state—Internal Revenue Service Area to Area Migration and County Income Data (only for 1972–1988).
*** Significantly different from zero at the 1-percent level.

So far, we have presented evidence that closeness of the race matters, even after controlling for the size of the population and the cost-benefit variables. Moreover, it is predicted closeness, not *ex post* closeness, that is shown to affect turnout.

However, these results cannot settle the more serious problem that the traditional pivotal-voter theory has with the data. Given the infinitesimal chance of being pivotal, why is turnout so large? And yet, the effect of the strategic variables, predicted closeness in particular, presents difficulties for any alternative theory that is not ultimately based on the probability of a tie. In Section III, we suggest

a new theory, one which is consistent with both the empirical results above and the fact that millions of people regularly vote in elections. But first we provide additional evidence to demonstrate the significant role of the strategic variables in explaining party effort.

II. Parties' Effort

While the previous section showed that individuals are more active when the race is closer and the size of the voting population is smaller, here we find similar effects for the efforts of the political parties. We examine calls and visits to individuals used to encourage turnout. This information comes from the American national elections studies conducted by the Center for Political Studies at the University of Michigan. In 1976, each respondent was asked whether a person from one of the political parties called or visited to discuss the campaign. Thirty-three percent of the 1,216 respondents said that a party made such a contact.[16]

Table 7 shows that the probability of a contact is a positive function of the predicted closeness of the race and a negative function of the size of the state's population. While both voting population and predicted closeness are statistically significant, the effect of predicted closeness is more important politically. On the margin, an increase of one million people in the state's voting population decreases the probability of a contact by 1.4 percent. An increase of 1 percent in the predicted closeness yields an increase of about 1 percent. This suggests that parties' efforts are reasonably elastic with respect to the predicted closeness.

Other exogenous variables in this estimation are used to control for elements that may affect the probability of contact (such as home owner status). We do not pretend to form a theory of party contacts. We simply divide these variables into four categories: characteristics presumably known by the party that make voting likely; willingness to accept a call or a visit; the difficulty of reaching the person; and demographics. The defi-

[16] We are using the 1976 survey because it is part of a panel study. Since we use a voter's previous participation decision in the estimation, we prefer to use a panel, which is more reliable on this point.

TABLE 7—PARTIES' EFFORT
Dependent variable (probit): Probability of party contact

Variable	Coefficient	Standard error
Voting population***	−0.0405	0.0104
Predicted closeness**	2.345	0.9839
Participation in 1972***	0.3459	0.1011
Member of a group***	0.2617	0.0854
Parents involved in politics	0.1120	0.0792
Easiness to vote*	0.1926	0.0934
Married	0.0332	0.0944
Crooked	−0.0629	0.0814
Trust*	0.1843	0.0866
Home owner*	0.2347	0.1054
Moved	−0.1200	0.0993
South	0.1519	0.1455
White	0.1974	0.1535
High education*	0.1765	0.0841
Low income*	−0.1945	0.0940
Constant***	−0.9794	0.2541

Notes: We divide the exogenous variables in the estimation of parties' effort into four categories: respondent's characteristics (which are known to the parties) that make her more likely to vote; respondent's degree of willingness to accept a contact from the party; parties' cost of reaching the person; and respondent's demographics.

Participation in 1972, Member of a group, Parents involved in politics, Easiness to vote, and *Married* are in the first category. All of them are dichotomous variables. Participation in 1972 is equal to one (for 76 percent of the respondents) if the respondent participated in the 1972 elections, and it is equal to zero otherwise. *Member of a group* is equal to one (for 28 percent of the respondents) if the respondent belongs to an organization or takes part in an activity that represents the interests and viewpoint of a group that she feels close to. *Parents involved in politics* is equal to one (for 46 percent of the respondents) if both the respondent's mother and father were interested in politics when she was growing up. *Easiness to vote* is equal to one (for 69 percent) if the only requirement in the respondent's place to be eligible to vote is age and U.S. citizenship; there are periods before a general election when additional locations are used to register voters; there are ways of registering other than going to an office in person; or there is a law which allows people to take time off from work to vote. Sixty-nine percent of the respondents were married in 1976.

Participation in 1972, Member of a group, and *Easiness to vote* should be in the parties' set of information. All these variables have the predicted sign and high significance level. The interest of the respondent's parents in politics may also be in the party set of information. However, while this variable has the right sign, it is not significant. A married person may represent a better target because a leader ends up contacting two people instead of one. However, this variable does not seem to be considered by the party.

Crooked and *Trust* are in the second category. *Crooked* is equal to one (41 percent of the observations) if the respondent thinks that "quite a few of the people running the government are crooked." *Trust* is equal to one (57 percent of the respondents) if the respondent thinks that "most people can be trusted." This category represents the willingness of the respondent to talk with a party person. A person who rejected the call may not recall being contacted. The data support the hypothesis with respect to *Trust,* but not with respect to *Crooked.*

Home owner and *Moved* are in the third category. *Home owner* is equal to one (78 percent of the observations) if the respondent owns her home, and *Moved* is equal to one (21 percent) if she moved into her home in the last couple of years. It should be easier for a party to follow an individual who owns her home and harder to locate a person who just moved. Both *Home owner* and *Moved* have the expected sign, but only the first one is significantly different from zero.

The rest of the variables are demographic. *South* is equal to one (25 percent) if the respondent lives in a solid southern state (Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Texas, and Virginia); *White* is equal to one (90 percent) if she is white; *High education* (50 percent) if her highest level of education is higher than 12 grades; and *Low income* (36 percent) if her family's income is in the lowest one-third of the income distribution. The higher the respondent's education and income, the higher the probability that a party called her.

* Significance level of 5 percent.
** Significance level of 2 percent.
*** Significance level of 1 percent.

nitions of these variables, their statistical descriptions, and their effect on the probability of a contact are presented after Table 7.

III. A Model

At this point we have established two empirical facts: both voter turnout and party effort are higher in states in which a close election is predicted. We believe these two effects are not just coincidental: high turnout is a result of increased effort. This intuition is supported by the empirical work of Gerald H. Kramer (1971) and Peter W. Wielhouwer and Brad Lockerbie (1994), who show that respondents who were contacted by the parties are more likely to participate.

We turn now to constructing a theoretical model that structures the equilibrium relationships among closeness, effort, and turnout. We believe that the model provides a new and viable interpretation of the pivotal-voter theory. Although the structural estimation provides an excellent fit to the data, we recognize that other interpretations of the data are possible.

The standard model of participation is that a person votes if $B + \pi V > C$, where B is the private benefit, V is the value of changing the outcome, π is the chance of being pivotal, and C is the private cost of voting. Our approach makes four departures from this basic formulation.

First, we divide the world into two types of people: leaders and followers. Leaders engage in the above strategic cost-benefit calculation when deciding how much effort to expend in working for a political candidate. They consider the closeness of the race, the level of uncertainty, and the influence of their effort on the electoral outcome. In particular, leaders consider how their effort will influence followers to get out and vote. For simplicity, our model has one leader per state.[17]

Followers vote or abstain based on a cost-benefit calculation, *but one that is decidedly*

nonstrategic. The benefit from participating depends on many factors, including candidate positions and competency, voters' education, income, marital status, precipitation on election day, and the presence of concurrent state and local election races. The calculation is nonstrategic in that the follower does not consider whether his or her vote will affect the outcome. Instead, followers consider how much effort their leaders have exerted to get them to vote.

Just as some people contribute money to a candidate because a friend asks them to, people vote because their friends encourage them to. We believe that social pressure is very important. There is a contagion effect. The more people in a social network that encourage a person to vote, the more likely that person is to vote and to encourage others to do the same.

Our second departure from the standard model concerns the value of changing the outcome, V. We recognize that there is a distinct value for winning the state, separate from winning the national election. Furthermore, for a vote to change the result of the national election there must be "double pivotalness." The vote has to change the state outcome, and the state's electoral votes must then change the national result. Thus, we include both state and national pivotal probabilities in our model.

The third and fourth innovations concern the calculation of the pivotal probabilities, π, that enter the leaders' cost-benefit calculus. These probabilities depend on the predicted outcome at both the state and national levels and are determined as part of a rational-expectations equilibrium. In addition, we include uncertainty as to the true population division between Democrats and Republicans. A predicted 52:48 split might still lead to a 50:50 outcome. This uncertainty over the true population split greatly increases the pivotal probabilities, as evidenced by the difference between Tables 1 and 2.[18]

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[17] There are obviously several different levels of leaders—for example, Jesse Jackson and Rush Limbaugh. To the extent that leaders at any of these levels are making strategic effort decisions or are influenced by effort from leaders at higher levels, the results carry through. In an earlier version of this paper, our model allowed for multiple leaders.

[18] The reason is straightforward. In a coin-toss model, if fraction d of the population are Democrats and a random person votes with chance p, then for any reasonably large population N the distribution of votes will be normal with a margin of victory (loss) of $p(1 - 2d)N$. The standard deviation is $(Np(1 - p))^{0.5}$ so that unless $d = 0.5$, the chance of a tie will be like observing a $N^{0.5}$ standard deviation event. This is infinitesimally small given the

The strategic cost-benefit calculation or pivotal-voter model then becomes the pivotal-leader model. The voting paradox returns just one step higher up the chain. Why do leaders expend effort to get followers to vote? One reason is that a leader influences many people with his or her effort. A second reason is that the leader cares about the state as well as the national outcome. Leaders also recognize the uncertainty about voter preferences. There is always the possibility that the election will be much closer than people expect, in which case, effort from leaders will have a high marginal product.

There are other reasons for leaders' effort that we do not consider in our model. Leaders may be individuals with a particularly high personal benefit associated with victory. This could be endogenous in that those with high benefits become leaders. Alternatively, leaders, as a result of their leadership, become eligible for appointed positions and, thus, anticipate a large V.[19] Another reason that leaders work hard is that their effort may induce some people to switch parties. Of course, it is much easier to get a person to vote than it is to change someone's vote. Hence, our focus is on increasing partisan participation and not on conversion.

Our view is that followers have some low probability of voting that determines their level of participation, absent any effort on the part of a leader. As a leader expends effort, this increases the possibility that the voter will recognize the benefits of the proposed candidate and respond to the effort.[20]

Leaders increase political participation in at least four ways. First, they decrease the direct cost of voting; for example, they organize volunteers to drive people to polls. Second, they decrease the cost of becoming informed by sharing their knowledge with their followers. Third, they increase the cost of not voting by imposing a social sanction on those who do not participate. They get the ball rolling to create the social pressure that starts the contagion effect. But all of this is a matter of degree. This is why the leader's effort is so important. Thus a fourth effect: leaders provide a signal through their actions. Potential voters are able to infer the relative importance of this race in terms of the issues and the closeness, based on the effort of their leaders.

In solving the model below, we consider a representative follower that prefers the Democratic candidate; the results for a Republican follower are analogous. A representative Democratic follower votes if his or her idiosyncratic cost μ is less than the benefit, ψ:

$$(1) \qquad \mu < \psi^d(E_d, x, \varepsilon),$$

where E_d represents the effort by a Democratic leader, x represents observable factors influencing the participation decision of all individuals, and ε represents unobservable common factors influencing the participation decision. Since x and ε are common factors, they are the same for all individuals in a state and a period; they differ across states and for each election period. Notice that we allow the participation function ψ to differ between the two parties.[21]

We assume that the distribution of μ in the population is uniform on $[0, 1]$. On election day, the proportion of Democrats that votes thus equals $\psi^d(E_d, x, \varepsilon)$.

Leaders have to choose their effort level early in the campaign, before they observe ε. Thus,

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multimillion voting population. On the other hand, we look at the case with deterministic voting but uncertainty over voters' preferences. If d has some distribution, then the chance of a tie vote (given equal turnouts) is essentially determined by the likelihood that d is one-half which, in turn, depends on the expectation of d and its variance.

[19] As Raymond Wolfinger (1994) points out, who you vote for may be anonymous, but whether you vote is not. This is doubly true for leaders. Effort and its result (turnout in a district) are observable, albeit imperfectly. In the event of victory, leaders may be rewarded for their effort. In the event of a defeat, they may be out of a job.

[20] The November 1993 Ed Rollins scandal in New Jersey suggests an alternative effort strategy for leaders. Instead of trying to get out the vote among their supporters, they can spend effort to suppress the vote of the opposition. While this may no doubt take place, it is our view that this is neither very

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important nor very effective. One difficulty with this strategy is that it has a tremendous potential to backfire.

[21] Most of the x variables, such as rainfall, governor's race, and other environmental data, are the same for the Republicans and the Democrats. Two of the x variables—average income and education—likely differ between the two parties. However, since we (as econometricians) do not observe these interparty differences, we assume that they are the same for all individuals in each state and period. To allow for some of these differences between the parties, we let ψ differ between them.

leaders make their effort decision using the knowledge of the distribution of ε, $f(\varepsilon)$.[22]

At the time they choose their effort, leaders are still unsure of their candidate's support in their state. While most of the previous studies assumed that the leaders know the exact division of the voting population between the two parties, we think that it is more reasonable to assume that leaders have some information to help them predict the vote share, but that the outcome is uncertain. Let the fraction of the population that prefers the Democratic candidate be represented by the random variable d. Leaders from both parties know the density function, $h(d)$, but not the realization of d.

The probability that the Democrats win, represented by P_{win}, is then the probability that $d \cdot \psi^d(E_d, x, \varepsilon) \geq (1 - d) \cdot \psi^r(E_r, x, \varepsilon)$ or the probability that $d \geq \psi^r/(\psi^r + \psi^d)$. Thus,

$$(2) \quad P_{win} = \int_{-\infty}^{\infty} \left[1 - H\left(\frac{\psi^r}{\psi^r + \psi^d}\right) \right] f(\varepsilon) \, d\varepsilon,$$

where $H(d)$ is the cumulative of $h(d)$. The marginal effect of effort is

$$(3) \quad \frac{\partial P_{win}}{\partial E_d}$$

$$= \int_{-\infty}^{\infty} \alpha_1(\varepsilon) \cdot (1 - \alpha_1(\varepsilon)) \frac{\psi_E^d(E_d, x, \varepsilon)}{\psi^d(E_d, x, \varepsilon)}$$

$$\times h(\alpha_1(\varepsilon)) f(\varepsilon) \, d\varepsilon,$$

where $\alpha_1(\varepsilon) = \psi^r(E_r, x, \varepsilon)/[\psi^d(E_d, x, \varepsilon) + \psi^r(E_r, x, \varepsilon)]$. This follows from differentiating 2 where we note that $[\partial \alpha_1(\varepsilon)/\partial E_d] = -\alpha_1 \cdot (1 - \alpha_1)[\psi_E^d(E_d, x, \varepsilon)/\psi^d(E_d, x, \varepsilon)]$.

Now, we return to the cost-benefit calculus for a leader. The utility of a Democratic leader depends on the value of winning, V_{win}, the probability of winning P_{win} (which depends on

[22] This commitment to an effort level has some parallels to John B. Londregan and Thomas Romer (1993). In their paper, parties commit to a candidate's platform without having full information about her ability, which becomes apparent only during the course of the campaign.

x, ε, and all the effort levels), and the cost of effort, which we denote by $C(E_d, N)$:

$$(4) \quad Expected \ Utility = V_{win} \cdot P_{win}(\, \cdot \,, E_d)$$

$$- C(E_d, N),$$

where N is the total voting-age population. We assume that the cost of effort in a state with a large population is higher. For example, the cost of television advertisement is a function of the audience size. Thus, reaching the same proportion of voters in California is more expensive than in Rhode Island.

The value of winning the state's vote, V_{win}, is made up of two components. One part is the impact that the state's vote has on the national election. We normalize the value of winning the national election to be 1. Winning the state will have different implications for the national election, depending on the state's electoral votes and the closeness of the election. Thus, we calculate each state's equilibrium chance of being pivotal in a national election, denoted by R. The second component to the value of winning the state's presidential vote is independent from winning the national election. A state party leader will typically work hard even in years when the party's presidential candidate will most likely lose. One reason are coat-tail effects for Senate, House, and state and local candidates. Another motivation is that states get a bonus in national convention delegates if the party carries the state.[23] We denote all these incen-

[23] The Democratic party determines the distribution of delegates' votes based on the following rule: A base of 3,000 delegate votes is distributed among the 50 states and the District of Columbia according to a formula giving equal weight to the sum of the vote for the Democratic candidates in the three (3) most recent presidential elections and to population by electoral vote. The formula in 1996 is expressed mathematically as follows:

Allocation Factor

$$= \left[0.5 \, \frac{(SDV1984 + SDV1988 + SDV1992)}{(TDV1984 + TDV1988 + TDV1992)} + \frac{SEV}{538} \right]$$

SDV = State Democratic Vote, SEV = State Electoral Vote, TDV = Total Democratic Vote.

The Republican party also gives each state bonus delegates based on the previous presidential election. In 1996,

tives by S. Putting the national and state components together, we get that $V_{win} = S + 1 \cdot R$.[24]

At this point, we can solve for the optimal level of effort, which is determined by the following pair of first-order conditions:[25]

$$(5) \quad \int_{-\infty}^{\infty} V_{win}\alpha_1(\varepsilon) \cdot (1 - \alpha_1(\varepsilon))$$

$$\times \frac{\psi_E^d(E_d, x, \varepsilon)}{\psi^d(E_d, x, \varepsilon)} h(\alpha_1(\varepsilon)) f(\varepsilon) \, d\varepsilon$$

$$- C_E(E_d, N) = 0,$$

$$\int_{-\infty}^{\infty} V_{win}\alpha_1(\varepsilon) \cdot (1 - \alpha_1(\varepsilon))$$

$$\times \frac{\psi_E^r(E_d, x, \varepsilon)}{\psi^r(E_d, x, \varepsilon)} h(\alpha_1(\varepsilon)) f(\varepsilon) \, d\varepsilon$$

$$- C_E(E_r, N) = 0.$$

Note that effort is a function of predicted closeness, not actual closeness, since leaders do not observe d or ε prior to determining their effort levels.

PROPOSITION 1: *If* $\psi^d(E, x, \varepsilon) = g(E) J^d(x, \varepsilon)$, *and* $\psi^r(E, x, \varepsilon) = g(E)J^r(x, \varepsilon)$, *where* $g(E)$ *is log-concave and* $C(E, N)$ *is strictly convex in* E, *then in equilibrium* $E_d = E_r$.

PROOF:

We can rewrite the first-order condition for the Democratic leader as:

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any state that cast its electoral votes for President Bush in 1992 received additional delegates at large: 4.5 delegates plus a number of delegates equal to 60 percent of the state's electoral vote.

[24] Notice that we assume that V is the same for Republicans and Democrats. While there are slight differences in the current incentives that state Democrats and Republicans are facing, we believe that these differences are insignificant.

[25] It remains to check that the second-order conditions are also satisfied so that a solution to the first-order conditions defines an equilibrium. Given the specification we use in Assumption 1, concavity is ensured, justifying our use of first-order conditions.

$$(6) \quad \int_{-\infty}^{\infty} V_{win}\alpha_1(\varepsilon)(1 - \alpha_1(\varepsilon)) \frac{g'(E)}{g(E)}$$

$$\times h(\alpha_1(\varepsilon))f(\varepsilon) \, d\varepsilon = C_E(E_d, N) \Rightarrow$$

$$\frac{\partial \ln(g(E_d))}{\partial E_d} \int_{-\infty}^{\infty} V_{win}\alpha_1(\varepsilon)(1 - \alpha_1(\varepsilon))$$

$$\times h(\alpha_1(\varepsilon))f(\varepsilon) \, d\varepsilon = C_E(E_d, N)$$

and the results for the Republican leader are analogous. Taking the ratio of the first-order conditions, we get:

$$(7) \quad \frac{\partial \ln(g(E_d))/\partial E_d}{\partial \ln(g(E_r))/\partial E_r} = \frac{C_E(E_d, N)}{C_E(E_r, N)}.$$

If one party had a higher value of E, it would then have a (weakly) lower value on the left-hand side due to the log-concavity of g, but a strictly higher value on the right-hand side due to the convexity of C—a contradiction.

At this point, we have a rational-expectations equilibrium model that leads to effort levels E_d and E_r and the implied participation rates ψ_d and ψ_r. To proceed further we need to specify functional forms for $\psi(E, x, \varepsilon)$ and $C(E, N)$.

ASSUMPTION 1:

$$(8) \quad \psi^d(E, x, \varepsilon) = \exp(\rho E + \beta_d^0 + x \cdot \beta + \varepsilon),$$

$$C(E, N) = \frac{E^2}{2} + \eta \cdot N \cdot E.$$

The function ψ for the Republicans is analogous. Notice that the only difference between the ψ functions is with respect to the a priori propensity to vote, β^0. To reach a larger group requires more effort— here that increase is linear with group size. These functional forms satisfy the condition of Proposition 1 so that equilibrium effort levels will be the same for the two parties.

PROPOSITION 2: *Under Assumption 1, the equilibrium common value of effort, E^*, solves*

$$E^* = (S + R) \cdot \rho \alpha_1 (1 - \alpha_1) h(\alpha_1) - \eta \cdot N,$$

(9)

$$\text{where } \alpha_1 = \frac{1}{(1 + \exp(\beta_d^0 - \beta_r^0))}.$$

This result follows from substitution into (9) and observing that $\alpha_1(\varepsilon)$ is no longer a function of ε.

COROLLARY 3: *Because effort levels are equal, the relative propensity to vote is based on the a priori propensities to vote* β_d^0 *and* β_r^0: $(\psi^d/\psi^r) = \exp(\beta_d^0 - \beta_r^0)$.

Calculating E^* requires knowledge of the state's chance of being pivotal. But that, in turn, depends on all of the effort levels. We solve for E^* and R simultaneously through simulations as an integral part of the structural estimation which is described in the next section.

The chance that state j is pivotal in election t is denoted $R_{jt}(Electoral\ Votes_t, \zeta_t)$, where the ζ_t are taken directly from Campbell (1992) as listed in Table 3. Thus R_{jt} is a complex function of the number of electoral votes for each state and the expected election results in each state. Previous attempts to provide a closed-form solution (Brams and Davis, 1974) required very restrictive assumptions. We overcome these difficulties by using simulations. As part of our structural estimation, we assess the probability that the Democratic candidate would win each state in each election year. Using these probabilities, we then randomly draw the winner of each state race in each election year. Based on this and the number of electoral votes each state has in each election year, we determine for each state whether it would have changed the election results in this scenario. We repeat this 100,000 times and set R_{jt} to be equal to the proportion of times that state j was pivotal in period t.

The highest R_{jt} in our sample is for New York in 1960 (the probability was 24.3 percent). Compared to other election years, 1948 had the highest average value of R_{jt} in our sample (7.1 percent). Other than in 1948,

1960, 1968, and 1976, the average yearly R_{jt} are almost zero. Table 8A presents the average R_{jt} in each year, and Table 8B describes the 25 observations with the highest R_{jt}. Note that these simulations are part of the structural estimation.

From (9) we can see that the effect of the uncertainty over d on effort is ambigous. Typically, $|d - \alpha_1| > \sigma_d$, in which case an increase in σ_d increases $h(\alpha_1)$ and thus effort. In the case when $|d - \alpha_1| < \sigma_d$, then $d \simeq \alpha_1$, and the probability of a tie is high without any uncertainty over d. Adding uncertainty makes the event $d \simeq \alpha_1$ less likely and thus decreases the probability of a tie. Tables 1 and 2 give a nice example of this phenomenon; the probability of a tie for Hawaii (1960) and Rhode Island (1956) is actually lower in Table 2 (with uncertainty) than in Table 1 (without it).

IV. Structural Estimation

After structuring the theory, we are now ready to return to the data. The model's restrictions guide the empirical study. In the nonstructural estimation, we measured the closeness of the race by the extent that the predicted winner's vote exceeds 50 percent. Instead of using various ad hoc measures of closeness, our structural estimation uses the pivotal probability that comes directly out of our equilibrium model.

An advantage of structural estimation is that its output is the parameters of the model. Thus, unlike estimated coefficients of a nonstructural estimation, our estimates have straightforward interpretations. For example, one of the main purposes of the following estimation is to assess the elasticity of the participation probability with respect to leaders' effort. Structural estimation will also allow us to measure differences in the a priori propensity to vote between Democrats and Republicans.

A. Estimation Procedure and Identification Issues

We are now ready to present the likelihood function. For state j in period t, the percent of the population that prefers the Democratic candidate is d_{jt}. We assume that the density function $h(d_{jt})$ is normal with mean $\bar{d}(\zeta_{jt})$ and variance σ_d^2. Note that $\bar{d}(\zeta_{jt})$ is the *predicted* underlying preference

TABLE 8A—THE NATIONAL PIVOTAL PROBABILITY OF STATES, R_{jt}, BY YEARS

Year	Mean percent
1948	7.13723
1952	0.00125
1956	0.0
1960	3.96591
1964	0.0
1968	1.89
1972	0.0
1976	0.4984
1980	0.0012
1984	0.0
1988	0.0

TABLE 8B—THE HIGHEST NATIONAL PIVOTAL PROBABILITIES

State	R_{jt} (percent)	Year	Number of electoral votes
New York	24.28	1960	45
Pennsylvania	20.05	1948	35
Texas	18.74	1948	23
Illinois	17.59	1948	28
California	17.21	1948	25
New York	16.44	1948	47
Ohio	14.34	1948	25
California	13.46	1960	32
Pennsylvania	12.99	1960	32
California	12.70	1968	40
Illinois	12.22	1960	27
Ohio	11.31	1960	25
Missouri	11.11	1948	15
Michigan	11.07	1948	19
New Jersey	11.03	1948	16
Massachusetts	10.71	1948	16
North Carolina	10.34	1948	14
Tennessee	8.79	1948	12
Georgia	8.69	1948	12
Indiana	8.39	1948	13
Virginia	7.78	1948	11
Kentucky	7.77	1948	11
Michigan	7.73	1960	20
Wisconsin	7.67	1948	12
Minnesota	7.59	1948	11

for the Democratic candidate: we assume $\bar{d}(\zeta_{jt}) = \zeta_{jt} \cdot b$ where the ζ_{jt} variables are taken directly from Campbell (1992).

However, we do not observe d_{jt} directly since we do not know the true number of nonvoting Democrats. Instead, we only see the total Democratic and Republican turnouts: $DP_{jt} = \psi_{jt}^d \cdot d_{jt}$ and $RP_{jt} = \psi_{jt}^r \cdot (1 - d_{jt})$. We let DV_{jt} represent the percentage of the voting population that votes Democrat:

$$(10) \quad DV_{jt} = \frac{DP_{jt}}{DP_{jt} + RP_{jt}}$$

$$= \frac{\psi_{jt}^d \cdot d_{jt}}{\psi_{jt}^d \cdot d_{jt} + \psi_{jt}^r \cdot (1 - d_{jt})}.$$

To calculate the likelihood of observing DV_{jt} and DP_{jt} conditional on all other observed variables, we derive the inferred values of ε_{jt} and d_{jt}. We can rearrange equation (10) to *infer* the true underlying percentage of Democrats, d_{jt}^*:

$$\frac{1 - d_{jt}^*}{d_{jt}^*} = \frac{(1 - DV_{jt})}{DV_{jt}} \cdot \frac{\psi_{jt}^d}{\psi_{jt}^r}$$

which, using Corollary 3, leads to $d_{jt}^* = \{1/ [1 + (1/DV_{jt} - 1) \cdot \exp(\beta_d^0 - \beta_r^0)]\}$.

This implies that the first element of our likelihood function is

$$(11) \quad f_1(DV_{jt}|\zeta_{jt} ; b, \beta_d^0, \beta_r^0, \sigma_d)$$

$$= \phi\left(\frac{d_{jt}^* - \bar{d}(\zeta_{jt})}{\sigma_d}\right)\left(\frac{d_{jt}^*}{DV_{jt}}\right)^2$$

$$\times \exp(\beta_d^0 - \beta_r^0),$$

where ϕ is the standard normal density.

We can also infer ε_{jt} from the observation DP_{jt} and the inferred values d_{jt}^* and E_{jt}^* [from equation (9)]:

$$\psi_{jt}^d = \exp(\rho E_{jt}^* + \beta_d^0 + x_{jt} \cdot \beta + \varepsilon_{jt}),$$

$$\varepsilon_{jt}^* = \ln\left(\frac{DP_{jt}}{d_{jt}^*}\right) - \rho E_{jt}^* - \beta_d^0 - x_{jt} \cdot \beta.$$

Thus the second element of our likelihood function is:

$$(12) \qquad f_2(DP_{jt}|DV_{jt}, \, x_{jt}, \, \zeta_{jt}, \, N_{jt},$$

$$Electoral \; Votes_{jt}; \, \beta, \, \beta_d^0, \, \rho, \, \sigma_\varepsilon,$$

$$b, \, \sigma_d, \, \eta, \, S) = \phi\left(\frac{\varepsilon_{jt}^*}{\sigma_\varepsilon}\right) \frac{1}{DP_{jt}},$$

where N_{jt} is the size of the voting population and x_{jt} measures some of the costs and benefits of voting for people in state j in period t. These variables include a concurrent gubernatorial race, precipitation on election day, the percent of recent movers into the state, and Jim Crow laws. We also control for the percent of minorities, per capita real income, and education. Dummy variables control for temporal aggregate shocks, and for unobserved differences between Alaska and Hawaii and the rest of the United States.

The likelihood of the Democratic share of the votes is described by equation (11), while the probability of the observed participation rate is presented in equation (12).[26] Putting these together, the likelihood function is

$$(13) \quad L(\mathbf{\Omega}) = \prod_{j=1}^{50} \prod_{t=1}^{11} f_2(DP_{jt}|DV_{jt}, \, x_{jt},$$

$$\zeta_{jt}, \, N_{jt}, \, Electoral \; Votes_{jt}; \, \mathbf{\Omega})$$

$$\cdot f_1(DV_{jt}|\zeta_{jt}, \, \mathbf{\Omega}),$$

where $\mathbf{\Omega}$ is a vector of the parameters b, β, β_d^0, β_r^0, η, V, σ_ε, σ_d, S, and ρ. This is the likelihood of observing two variables—Democratic vote share and participation rate—given the exogenous variables x, N, *Electoral Votes*, and Campbell's variables, ζ. Notice that the ζs appear in both parts of the likelihood function because they affect both the closeness of the race and the participation rate. They influence the participation rate, the ratio (DP_{jt}/DV_{jt}), through their effect on effort levels. Our estimate is the vector $\hat{\mathbf{\Omega}}$ that maximizes this value.

The identification of the model is straightfor-

ward. To understand the identification of ρ, notice that it only appears in the inferred value of ε in the form of $\rho \cdot E^*$, which can be rewritten as

$$\rho E_{jt}^* = \rho^2 (S + R_{jt}) \alpha_1 (1 - \alpha_1)$$

$$\times \phi\left(\frac{\alpha_1 - \bar{d}(\zeta_{jt})}{\sigma_d}\right) - \rho \cdot \eta \cdot N_{jt}.$$

This equation makes it clear that the strategic variables—state probability of being pivotal, R_{jt}, voting population size, N_{jt}, and the predicted closeness $\phi(\cdot)$—are the ones that identify ρ. Also, notice that we assess the effect of R_{jt} by its size relative to our estimate of S. The probability R_{jt} is primarily a function of the number of electoral votes, which is not included anywhere else in the model. Thus, a major identifying factor of the effect of R_{jt} is a solid data source—the number of electoral votes.

B. Results

Table 9 presents the parameters that maximize the likelihood function in equation 13.[27] The fit of the model is quite good. In spite of all the restrictions implied by the theoretical structure, the model explains 87.62 percent of the variance of DP_{jt} and 84.87 percent of the variance of DV_{jt}. Furthermore, without the period dummies, the model would still explain 80 percent of the variance of DP_{jt}.

Our next concern is whether the effect of the unobserved effort level is significant both economically and statistically. The parameter ρ is positive as expected (0.58) and significantly different from zero at the 1-percent level. The empirical effect of closeness is substantial—an increase of 1 percent in the closeness of the race increases effort and leads to an increase of 0.34 percent in participation. Our estimate of ρ represents the combined effect of all the ways leaders encourage participation—advertisement, party contacts, get-out-the-vote, etc.

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[26] Notice that the participation rate is the ratio of DV over DP.

[27] Note that eight out of the 539 observations have unavailable data, which prevents us from calculating the predicted Democrat vote share. For these cases, we used the actual share and calculated the likelihood using only f_2. Estimation results are not sensitive to this decision.

TABLE 9—STRUCTURAL ESTIMATION
R^2 of DP = 87.62 R^2 of DV = 84.87
Log-likelihood = 2074.7

Parameter	Estimate	Standard error
σ_ϵ***	0.1156	0.0032
β_d^0***	-1.129	0.0683
β_r^0***	-0.8581	0.0754
ρ***	0.5855	0.1431
η***	0.1490	0.0564
$S^\#$	0.0790	0.0498
$\beta_{\text{Governor's Race}}$***	0.4517	0.1289
β_{Rain}**	-0.0806	0.0337
$\beta_{\text{Jim Crow}}$***	-0.3510	0.0226
β_{Income}***	0.2186	0.0484
β_{Black}***	-1.001	0.0672
$\beta_{\text{Moved In}}$***	-0.0329	0.0054
$\beta_{\text{Education}}$***	0.3613	0.0741
External states (Hawaii, Alaska)***	-0.1770	0.0297
1988	0.0468	0.0511
1984**	0.1207	0.0490
1980	0.0326	0.0494
1976***	0.1465	0.0519
1972***	0.1653	0.0477
1968	0.0172	0.0300
1964***	0.3289	0.0274
1960***	0.2646	0.0252
1956***	0.2049	0.0246
1952***	0.2679	0.0257
σ_d***	0.0378	0.0012
b_0***	0.2932	0.0219
Gallup poll***	0.0052	0.0003
GNP growth***	0.0209	0.0017
Incumbent***	0.0132	0.0031
VP candidate's home state**	0.0195	0.0098
Presidential candidate's state***	0.0605	0.0103
ADA and ACA scores***	0.0004	0.00005
Previous vote***	0.0033	0.0003
Previous (8 years) vote***	0.0025	0.0002
State legislature***	0.0004	0.0001
State economic growth***	0.0063	0.0015
South (1964)***	-0.1443	0.0659
Southern Democrat***	0.0776	0.0097
South (1964)***	-0.0928	0.0285
West (1976 and 1980)***	-0.0713	0.0101
North Central (1972)***	0.0569	0.0168
New England (1960 and 1964)***	0.0679	0.0141

Notes: When we estimate the model with the constraint S = 0, the likelihood falls to 2068.24. Thus, we reject the hypothesis that S = 0 even at the 0.1-percent significance level.

   * Significance level of 5 percent.
  ** Significance level of 2 percent.
 *** Significance level of 1 percent.

We find these results very encouraging and proceed by examining the role of the other strategic variables N and R_{jt} on effort. We hy-

pothesized that the cost of effort increases linearly with the size of the voting population. The parameter η is 0.15 and is significant at the 1-percent level. This implies that an increase of one million people (holding electoral votes and everything else constant) would lead to less effort which, in turn, would result in a 1-percent decrease in participation.

We now turn to the third strategic element that affects leaders' effort—the value of winning. Using the likelihood ratio test, we reject the hypothesis that the value of winning the national election is zero at the 1-percent significance level. (We reject the hypothesis that V_{win} = S + 0 · R versus the alternative hypothesis that V_{win} = S + 1 · R.) Thus, differences among states with respect to R help us explain the variation in the unobserved effort levels and the observed participation rates. This means that leaders care about winning the elections in their states and also about the effect this has on helping their party win the national elections.[28] We estimate S equals 0.079, which implies that leaders value winning the national election at 13 times the value of winning the state. However, given the typically small value of R_{jt}, in almost all cases (519 out of the 539), the direct value of winning the state had a larger net impact on motivating effort.

These results demonstrate that the pivotal-leader theory is strongly consistent with the data. However, notice the degree of sophistication leaders need to assess the potentially pivotal role of their states in the national election. They would need to estimate the closeness of the races in all the states and then to calculate the complex R_{jt} (something which we could only do through simulation). An alternative hypothesis that might also be consistent with the results reported above is that leaders use the number of electoral votes as a proxy for R_{jt}. One way to examine this hypothesis is by reestimating the model replacing R_{jt} with a polynomial function of the number of electoral votes. This leads to a significantly higher likelihood, 2080.6, and a higher R^2 of the participation rate, 87.95 per-

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[28] Brams and Davis (1974) suggested another interpretation of this effect. According to them, candidates allocate campaign resources roughly in proportion to the ³⁄₂'s power of the electoral votes of each state.

cent. Since these models are not nested, we cannot test one model versus the other. Still, these results suggest that state leaders may be approximating R_{jt} with the number of electoral votes. In the next section, we present additional support for this perspective.[29]

We briefly discuss the effects of the nonstrategic variables on participation. The predicted participation rate of a median-income, high-education white in the 1988 elections is 68.3 percent.[30] The predicted participation rate of a black individual with the same characteristics is 25 percent. Jim Crow laws decrease the predicted participation rate by 30 percent. One inch of rain reduces turnout by 8 percent. The participation rate of a person who just moved into a state is 3 percent lower. A governor's race increases predicted participation rate by 4.5 percent. The elasticity of the participation rate with respect to median income is 0.22. Education has a large effect: people who did not complete high school participate at only 70 percent of the rate of high-school graduates.

The structural estimation enables us to address the issue of whether Republicans and Democrats differ in their a priori propensity to vote. We find that they do—$\beta_d^0 \neq \beta_r^0$.

To understand the identification of different a priori vote propensities, temporarily ignore the exogenous variables. With only endogenous variables we can still identify five parameters. The five identifiers are the expectations and the variances of DV_{jt} and DP_{jt} and the covariance between them. This leads to identification of σ_d, σ_ε, b^0, β_d^0, and β_r^0.

To see the intuition of this identification, consider the relationship between the Democratic vote share, DV_{jt}, and the participation rate. If the participation rate of the Republicans is higher than that of the Democrats, then an increase in DV_{jt} should be accompanied by

a decrease in the participation rate. If there is no difference between the participation rates of the two groups, then the correlation between DV_{jt} and participation should be zero or insignificant. The covariance between DP_{jt} and DV_{jt} reveals similar information, but in a more complex way.

Both the likelihood ratio test and the standard errors of β_d^0 and β_r^0 make it clear that the voting propensity of Democrats and the Republicans are different: a Republican is 1.32 times as likely to vote as an otherwise similar Democrat. The unconditional correlation between DV and the participation rate is -0.12. If we return to our representative voter, the propensity of a Democrat to vote is 59 percent, while for a Republican the number is about 78 percent. The difference between β_d^0 and β_r^0 may reflect an intrinsic difference between Democrats and Republicans as well as unobserved party differences in the underlying demographic variables, such as income and racial composition. (Recall that we do not observe interparty differences in demographic variables.)

Previous studies have found higher turnout among registered Republicans than among registered Democrats. We do not restrict ourselves to registered voters. However, we show that people who prefer the Republican candidate—be they registered Republicans, Democrats or independents—are more likely to vote than those who prefer the Democrat candidate. Thus, our results are consistent with this common wisdom, but contradict the view that nonvoters have similar enough preferences to voters that if everyone went to the polls outcomes would not change. Our results imply that there are more Democrats in the overall population than among the voting population.

Since we have the parameters of the model, we can predict the change in election results if we required everyone to vote. Table 10 presents the actual and predicted electoral vote count (summing up state by state) for each of the 11 presidential elections between 1948 and 1988.[31] The predicted vote shares in each state have been adjusted to take away the Republican

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[29] There is another interpretation of this evidence: the effort level in each state is a result of the combined efforts of state and national leaders. State leaders care only about the state outcome, and national leaders only about the national outcome. Our findings can then be interpreted as evidence that turnout responds to effort by both state and national leaders.

[30] This baseline case also assumes that the person did not recently move into the state and that there was no governor's race nor precipitation on election day.

[31] We ignore the District of Columbia.

TABLE 10—ELECTORAL VOTE, ACTUAL AND ADJUSTED FOR EQUAL PROPENSITY TO VOTE

Year	Actual D vote	Actual R vote	Adjusted D vote	Adjusted R vote
1988	109	426	346	189
1984	10	525	83	452
1980	46	489	450	85
1976	294	241	492	43
1972	14	521	68	467
1968	198	320	486	32
1964	483	42	508	17
1960	306	223	503	26
1956	74	457	312	219
1952	89	442	347	184
1948	331	189	502	18

advantage of a higher participation rate. Given the large difference in voting rates, if the propensity to vote were equalized, *all of the Republican presidents elected during the last 50 years would have lost their first election.* (Eisenhower probably would have lost his 1956 reelection campaign as well.) Equalizing the participation rates would have reversed the results for Eisenhower in 1952 and in 1956, Nixon in 1968, Reagan in 1980, and Bush in 1988. Had they been elected, however, Nixon in 1972, and Reagan in 1988, would still have been reelected.

V. Measurement of Leaders' Effort

Our results suggest that leaders' effort has an important role in explaining the effects of strategic variables on the participation rate. We can also look for some direct confirmation that our inferred effort variables are an accurate measure of political activity. Since 1956, the American National Elections surveys have included the question: "The political parties try to talk to as many people as they can to get them to vote for their candidates. Did anyone from the political parties call you up or come around and talk to you about the campaign this year? Which party was that?" We use this activity by political parties as a proxy of leaders' effort and denote the proportion of people who were contacted in each state and election year by $Contact_{jt}$.[32]

An interesting test of our model is the fit between our predicted effort level and $Contact_{jt}$. We regress $Contact_{jt}$ on the inferred effort levels and state and period dummies. We control for unobserved heterogeneity among the states and for time effects since we do not present a complete theory of party contact that can explain these differences. Table 11 reports the coefficients for the effort variable and the time dummies (state dummies are not reported). Notice that the use of contact increased in the 1960's, reached a peak in 1976, and has declined since then. The inferred effort level is positively correlated with $Contact_{jt}$ and significantly different from zero at the 5-percent level. This means that, although our model did not include *any* information on party contact, the inferred effort levels are reasonably good predictors of $Contact_{jt}$. We consider this solid support for the follow-the-leader theory. Furthermore, recall that Wielhouwer and Lockerbie (1994) showed that respondents who were contacted by the parties are more likely to participate.

The closest work to these results is that of Jonathan Nagler and Jay Leighley (1992). Using a unique data set, they show that state-by-state campaign expenditures on nonnetwork advertising for 1972 were higher in states with closer races and larger electoral votes. While these data are not appropriate to test our model—since these expenditures are decided by

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[32] The accuracy of $Contact_{jt}$ is a function of the number of surveyed people in each state and election year. Thus, we used data on $Contact_{jt}$ only when at least ten people were

surveyed. This leaves us with 308 observations out of our 539. On average, 23 percent of the individuals were contacted. The highest $Contact_{jt}$ numbers are for 1976, with 71 percent for Oregon and 67 percent for Kansas and Utah.

TABLE 11—CONTACT AS A FUNCTION OF INFERRED EFFORT
Dependent variable: Proportion of individuals
contacted by a party

Variable	Estimate	Standard error
Effort	0.0871	0.0451
1988	0.0402	0.0253
1984	−0.0652	0.0246
1980	0.0733	0.0242
1976	0.1261	0.0238
1972	0.1248	0.0254
1968	0.0750	0.0251
1964	0.0891	0.0242
1960	0.0321	0.0258

the presidential campaign, not by state leaders—these results are very interesting. Although we found that R_{jt} is almost zero for all the states in 1972, the presidential campaigns spent more money in states with more electoral votes. This seems consistent with our finding that a polynomial function of electoral votes explains effort and participation better than R_{jt}. We suggest that leaders might be using electoral votes to proxy R_{jt}. There are two alternative explanations for this finding: even when a presidential candidate knows he lost, he might still care about the number of electoral votes he earns; he also cares about his coat-tail effect on the Houses. In both cases, candidates would distribute money based on the number of electoral votes, independent of R_{jt}.

VI. Conclusion

This study makes several empirical and theoretical contributions to the study of political participation. We find that both participation rate and political parties' efforts are a positive function of predicted closeness and a negative function of the voting population size. To explain these results and to structure the estimation, we introduce a follow-the-leader theory of political participation. The model has several novel features. It emphasizes the role of political leaders and their concern for influencing both state and national elections. Uncertainty about preferences replaces uncertainty created by coin-toss model thus greatly increasing the likelihood that a state party's effort to increase turnout can change the result in that state. This framework also allows us to capture the effect

of uncertainty and voter population size on leaders' pivotal probabilities.

Structural estimation supports the pivotal-leader theory. We find that an increase of 1 percent in the closeness of the race increases effort and leads to a 0.34-percent increase in participation. Furthermore, an increase of one million people in the voting population increases the cost of effort and, thus, decreases the participation rate by 1 percent. In almost all cases, leaders seem to care more about winning their state for its own sake rather than for its value in winning the national election. This is based on our calculation of the probability that a state would be pivotal in the national election.

Although our model did not include *any* information on party contact, the inferred effort level predicts the proportion of people who were contacted by the parties in each year and state.

Structural estimation also enables us to identify different baseline voting propensities of Republicans and Democrats. Whatever the cause of these differences (including demographics), we find that Republicans are 32 percent more likely to vote than are Democrats. If voting had been mandatory and, thus, participation rates had been equalized, all of the Republican presidents elected during the last 50 years would have lost their first elections.

In sum, this paper interweaves new theory and data to show that pivotalness matters—and it makes sense that it does. The strategic component to political participation is an important part of the calculus of voting.

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