An Empirical Spatial Model of Congressional Campaigns

Nolan M. McCarty

University of Southern California

and

Keith T. Poole

Carnegie-Mellon University

November, 1995

* We would like to thank Howard Rosenthal and Larry Rothenberg for useful comments and Richard Groper for research assistance.

Abstract

Testing and estimating formal models of political behavior has not advanced as far as theoretical applications. One of the major literatures in formal theory is the spatial model of electoral competition which has its origins in the work of Black (1948) and Downs (1957). These models are used to make predictions about the policy positions candidates take in order to win elections. A lack of data on these candidate positions, especially challengers who never serve in Congress, has made direct testing of these models on congressional elections difficult.

Recently, researchers have begun to incorporate campaign finance into the standard Downsian model. These models of position-induced contributions examine the trade-off that candidates make between choosing positions favorable to interest group contributors and positions favorable to voters. A major premise of these models is that interest group contributions are based on the policy positions of candidates. This has been borne out empirically in the case of incumbents, but not challengers.

To test key hypotheses of these models, we develop a simple spatial model of position-induced campaign contributions where the PAC's decision to contribute or abstain from each race is a function of the policy distance between the PAC and the candidates. We use data from political action committee contributions in order to estimate the locations of incumbents, challengers, and PACs. Our model reliably estimates the spatial positions as well as correctly predicts nearly 74% of the contribution/abstention decisions of the PACs. Conditional upon making a contribution, we correctly predict the contribution in 94% of the cases. These results are strong evidence for position-induced campaign contributions. Furthermore, our estimates of candidate positions allow us to address issues of platform convergence between candidates.

1. INTRODUCTION

One of the fundamental questions in the study of democratic institutions is the extent to which competition between political parties and candidates leads to "representative" political outcomes; that is, outcomes that would occur if the electorate itself made the decisions directly. Duncan Black in *The Theory of Committees* (1948) showed that with single-peaked preferences, a single policy dimension, and majority rule, the policy preferred by the median voter would prevail in a direct election. Later in *An Economic Theory of Democracy* (1957), Anthony Downs showed that under essentially the same assumptions the outcome of two party competition would also be the preferred policy of the median voter.

The median voter result has been attacked by theorists who have shown that under more plausible assumptions (e.g., candidates with policy preferences, incomplete information, multiple policy dimensions) parties and candidates would not necessarily converge to the median voter. A large theoretical literature on two-party competition has been developed with results that vary with assumptions about candidates' and voters' preferences, beliefs, and information, as well as the form of the electoral institution.[1]

Ideally, a complete empirical study of platform competition of congressional candidates would require estimates of the positions of both candidates. Interest group ratings such as those provided by the Americans for Democratic Action or the League of Conservation Voters as well as roll call voting studies such as Poole and Rosenthal (1985, 1991), solve half of the problem as they provide reasonable estimates of congressional incumbents, but little is known about the positions that challengers take in congressional elections.

Recently, the critique and extension of the simple Downsian model has been joined by scholars interested in the role of money in electoral campaigns. These scholars have begun to incorporate campaign finance into spatial models of elections by assuming that interest groups make position-induced campaign contributions.[2] In these models, interest groups attempt to further their policy agendas by contributing towards the election of candidates who have pledged to support their policy agendas.
In these models the optimal platform locations of candidates are influenced not only by a need to attract votes, but also to attract interest group contributions. In turn, candidates must locate in positions

favorable to interest groups to generate contributions. While voters' interests may draw candidates closer together, the fundraising concerns may lead to divergence in platforms if interest group money comes predominantly from non-moderate groups.

An implication of all of these models is that in the final stage interest groups will base their contribution decisions (at least in part) on the proximity of the candidates' platforms to their own legislative goals. In fact, there is considerable evidence that interest group contributions are affected by the ideological positions of the candidates. The empirical literature on political action committee contributions (PACs) (Poole and Romer, 1985; Poole, Romer, and Rosenthal, 1986; and McCarty and Rothenberg, 1994) demonstrates that ideology or spatial locations of congressional incumbents is a significant determinant of PAC contributions. Conditional on a PAC making a contribution, the Poole and Romer model of spatial consistency can correctly predict the recipient in more than 91% of the cases. However, in this literature as well, little is known about the effect on the positions of congressional challengers.

In this paper, we attempt to address the issues of candidate location and position-induced campaign contributions by estimating a simple spatial model of PAC contributions. In order to have a tractable procedure for estimating the parameters of interest, we focus only on the final stage of a simplified candidate/contributor game where candidates have already positioned themselves and contributors contribute to the most proximate candidates. Thus, we cannot make direct inferences about the processes of candidate competition and especially the influence of contributions on positions. We will only be able to observe the resultant patterns of candidate positions and contributions.

We formalize our model of PAC contribution in Section 2. Section 3 outlines our estimation approach and several statistical and identification issues are addressed in Section 4. We discuss our data in Section 5 and our estimation results in Section 6. Section 7 outlines our conclusions.

2. A Simple Model of Political Action Committee Contributions

In order to facilitate estimation of the parameters of interest (the spatial locations of candidates and contributors), we consider a very simple spatial model of a PAC's allocation decisions across electoral contests. We only explicitly model the final stage of the contributor/candidate game where contribution behavior is made that is consistent with the previous location decisions of candidates. A timing structure where platforms are adopted first and contributions are made subsequently is common to many of the theoretical models in this literature.

Suppose that there are p PACs indexed $i = 1,...,p$ who must choose between making contributions to 2q candidates in q different contests indexed $j=1,...,q$. We assume that each PAC makes only one contribution in each election.[3] We assume that PAC i has an ideal policy of x_{ik} for $k = 1,...,S$ where S is the number of policy dimensions.[4] Since we only consider races with an incumbent in our data analysis, we can label the two candidates I and C for incumbent and challenger, respectively. These candidates have chosen platforms z_{jkI} and z_{jkC}.[5]

We assume that the PACs preferences over the two candidates are a function of the distance between the each candidate and the PAC and a stochastic error term. Let U_{ijI} and U_{ijC} be the utility that PAC i receives from the election of each candidate in contest j. Following Poole and Rosenthal (1991), we assume that each PAC evaluates each candidate in terms of a stochastic spatial utility function that is quasi-concave and decreasing in the distance between the PAC and the candidate. PAC i's utility from each candidate is assumed to be:

$$U_{ijI} = u_{ijI} + \varepsilon_{ijI} = \beta \exp\left[-d_{ijI}^2 + g_{ijI}\right] + \varepsilon_{ijI} \tag{1}$$

$$U_{ijC} = u_{ijC} + \varepsilon_{ijC} = \beta \exp\left[-d_{ijC}^2 + g_{ijC}\right] + \varepsilon_{ijC} \tag{2}$$

where β is a signal-to-noise ratio[6], g_{ijI} and g_{ijC} are any non-spatial utility that PAC i gets from either candidate in race j, ε is the stochastic portion of the utility function, and

$$d_{ijI}^2 = \sum_{k=1}^{S}\left(x_{ik} - z_{jkI}\right)^2 \quad \text{and} \tag{3}$$

$$d_{ijC}^2 = \sum_{k=1}^{S}\left(x_{ik} - z_{jkC}\right)^2 \tag{4}$$

One might think of the g_{ij}'s, as non-spatial bias PAC i may have for one candidate over the other. For example, if $g_{ijI} > g_{ijC}$, the PAC i exhibits a bias in favor of the incumbent in race j which may result in an overall preference for the incumbent even if the challenger is closer to the PAC on the policy dimension. In principal, these bias terms could be a function of any number of PAC or candidate specific variables such as seniority, preferred committee assignments, or incumbency. For the sake of parsimony, we concentrate on estimating an incumbency bias. Hence, we assume that $g_{ijI} = g_i$ for all j and $g_{ijC} = 0$. Consequently our estimate of g_i measure how much additional utility PAC i places on incumbents in general. In some cases, it may be plausible that $g_i < 0$, suggesting that PAC i exhibits a bias in favor of challengers. This may be plausible for more ideological PACs who seek more radical changes to the ideological composition of the legislature by specifically targeting incumbents.[7]

We also assume that the ε's are distributed independently and identically across PAC and candidates. While it is necessary to insure the tractability of the estimation process, it is not without some loss of generality. For example, it rules out strategic behavior between PACs such as free riding. If the error terms were perfectly observable, each PACs could condition its choices on the realizations of the other PAC's error processes and the i.i.d. assumption would be violated. However, perfect observability of other PACs errors is probably not realistic, so we believe that the problems associated with the i.i.d. assumption will be minor.

In order to maximize the benefit of its contributions, PACs must consider the effectiveness of the contribution in favorably influencing the election. Let ρ_j be the probability a contribution in race j will influence the outcome of the election. We can think of ρ_j as being a measure of the ex ante expected closeness of race j. As long as PAC i cannot afford to contribute in every race, the solution to its optimization problem is to contribute to the races with the highest values of $\rho_j |U_{ijI} - U_{ijC}|$. Assume that due to budget constraints, PAC i may make only B_i contributions. Let V_i be the B_i th highest value of $\rho_j |U_{ijI} - U_{ijC}|$ and define $N_{ij} \equiv V_i / \rho_j$. Thus, PAC i will contribute to all those races where $|U_{ijC} - U_{ijI}| > N_{ij}$. Consequently, N_{ij} is a utility difference threshold that must be exceeded to generate a contribution. PAC i will contribute to the incumbent in race j if $U_{ijI} - U_{ijC} > N_{ij}$ and to the challenger if $U_{ijC} - U_{ijI} > N_{ij}$. If $|U_{ijC} - U_{ijI}| < N_{ij}$, PAC i will contribute to neither candidate.

We now turn to specifying the form of the threshold parameter, N_{ij}. N_{ij} should be a function of both PAC i's ability to make contributions as well as the closeness of race j. Unfortunately, incorporating PAC specific budget data into this model is difficult due to the availability of data.[8] Consequently, to capture the effect of budget size we incorporate a PAC specific fixed effect into our specification of N_{ij}. To measure the effect due to the closeness of the race, we let R_j be the absolute difference between the incumbent's two party vote share in race j and 0.5. Consequently, R_j is small in close races and big in landslides. The theory predicts that N_{ij} is increasing in R_j.[9] Given this restriction and the restriction that $N_{ij} > 0$, we give N_{ij} the following functional form:

$$N_{ij} = \exp(\alpha_i + \gamma R_j) \tag{8}$$

The α_i term is the PAC specific effect which captures the fact that budgets and resources will vary across PACs. When α_i is large, the PAC makes contributions in more races.[10] The γ term identifies an assumed common effect of R_j on contribution decisions. If close races produce more contributions, then we would predict that $\gamma > 0$. The exponential functional form was chosen because it satisfies the restriction that $N_{ij} > 0$ which is necessary so that the probability of abstaining will be well defined.[11]

The intuition of our specification of the model can be demonstrated via simple diagrams. Figure 1 shows how, given a challenger location and a PAC with a given incumbency preference and contribution threshold, the location of the incumbent affects the contribution decision. The PAC receives utility U_C from the challenger. The PAC gives to the challenger if the utility from the incumbent is less than $U_C - N$ and gives to the incumbent if the utility from the incumbent exceeds $U_C + N$. For incumbents that provide utility in the interval $[U_C - N, U_C + N]$ the PAC abstains. When the incumbent is in the regions marked C, the contribution goes to the challenger. If the incumbent is in the region labeled B, the incumbent receives a contribution and if the incumbent is in the A regions, the PAC abstains.

Figure 1 about Here

Figure 2 shows how, given a pair of candidate locations and a value for N, the location of a PAC affects its contribution decisions. The figure depicts the utility from contributing to each candidate as a function of distance between each candidate and each PAC location. The solid vertical lines are points where the difference in the utilities equals the threshold N. These lines define regions of different PAC behavior. If the PAC is located in region B, the PAC will contribute to the incumbent because she provides the greater utility to the PAC and the difference in utilities exceeds N. Likewise PACs in region C give to the challenger. In all of the regions marked A, no PACs contribute as the difference in utilities does not exceed N.

Figure 2 about Here

Given our specification, we can compute the probabilities for each PAC's observed choices. Let Q_{ijA} be the probability that PAC i abstains in race j. Thus,

$$Q_{ijA} = \Pr(\text{abstain}) = \Pr\left(\left|u_{ijI} + \varepsilon_{ijI} - u_{ijC} - \varepsilon_{ijC}\right| < N_{ij}\right) \tag{9}$$

$$= 1 - \Pr\left(u_{ijI} + \varepsilon_{ijI} - u_{ijC} - \varepsilon_{ijC} > N_{ij}\right) - \Pr\left(u_{ijI} + \varepsilon_{ijI} - u_{ijC} - \varepsilon_{ijC} < -N_{ij}\right)$$

$$= \Pr\left(\varepsilon_{ijI} - \varepsilon_{ijC} < N_{ij} - u_{ijI} + u_{ijC}\right) - \Pr\left(\varepsilon_{ijI} - \varepsilon_{ijC} < u_{ijC} - N_{ij} - u_{ijI}\right)$$

Let F(•) be the cumulative density function of $\varepsilon_{ijI} - \varepsilon_{ijC}$. Then

$$Q_{ijA} = F\left(N_{ij} - u_{ijI} + u_{ijC}\right) - F\left(u_{ijC} - N_{ij} - u_{ijI}\right) = \frac{\exp\left(N_{ij} + u_{ijC}\right)}{\exp\left(u_{ijI}\right) + \exp\left(N_{ij} + u_{ijC}\right)} - \frac{\exp\left(u_{ijC}\right)}{\exp\left(N_{ij} + u_{ijI}\right) + \exp\left(u_{ijC}\right)} \tag{10}$$

The probability that a contribution is made to the incumbent is then

$$Q_{ijI} = \Pr\left(u_{ijI} + \varepsilon_{ijI} - u_{ijC} - \varepsilon_{ijC} > N_{ij}\right)$$

$$= F\left(u_{ijI} - N_{ij} - u_{ijC}\right) = \frac{\exp\left(u_{ijI}\right)}{\exp\left(N_{ij} + u_{ijC}\right) + \exp\left(u_{ijI}\right)} \tag{11}$$

Similarly, the probability of contributing to the challenger is

$$Q_{ijC} = \Pr\left(u_{ijC} + \varepsilon_{ijC} - u_{ijI} - \varepsilon_{ijI} > N_{ij}\right)$$

$$= F\left(u_{ijC} - N_{ij} - u_{ijI}\right) = \frac{\exp\left(u_{ijC}\right)}{\exp\left(N_{ij} + u_{ijI}\right) + \exp\left(u_{ijC}\right)} \tag{12}$$

Therefore, we write the likelihood function for the trinomial logit as follows:

$$L = \prod_{i=1}^{p} \prod_{j=1}^{q} Q_{ijA}^{D_{ijA}} Q_{ijI}^{D_{ijI}} Q_{ijC}^{D_{ijC}} \tag{13}$$

where $D_{ijl} = 1$ if choice l is made and 0 otherwise, where $l \in \{A,I,C\}$.

Following the usual practice, we maximize

$$\ln L = \sum_{i=1}^{p}\sum_{j=1}^{q}\left[D_{ijA}\ln Q_{ijA} + D_{ijI}\ln Q_{ijI} + D_{ijC}\ln Q_{ijC}\right] \tag{14}$$

3. Estimation

In estimating the parameters of the model, we use an extension of the one dimensional NOMINATE developed by Poole and Rosenthal (1985, 1991, 1996). In our model, as well as in the Poole and Rosenthal model, the large number of parameters makes simultaneous estimation of all parameters impractical. In order to avoid these problems, we divide the parameters into three sets and estimate each set of parameters while holding the other two constant. The three phases of our procedure (which we dub PAC-NOMINATE) and the parameters estimated in each phase are:

UTILITY PHASE: Estimate β and γ

CONTEST PHASE: Estimate z_{jkI} and z_{jkC}

PAC PHASE: Estimate x_{ik}, α_i, and g_i

Estimation is further simplified because, within each phase, the second derivative of each parameter with respect to the other parameters in the phase is zero so that each parameter can be estimated separately.[12] This procedure is repeated for each dimension holding the results of the lower dimensions constant.

The non-linearity of the likelihood function significantly complicates estimation and, for this reason, good starting values are essential to avoid local maxima. For incumbent locations, we use the Poole/Rosenthal estimates of incumbent's spatial location obtained from their analysis of roll call voting. Unfortunately, a good procedure for challenger starts is unclear so we simply use the median position of the challenger's party from the Poole/Rosenthal estimates.

Obtaining starting values for the PAC coordinates and thresholds is also difficult. Consider a case with perfect spatial contributions with the incumbents ordered left to right by their ideal points and challengers evaluated at their party median. One might expect to observe the following pattern of contributions by a particular PAC:

PAC

AAAAAAIIII * IIIIAAAAAAAACCCCAAAAA

Incumbent's Location

"A" denotes the incumbent location in a race in which the PAC abstained, "I" denotes the incumbent location in a race where the PAC contributes to the incumbent, and "C" denotes the incumbent location in a race where the PAC contributed to the challenger. In this case, the coordinate of the PAC would be approximately equal to the coordinate of the median incumbent for which a contribution was given (denoted in the diagram by "*").

The following pattern illustrates the problem with this procedure for finding starting estimates for the PACs:

IIIIIIIIIIIAAAAAAAAAACCCCAAAAA

Incumbent Location

Clearly, the PAC coordinate is not identified because we do not know whether the PAC lies to the left of its leftmost contribution. Unfortunately, there is no clear way around this problem, so we calculate the starting values of the PAC coordinates exactly as in the first example. Consequently, some of the starting coordinates for the PACs are not extreme enough. This is not a problem because PAC-NOMINATE only requires good starts for two of the three phases. Note that holding the two phases with good starts constant and estimating the third phase produces maximum likelihood estimates conditional on holding the "good" starts fixed. Thus, the PAC parameter starting procedure outlined above is used only to speed convergence.

4. Statistical and Identification Issues

The incidental parameters problem is an important statistical issue arising in PAC-NOMINATE (and NOMINATE as well). This problem arises because as PACs and contests are added to the data set, more parameters are added. The parameters that are added as the sample grows are referred to as incidental. Except for β and γ, all the parameters estimated by PAC-NOMINATE are incidental. The standard proof of the consistency of a maximum likelihood estimator assumes that the number of parameters is held constant as the sample size goes to infinity. Since the set of parameters in PAC-NOMINATE grows with the sample size, this proof is inappropriate. Even with an infinite sample size, we cannot guarantee that the PAC-NOMINATE parameters will converge to the their true values. Fortunately, this problem has little practical significance since the number of parameters grows much more slowly than the number of observations. For example, the addition of a PAC to the data set adds only 3 additional parameters but provides q extra observations. Monte Carlo work reported in the appendix confirms Poole and Rosenthal's findings that recovery of the true parameters is quite good.

Two potential identification problems of the NOMINATE procedure are also relevant here: "perfect" contests and "perfect extremist" PACs. To facilitate discussion of these issues, let $z_{Mj} = (z_{jI} + z_{jC})/2$ be the midpoint of the two candidate positions; and let $d_j = (z_{jC} - z_{jI})/2$ be one half the "distance" between the two candidates. We put distance in quotes because d_j can be negative. Thus, $z_{jI} = z_{Mj} - d_j$ and $z_{jC} = z_{Mj} + d_j$.

To understand the "perfect contest" problem, consider the following pattern of PAC contributions which might occur for a given contest:

x_1 y_1 z y_2 x_2
IIIIIIIIII|CCCCCCCCCC

where I is the location of a PAC that gave to the incumbent and C is the location of a PAC that gave to the challenger in a given contest. The midpoint of the two candidate positions is precisely located at point z, but any pair of positions such as (x_1,x_2) and (y_1,y_2) lead to identical PAC behavior. In fact any contest pair (x_1,x_2) in the set $\{(x_1,x_2): (x_1+x_2)/2 = z\}$ leads to identical behavior. Therefore, for perfect contributions the midpoint z_{Mj} is identified, but d_j is not. The presence of error and abstention mitigates this problem somewhat, but d_j is still less precisely estimated than z_{Mj} in Monte Carlo experiments. This problem is inconsequential for PAC locations as reliable midpoint estimates are sufficient for identification. However, the estimates of candidate positions will be affected.

In general, it cannot be guaranteed that every contest will have identified parameters because of this problem. The parameters of some contests must be constrained so that at least the midpoint of the contest z_{Mj} lies in the space spanned by the PACs. In cases where the midpoint of the contest is estimated outside the PAC space, the midpoint is placed at the nearest edge of the space and the contest distance (d_j) is estimated via a grid search. In cases where the midpoint is in the interior but both candidate ideal points are estimated off opposite ends of the space, we perform a grid search such that at least one of the candidates is in the interior of the PAC space. These constraints can not be expected to give the true contest parameters, but they do serve to minimize the effect on the estimation of the unconstrained parameters.

Note, however, that the perfect contribution problem is eliminated if one of the candidate's position is known. Combining the known position and the estimated midpoint leads to a precise estimate of the other candidate. Incumbent legislator positions can be estimated from other data such as roll call voting. To this end, we also use Poole and Rosenthal estimates of incumbent positions to help us identify the positions of the challengers.

The "perfect extremist" PAC is one who is observed contributing to the most liberal or most conservative alternative in each race. Identification is problematic in this case because this pattern should emerge for all PACs located outside the space spanned by the candidates. However, this problem is also greatly mitigated by abstention. Consider a PAC that is observed giving only to liberal candidates. Unless it gives to every race, there are some liberal candidates from which it abstains. If the PAC's threshold is known and voting is perfect, the PAC's ideal point is approximately the point that equates the utility difference of the most liberal abstention with the threshold.

Again, in general, it cannot be guaranteed that the extremist PAC's location will be identified. When a PAC's location is not identified, it begins to "sag". That is, its estimated location begins to move far away from the nearest identified PAC. To solve this problem, whenever the distance between an extreme PAC and its nearest neighbor becomes excessive, we constrain its location to be that of the nearest unconstrained PAC. Fortunately, less than 5% of all PACs and contests need to be constrained.

Monte Carlo evidence in Poole and Rosenthal (1991) shows that in spite of these problems the recovery of ideal points is quite good as the correlations between the "true" and estimated parameters usually exceed .99. A similar Monte Carlo study was conducted for the PAC-NOMINATE model of this paper and is reported in the appendix. We find, in spite of the issues raised above, the recovery of the spatial positions of candidates and contributors is quite good as is the recovery of the bias and abstention parameters.

5. The Data

The data used in this analysis consists of the contributions made by the 500 largest political action committees in the elections from 1978 to 1986. Unfortunately, in some races the challenger did not receive enough contributions to be estimated. In order to be included in our analysis, we required that a challenger receive at least 10 contributions. In 1978, 258 races could not be estimated due to lack of challenger contributions. However, 47 of the 258 were unopposed incumbents. In only one case did a challenger win the election and not receive enough PAC contributions to be estimated. Only 10 of the eliminated races involved incumbents who won by less that 15 percentage points. The average margin of all of the omitted races was 76% to 22%. Excluding unopposed incumbents, the average margin was 72% to 27% while in the included races the incumbents only garnered 59% of the vote. These results not only underscore the relation between PAC contributions and the success of the challenger, but also suggest that the races not estimated by PAC-NOMINATE tend to much more lopsided and less interesting than those that were estimated.

In addition to having to exclude certain races from the analysis, some PACs could not be included. Political party PACs were excluded because a spatial model was clearly not appropriate since political party PACs are constrained to only give to members of their own party. Other PACs simply did not make enough total contributions to challengers to be appropriately estimated. We required 25 total contributions and 10 contributions to challengers to be included in our estimates.

Another concern with the data is that, in the 1986 election, PACs made far fewer contributions to challengers than they had in previous elections. The 500 PACs in the sample made less than 3500 contributions to challengers in the 1986 election compared with over 7000 in 1982. This led to the estimation of far fewer PACs and candidates in 1986 than in previous elections.

6. Results

We estimated the model for the five elections from 1978 to 1986 as well as one in which the five election cycles are pooled. In the pooled model, we constrain each incumbent and each political action committee to a single spatial location throughout all five election cycles. The data set consists of the PACs who made 25 or more contributions and the contests in which the challenger received 10 or more contributions from PACs in the sample. Table 1 shows the frequency of each type of contribution by various types of PACs. We estimated both one and two dimensional versions of the model.

Table 1 About Here

The estimation results reveal that the simple spatial model is a good fit to the data. We list some summary statistics for each estimation in Table 2. The geometric mean probabilities (GMP)[13] are quite high considering that the model must predict one of a possible three choices. The results of the pooled estimation are quite similar to those of individual elections, underscoring the stability of PAC and incumbent locations over time. The goodness of fit measures for the two-dimensional results were not substantially better than those for the one dimensional model even though the two dimensional model contains $p + 2q$ additional parameters. This underscores finding by Poole and Rosenthal (1985,1991) that the first policy dimension accounts for most roll call voting decisions over this time period. It should not surprising then that one policy dimension captures most of the PAC contribution decisions as well. We stress however that these results do not suggest that a second dimension will not be important for some smaller, single issue groups that are not included in our sample.

Table 2 About Here

In the sections that follow, we evaluate the results and explore their implications about spatial behavior by candidates and political action committees.

6.1 Classification Analysis

Although the algorithm maximizes likelihood rather than minimizes classification errors, an analysis of classifications errors is a useful heuristic for evaluating PAC-NOMINATE. The cross classification tables are shown in Table 3. The percentage of correct classification for PAC-NOMINATE over all years respectively is 73.8 (68,099 out of 92,223) which is quite respectable for a three choice model.

Table 3 About Here

Note that in Table 3 the sum of the (abst,chall) and (abst,incum) cells always exceeds the sum of the (chall,abst) and (incum,abst) cells. This means that errors in which abstention was incorrectly predicted exceeds the errors where a contribution was incorrectly predicted; in short, PAC-NOMINATE over-predicts abstention.[14] Almost all classification errors involve incorrect predictions about abstention.[15] The algorithm rarely predicts the wrong recipient of an actual contribution. Less than 1% of all predictions of actual contributions result in an incumbent contribution being predicted when the actual contribution is to the challenger or vice versa.

To properly evaluate our model, its success at correctly classifying the observed choices must be compared with other estimations and appropriate null models. Most other models of PAC contribution have attempted to classify only the contributions that were actually made. Since PAC-NOMINATE attempts to predict abstention as well, the classification analysis must be modified to make the results comparable to other studies. To do this we ignore abstention choices by PACs and classify actual contributions based on the estimated values of P_{ijI} and P_{ijC}. This classification method correctly classifies almost 94% of all actual contributions. This exceeds the 91% classification success reported from the spatial model of Poole and Romer (1985) as well as the null models they discuss (e.g. a party model and a model where all contributions are to incumbents).

However, when classifying abstention as well as the contribution recipient, the null models of Poole and Romer (1985) make little sense and other null models must be considered. One possible null model would be to predict that all PACs always abstain since abstention is the most common choice observed in the data. The classification success of predicting that all PACs always abstain ranges from 57.3 in 1980 to 46.6 in 1986. Poole, Romer, and Rosenthal (1987) evaluate their model of contribution\abstention decisions against a similar benchmark where each PAC always makes the modal choice of its own actual contributions. A PAC that generally gives to incumbents is predicted to always give to incumbents and one that generally abstains is predicted to always abstain. This model will always classify better than the "always abstain" model, because PACs whose modal choice is not abstention will be classified better. However, for most PACs abstention is the modal choice so the models give roughly similar results.

A straightforward way of assessing PAC-NOMINATE's marginal contribution in classifying contributions beyond the benchmark models is the Proportional Reduction in Error (PRE). The PRE is defined as:

$$\text{PRE} = 1 - \frac{\text{PAC} - \text{NOMINATE errors}}{\text{NULL MODEL errors}}$$

Table 3 reports the PRE-A and PRE-M which are the PREs in which the null models are abstention and modal response respectively. They are comparable to those reported by Poole, Romer, and Rosenthal (1987) who use a much narrower sample of PACs.

Evaluating the performance of our model is not possible simply by looking at the aggregate classification success. The model makes specific predictions about the spatial patterns of contributions. A comparison of the spatial patterns of the predicted versus the actual contributions gives a better sense of the model's performance by showing whether or not the errors of our model are systematic. Figure 3 demonstrates the contribution behavior of 50 PACs to 10 incumbents in the 1984 election cycle. Both the PACs and the incumbents were drawn uniform intervals of the rank ordering their estimated ideal points and appear in Figure 3 in order of those estimates. For each incumbent, the top line represents the actual contribution behavior of the 50 PACs and the second line represents the predicted contribution. The PACs are arrayed in order of their estimated positions and the choices of each PAC is represented by "A" for abstain, "I" for contributor to the incumbent, and "C" for contribute to the challenger. Since the PACs are arrayed in order, we would expect to see clustering of "I" near the position of the incumbent and clusterings of "C" away from the PAC. This pattern is clearly evidenced in the top lines in Figure 3. Figure 3 also underscores why few of the model's errors are mistakes about the recipient of the contribution. The clusters of "I" and "C" are not distinct from one another for very few PACs. Comparison of the actual and predicted contribution patterns once again demonstrate the over prediction of abstention as many of the errors are predicted abstentions amongst clusters of "I" or "C".

Figure 3 about Here

6.2 Electoral Contest Estimates

The estimated coordinates of incumbents and challengers from the pooled estimation are presented geometrically in Figure 4. In the diagram the Y-axis represents the challenger location and the X-axis is the incumbent location. We code each contest via a token: D, S, R, or C depending on whether the incumbent is a Democrat, Southern Democrat, Republican, or Southern Republican. The absence of tokens on the 45° line shows that most races were quite polarized in the policy space. In each diagram, there is a locus of D tokens and of R tokens which tend to be located symmetrically with respect to the 45° line.

Figure 4 about Here

Table 4 gives the mean location for each party's incumbents and challengers from the pooled estimation. An interesting issue in the literature on congressional elections is the question of whether the challengers of a given party look systematically different from its incumbents. Banks and Kiewiet (1989) argue that the incumbency advantage makes the cost of running low quality and non-credible challengers small. It is straight-forward to extend their hypothesis to the policy positions of challengers vis a vis incumbents. Their "rational turkey" hypothesis would suggest that a party's challengers should be more extreme as a group than its incumbents. We test this hypothesis by the standard differences in means tests on the sample of incumbents and challengers. As Table 4 shows we find mixed support for this hypothesis as Democratic challengers are more liberal than their incumbent counterparts. However, Republican challengers are also more liberal than the incumbents.

Table 4 about Here

One of the most important theoretical issues in spatial theory is the determination of candidate locations in a two-party election. Previously, the nonexistence of data on challenger locations has made testing these theories difficult. Having recovered challenger positions from our procedure, we test an extremely simple model of candidate locations using the data from PAC-NOMINATE:

$$CL_t = \alpha_o + \alpha_1 IL_t + \varepsilon_t$$

where CL_t is the challenger location in election t, IL_t is the incumbent location in election t, and ε_t is an error term. In particular, the simple Downsian model with convergence is given by $\alpha_o = 0$ and $\alpha_1 = 1$. We estimate the model separately based on the party of the incumbent. Table 5 reports the results of the model for Northern and Southern Democratic incumbents, Northern and Southern Republican incumbents, and the F-test for the platform convergence hypothesis.

Table 5 about Here

The Downsian model is easily rejected by our data for all four subsets. The large and significant intercept terms are indicative of substantial polarization in these congressional contests on the first dimension. The results indicate that Republican challengers locate significantly to the right of Democratic incumbents and Democratic challengers locate to the left of Republican incumbents. However, three of the four subsets indicate support for one of Downs' key predictions: that the more liberal the incumbent, the more liberal the challenger. The sole exception is the case of Southern Republican incumbents where the position of the incumbent seems to have little impact on the challenger's location. Thus, while total convergence is rejected, the data clearly demonstrate that there are statistically significant relationships between the positions of the candidates suggesting the possibility of strategic interaction between candidates.

6.3 PAC Estimates

The estimated PAC locations and incumbency biases from the pooled model are shown in Figure 5. The y-axis represents the incumbency bias, and the x-axis represents the PAC locations in the policy space. The tokens are coded as to the type of PAC: L for labor, C for corporation, T for trade/professional organization, and O for other. Figure 5 reveals some interesting patterns. First of all, the PAC locations are trimodal. There are few centrist PACs and there are few PACs located in the region from roughly the mean Democratic position to the first quartile of the Republican positions (-.269 to .170). Labor PACs tend to cluster just to the left of the first quartile Democrat (-.500). Most corporations and trade groups cluster between the first quartile and third quartile Republican (.170 to .299). However, there is large group of corporations and trade groups that lie to the right of three-fourths of the Republican party. The groups in the OTHER category range from the Sierra Club to the National Rifle Association to the National Conservative Political Action Committee. These groups tend to flank the labor, trade, and corporate groups on the extremes.

Figure 5 about Here

Table 6 compares the average PAC locations, incumbency biases, indifference thresholds, and geometric mean probabilities for each group of PACs from the pooled estimates. The groups are quite different in their incumbency biases. Labor groups tend to have much higher estimated incumbency biases than corporations or trade associations. Surprisingly, however, there is no general tendency for corporations to prefer incumbents more than trade groups because, as Figure 5 shows, the right-wing corporate groups had low and even negative incumbency biases. However, there is a tendency for center-right corporations to have higher incumbency biases than the labor groups. The indifference thresholds also differentiate the groups. Trade associations have the lowest average threshold, followed by labor unions, and then corporations.

Table 6 about Here

The geometric mean probabilities for the groups are also interesting. The GMP measures the fit of each group's choices to a spatial model. A higher GMP represents a greater spatial or ideological consistency. Labor groups are much more ideological than the trade groups and corporations. In fact, labor unions fit the ideological model better than the groups in the "Other" category which is dominated by so-called ideological PACs. Trade groups are the least ideological, perhaps reflecting their pragmatic need to build very large, broad based, coalitions.

6.4 Comparison with Poole and Rosenthal Estimates

A useful experiment can be conducted by constraining the location of all incumbents to their location as estimated by Poole and Rosenthal from roll call data (hereafter referred to as PR estimates). If the PAC's spatial evaluations of the incumbents are the same as those implied by roll call voting, the constrained and unconstrained models should yield similar results. Since the models are nested, the significance of the constraints can be tested. Table 7 gives the results from the Poole-Rosenthal constrained model on the pooled data.

Table 7 about Here

In all years the difference in likelihood between the two models is significant using the standard likelihood ratio test. However, the large number of constraints involved makes exceeding the critical value of this test quite easy. A more realistic way of assessing the practical importance of the restrictions is to evaluate the similarity of the parameters estimated by both models. Table 8 gives the Pearson correlations between the parameters of each model. Interestingly, these correlations are very high in the case of PAC parameters estimated in the constrained and unconstrained models. However, the correlation between the unconstrained incumbent and challenger locations and the PR estimates is somewhat lower. While the correlations are high, there appears to be a noticeable difference between the PAC evaluations of the candidates and their records on roll call voting.

Table 8 about Here

PR estimates are based on almost all roll call votes made during a Congress, whereas most PACs may only be aware of, and base their decisions on, a handful of roll calls. By evaluating the candidates on only a handful of votes, PACs could not make fine distinctions between legislators. There is some evidence for this "coarseness" of PAC evaluations. The correlations of candidate positions with the PR estimates by party are also reported in Table 8. These results show that PAC evaluations of incumbents within each party deviate somewhat more from the PR estimates. The correlation of incumbent positions with PR estimates among Democrats is generally somewhat higher than that among Republicans, perhaps reflecting the relative homogeneity of the Republicans. It is clear that PACs distinguish well among incumbents from different parties and even different wings of the parties but not between members of the same group.

A test of the hypothesis that PACs make only coarse judgments about ideology can be conducted by constraining the incumbents to the mean of their PR party quartile and estimating the PAC-NOMINATE model. If the coarseness hypothesis is true, the log-likelihood of this constrained model should be close to that of the model where incumbents are constrained to the PR coordinates. We conducted this experiment on the pooled data and the results are listed in Table 7. The party quartile model performs almost as well as the model using the PR coordinates. This suggests that the PAC's information may not be better than simply locating candidates by quartile. By way of comparison, we also ran a restricted three party model with just three incumbent ideal points -- one for Northern Democrats, one for Southern Democrats, and one for Republicans. The fall in log-likelihood for this model is much greater suggesting that PACs make use of more than just party information, but that their information on the spatial location of incumbents may be limited to a coarse partition into party factions or wings.

The coarseness of PAC information about candidate positions can also be seen by comparing the positions of challengers who won their elections with their estimated positions in later years. Our sample included 58 challengers who successfully defeated the incumbent. For these challengers, the pooled estimations provide a position both as a challenger and as an incumbent. The simple correlation of these positions demonstrate that the PACs did reasonably well in predicting the future positions of the successful challengers. The correlation between the positions was .70. However, much of this success is based simply on partisanship. The correlation of the positions among the Democratic and Republican sub-samples was much lower .25 and .06 respectively. It seems as though the PACs did not do as well in predicting the intraparty policy differences between the challengers.

7. Conclusions

Political action committee contribution behavior can be modeled parsimoniously in terms of an unidimensional spatial model with abstention and incumbency biases. Almost 74% of all abstention/contribution choices can be predicted by this model and the correct recipient of an actual contribution can be predicted for 94% of the actual contributions. This is strong support for the hypotheses underlying position-induced campaign contributions.

Given the demonstrated importance of ideology in campaign contributions, our estimates of PAC policy positions tell us much about these interest groups. We find that there are substantial differences in the ideological patterns of campaign contributions between the major classes of economic interest groups -- labor unions, corporations, and trade groups. In addition to the obvious result that the groups occupy different positions in the liberal-conservative continuum, we find that unions tend to be more ideologically consistent in their contributions while many corporations and trade associations tend to be more pragmatic in their contributions by stressing incumbency. However, corporate PACs are a very diverse group as there are many who are very ideologically conservative and focus on contributions to challengers in order to upset the Democratic majority in the House of Representatives.

We also find that, contrary to the simple Downsian model, Congressional contests are polarized. However, we do find a statistical relationship between the positions of incumbents and challengers suggestive of some strategic interaction along the lines suggested by theories of candidate competition.

While the results as a whole are supportive of position-induced campaign contribution models, many more questions need to be answered. While we estimate that candidate platforms and interest group ideal points are polarized, we are unable to prove that there is a causal link between the two. Further as we only model the final stage of the contribution process, we are unable to examine the tradeoff between dollars and votes that candidates face when choosing their electoral strategies. Clearly, the role of interest group money in influencing electoral competition will continue to be an important area of scholarly interest in the future.

Table 1

Contribution Choices Made by Each Type of PAC

For PACs who made at least 25 contributions

(Percentages may not add to 100 due to rounding)

	Challenger	Abstain	Incumbent
Corporate	5569 (13%)	27206 (63%)	10752 (25%)
Labor	5925 (23%)	12159 (46%)	8128 (31%)
Trade/Professional	1856 (15%)	6409 (51%)	4269 (34%)
Other	4068 (20%)	12222 (60%)	4247 (21%)

Table 2

Estimation Results

	#PACs	#Races	β	SE(β)	γ	SE(γ)	$\ln\mathcal{L}$	GMP
1978	102	118	13.56	.145	.939	.060	-6776.2	.569
1980	165	123	10.27	.085	.892	.059	-12293.8	.545
1982	177	166	9.51	.071	.763	.033	-17246.1	.556
1984	182	127	12.79	.105	1.282	.038	-13584.5	.556
1986	86	86	10.85	.149	.889	.073	-4153.9	.570
Pooled	299	384	5.98	.025	.362	.022	-56287.8	.543
2-Dim	299	384	6.56	.026	.524	.022	-55871.2	.545

Table 3

Classification Results

1978

	Actual		
Predicted	**Challenger**	**Abstain**	**Incumbent**
Challenger	1203	521	20
Abstain	890	5656	947
Incumbent	20	683	2096

% Correct Classification = .744

"Always Abstain" Class = .570

PRE-A = .404

PRE-M= .341

1980

	Actual		
Predicted	**Challenger**	**Abstain**	**Incumbent**
Challenger	1858	790	41
Abstain	1683	9753	1868
Incumbent	50	1097	3155

% Correct Classification = .727

"Always Abstain" Class = .573

PRE-A = .359

PRE-M = .294

1982

Actual

Predicted	**Challenger**	**Abstain**	**Incumbent**
Challenger	2661	979	48
Abstain	2207	14457	2619
Incumbent	47	1735	4629

% Correct Classification = .740

"Always Abstain" Class = .554

PRE-A = .416

PRE-M = .320

1984

Actual

Predicted	**Challenger**	**Abstain**	**Incumbent**
Challenger	2317	854	60
Abstain	1689	10428	1943
Incumbent	46	1418	4359

% Correct Classification = .740

"Always Abstain" Class = .549

PRE-A = .422

PRE-M = .373

1986

Actual

Predicted	**Challenger**	**Abstain**	**Incumbent**
Challenger	1179	371	25
Abstain	556	2627	442
Incumbent	9	446	1721

% Correct Classification = .747

"Always Abstain" Class = .466

PRE-A = .527

PRE-M= .466

Pooled

Actual

Predicted	**Challenger**	**Abstain**	**Incumbent**
Challenger	8152	3575	174
Abstain	8093	42778	8488
Incumbent	170	5310	15311

% Correct Classification = .718

"Always Abstain" Class = .562

PRE-A = .358

PRE-M= .279

Table 4

Party Means

	Democrats	Republicans
Incumbents	-.205	.301
Challengers	-.268	.184
T-Value	2.02**	4.40***

*** Significant at 1% level

** Significant at 5% level

Table 5

OLS Results

Dependent Variable – Challenger Location

Incumbent	**N. Democrat**	**S. Democrat**	**N. Republican**	**S. Republican**
Constant (α_0)	0.368*** (0.024)	0.251*** (0.041)	-0.498*** (0.029)	-0.381*** (0.045)
Inc. Location (α_1)	0.795*** (0.053)	0.658*** (0.083)	0.853*** (0.076)	0.086 (0.119)
R^2 (adj)	0.478	0.421	.355	-.007
N	240	87	230	63
F-test (Downsian)	300.11***	25.95***	17.46***	252.1***

* Significant at 10% level

** Significant at 5% level

*** Significant at 1% level

Table 6

PAC Averages

	#	GMP	Location	Indifference Threshold	Incumbency Bias
Corporate	131	.532	.308	.879	.046
Labor	77	.548	-.534	.719	.172
Trade/Prof	50	.497	.164	.675	.106
Other	38	.543	.290	.847	.081

Table 7

Results from Restricted Models

	$\ln\mathcal{L}$	GMP	Classification
Unconstrained	-56287.8	.5432	.718
Poole-Rosenthal	-60418.4	.5194	.704
Party Quartiles	-60588.7	.5184	.703
3 Party Model	-60970.2	.5163	.701

Table 8

Correlation of Parameters with Poole-Rosenthal Constrained Model

	Correlation
PACs	.953
Incumbents	.717
Democrats	.574
Republicans	.075
Challengers	.665
Democrats	.715
Republicans	.431

Bibliography

Austen-Smith, David. 1987. "Interest Groups, Campaign Contributions, and Probabilistic Voting," *Public Choice*, 53:123-139.

Banks, Jeffrey and D. Roderick Kiewiet. 1989. "Explaining Patterns of Candidate Competition in Congressional Elections." *American Journal of Political Science*, 33:991-1015.

Baron, David P. 1994. "Electoral Competition with Informed and Uninformed Voters," *American Political Science Review*, 88:43-57.

Black, Duncan. 1948. *The Theory of Committees.* Cambridge: Cambridge University Press.

Bernt, E.K., B.H. Hall, R.E. Hall, and Hausman, J.A. 1974. "Estimation and Inference in Nonlinear Structural Models," *Annals of Economic and Social Measurement*, 3-4:653-666.

Davis, Otto, Melvin Hinich and Peter Ordeshook. 1970. "An Expository Development of a Mathematical Model of the Political Process," *American Political Science Review*, 64:426-448.

Downs, Anthony. 1957. *An Economic Theory of Democracy.* New York: Harper Row.

Efron, Bradley. 1979. "Bootstrap Methods: Another Look at the Jackknife." *Annals of Statistics*, 7:1-26.

Enelow, James M. and Hinich, Melvin J. eds. 1990. *Advances in the Spatial Theory of Voting,* New York: Cambridge University Press.

Gopoian, J. David. 1984. "What Makes PACs Tick? Analysis of the Allocation Patterns of Economic Interest Groups," *American Journal of Political Science*, 28:259-281.

Greene, William H. 1990. *Econometric Analysis.* New York: MacMillan Publishing Company.

Grier, Kevin B. and Michael C. Munger. 1991. "Committee Assignments, Constituent Preferences, and Campaign Contributions," *Economic Inquiry,* 29:24-43.

Hinich, Melvin J. and Ordeshook, Peter C. 1969. "Abstentions and Equilibrium in the Electoral Process," *Public Choice,* 8:81-100.

Hinich, Melvin J. and Michael C. Munger. 1994. *Ideology and the Theory of Political Choice.* Ann Arbor: The University of Michigan Press.

Jacobson, Gary. 1980. *Money and Politics.* New Haven: Yale University Press.

Londregan, John and Thomas Romer. 1993. "Polarization, Incumbency, and the Personal Vote," in William A. Barnett, Melvin J. Hinich, and Norman J. Schofield (eds.) *Political Economy: Insttutions, Competition, and Representation.* Cambridge: Cambrige Univeristy Press.

Morton, Rebecca. 1993. "Incomplete Information and Ideological Explanations of Platform Divergence," *American Political Science Review,* 87:382-392.

Morton, Rebecca and Charles Cameron. 1992. "Elections and the Theory of Campaign Contributions: A Survey and Critical Analysis," *Economics and Politics,* 4:79-108.

Munger, Michael C. 1989. "A Simple Test of the Hypothesis that Committee Jurisdictions Shape Corporate Political Action Committee Contributions," *Public Choice,* 62:181-186.

Palfrey, Thomas R. and Keith T. Poole. 1987. "The Relationship between Information, Ideology, and Voting Behavior," *American Journal of Political Science,* 31:511-530.

Poole, Keith T. and Thomas Romer. 1985. "Patterns of Political Action Committee Contributions to the 1980 Campaigns for the United States House of Representatives," *Public Choice,* 47:63-111.

Poole, Keith T., Thomas Romer, and Howard Rosenthal. 1987. "Revealed Preferences of Political Action Committees," *AEA Papers and Procedings,* 77:298-302.

Poole, Keith T. and Howard Rosenthal. 1985. "A Spatial Model for Legislative Roll Call Analysis," *American Journal of Political Science*, 29:357-384.

________. 1991. "Patterns of Congressional Voting," *American Journal of Political Science*, 35:228-278.

________. 1996. *Congress: A Political-Economic History of Roll Call Voting*. New York: Oxford University Press (forthcoming).

Sabato, Larry. 1984. *PAC Power: Inside the World of Political Action Committees*. New York: Norton.

Snyder, James. 1992. "Artificial Extremism in Interest Group Ratings," *Legislative Studies Quarterly*, 27:319-346.

Welch, William P. 1980. "The Allocation of Political Monies: Economic Interest Groups," *Public Choice*, 36:209-234.

Wittman, Donald. 1983. "Candidate Motivation: A Synthesis of Alternatives," *American Political Science Review*, 72:142-157.

Wright, John R. 1985. "PACs, Contributions, and Roll Calls: An Organizational Perspective," *American Political Science Review*, 79:400-414.

Appendix— Monte Carlo Simulations

Table A1 shows the results of several Monte Carlo tests of our procedure for recovering candidate locations. The model was run five times with varying levels of error ranging from $\beta = 8$ to $\beta = 3$.[16] For each run, we used the Poole\Rosenthal estimates from the 1980 election as the true values for incumbents and randomly drew challengers from the distribution of Poole/Rosenthal estimates from the appropriate party. The true PAC coordinates were distributed uniformly throughout the space. The uniform distribution of PAC locations has no effect on the Monte Carlo results. There is no difference in the precision of recovery if the PAC locations estimated from the actual data are used as true values in the Monte Carlo experiments; this suggests that recovery is insensitive to the distribution of PACs. Each PAC was given identical incumbency biases and indifference thresholds. These parameters were adjusted along with β in order to assure approximately equal proportions of abstention and contribution in each run. In Table A1, we report the geometric mean probability, the percentage correct classification, the Pearson correlation of the estimates with the true coordinates, the mean value of the biases and thresholds, and the estimates of γ.

The recovery of PAC coordinates is quite good. The contest coordinates are slightly less precise due to the identification problems previously cited.

Bootstrapping Results

Because the alternating algorithm that we outline above computes the standard errors from the outter products of only a subset of gradients, this procedure does not produce the true standard errors of the coefficients. To assess the extent of this problem, we conducted 50 bootstrapping experiments to estimate the standard errors of the candidate locations (see Efron, 1979). In each of these experiments, we drew with replacement 384 races from the 384 actual races in the pooled data set. We then estimated the pooled model and computed the standard error of the incumbent and challenger locations. The distribution of the standard errors is given in Figure A1. Most of the estimated standard errors range from

0.1 to 0.2. Given that the estimated policy space is 2 units long, this suggests that most candidates are reasonably precisely estimated.

Table A1

Results of Monte Carlo Simulations

		β	INDF (N)	INCM (g)	γ
True	Values	9	1.0	.20	1.0

	GMP	CLASS	$C(Z_I)$	$C(Z_C)$	C(X)	M(N)	M(g)	β	γ
1	.743	.874	.989	.979	.998	.999	.198	9.28	1.073
2	.728	.865	.990	.983	.997	.992	.193	9.25	1.093
3	.740	.873	.984	.975	.997	.943	.200	9.29	1.093
4	.729	.866	.988	.981	.998	.995	.200	9.22	1.061
5	.739	.873	.987	.976	.998	.992	.200	9.24	1.079

		β	INDF (N)	INCM (g)	γ
True	Values	8	1.0	.20	1.0

	GMP	CLASS	$C(Z_I)$	$C(Z_C)$	C(X)	M(N)	M(g)	β	γ
1	.704	.850	.986	.977	.998	.974	.197	8.16	1.059
2	.703	.851	.991	.985	.993	.994	.204	8.19	1.063
3	.697	.845	.989	.979	.998	1.002	.199	8.16	1.043
4	.703	.848	.988	.978	.998	.982	.201	8.21	1.083
5	.702	.850	.991	.990	.998	.991	.204	8.25	1.105

		β	INDF (N)	INCM (g)	γ
True	Values	7	1.0	.20	1.0

	GMP	CLASS	$C(Z_I)$	$C(Z_C)$	C(X)	M(N)	M(g)	β	γ
1	.662	.819	.992	.986	.998	.988	.203	7.09	1.033
2	.668	.826	.990	.983	.998	.987	.204	7.14	1.059
3	.664	.822	.992	.986	.998	1.006	.204	7.14	1.042
4	.671	.829	.989	.981	.998	.983	.200	7.12	1.042
5	.666	.825	.990	.981	.998	.996	.201	7.17	1.080

		β	INDF (N)	INCM (g)	γ				
True	Values	6	1.0	.20	1.0				
	GMP	CLASS	$C(Z_I)$	$C(Z_C)$	C(X)	M(N)	M(g)	β	γ
1	.633	.797	.989	.983	.998	.994	.198	6.13	1.070
2	.622	.787	.992	.985	.997	1.007	.200	6.11	1.051
3	.630	.794	.990	.981	.997	1.009	.202	6.08	1.028
4	.626	.793	.993	.985	.998	.994	.200	6.11	1.050
5	.635	.800	.988	.981	.998	.995	.202	6.11	1.054

		β	INDF (N)	INCM (g)	γ				
True	Values	5	1.0	.20	1.0				
	GMP	CLASS	$C(Z_I)$	$C(Z_C)$	C(X)	M(N)	M(g)	β	γ
1	.598	.760	.989	.980	.996	.991	.199	5.10	1.060
2	.596	.762	.989	.980	.997	.994	.204	5.07	1.025
3	.596	.760	.988	.976	.997	1.001	.208	5.08	1.055
4	.599	.763	.987	.980	.997	1.001	.206	5.05	1.016
5	.597	.762	.991	.984	.997	.991	.198	5.06	1.016

		β	INDF (N)	INCM (g)	γ				
True	Values	4	1.0	.20	1.0				
	GMP	CLASS	$C(Z_I)$	$C(Z_C)$	C(X)	M(N)	M(g)	β	γ
1	.579	.739	.982	.969	.994	.994	.195	4.04	1.018
2	.574	.732	.986	.971	.993	1.002	.203	4.00	.969
3	.576	.732	.980	.964	.994	1.005	.211	4.06	1.001
4	.579	.737	.987	.974	.993	.991	.193	4.03	1.000
5	.576	.735	.984	.975	.993	.990	.200	4.03	1.020

Key -- C(y) = correlation of estimated and true values of y

M(y) = mean of estimated values of y

Figure 1

How Contributions Vary with Incumbent Location

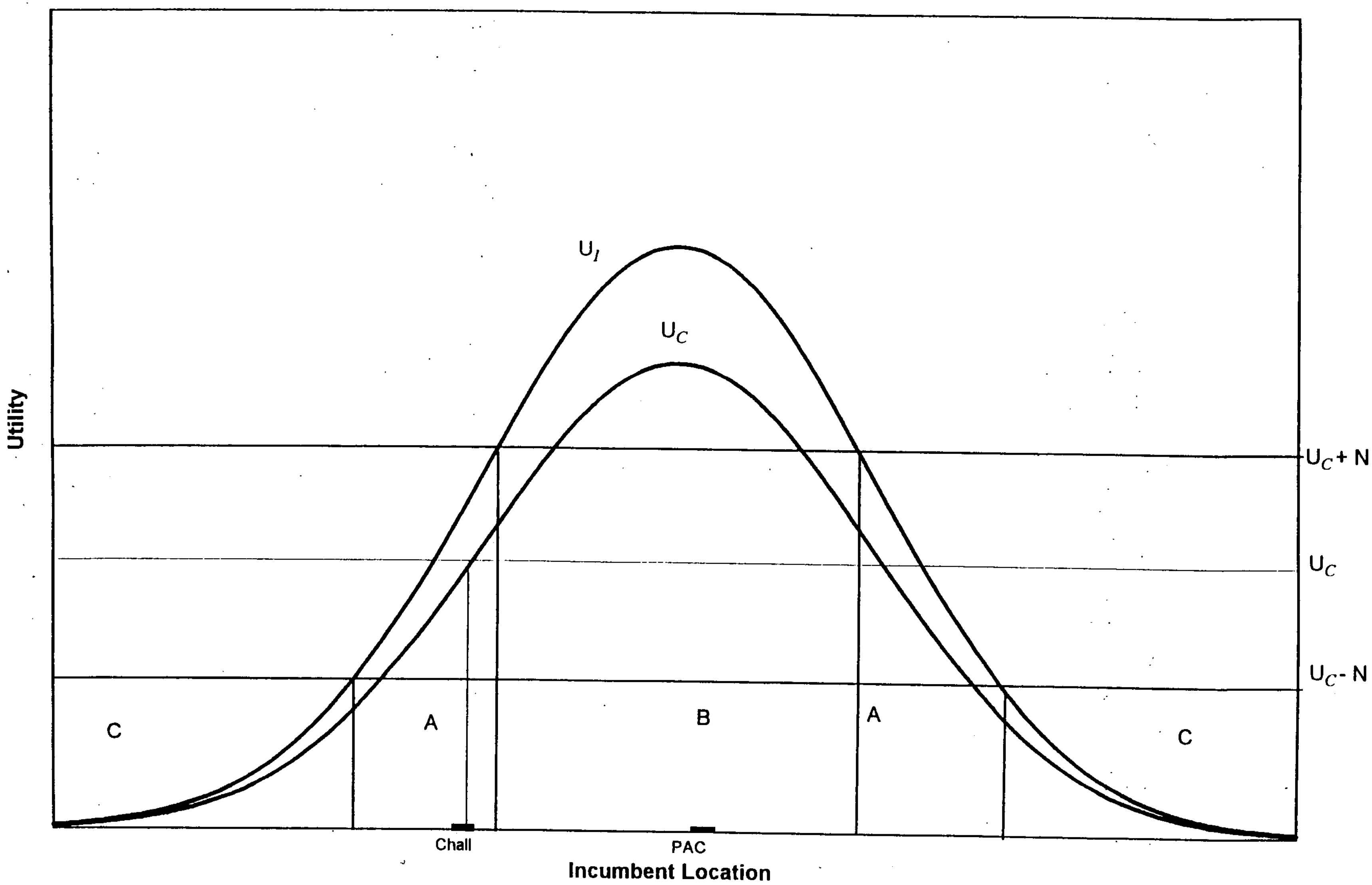


Figure 1

How Contributions Vary with Incumbent Location

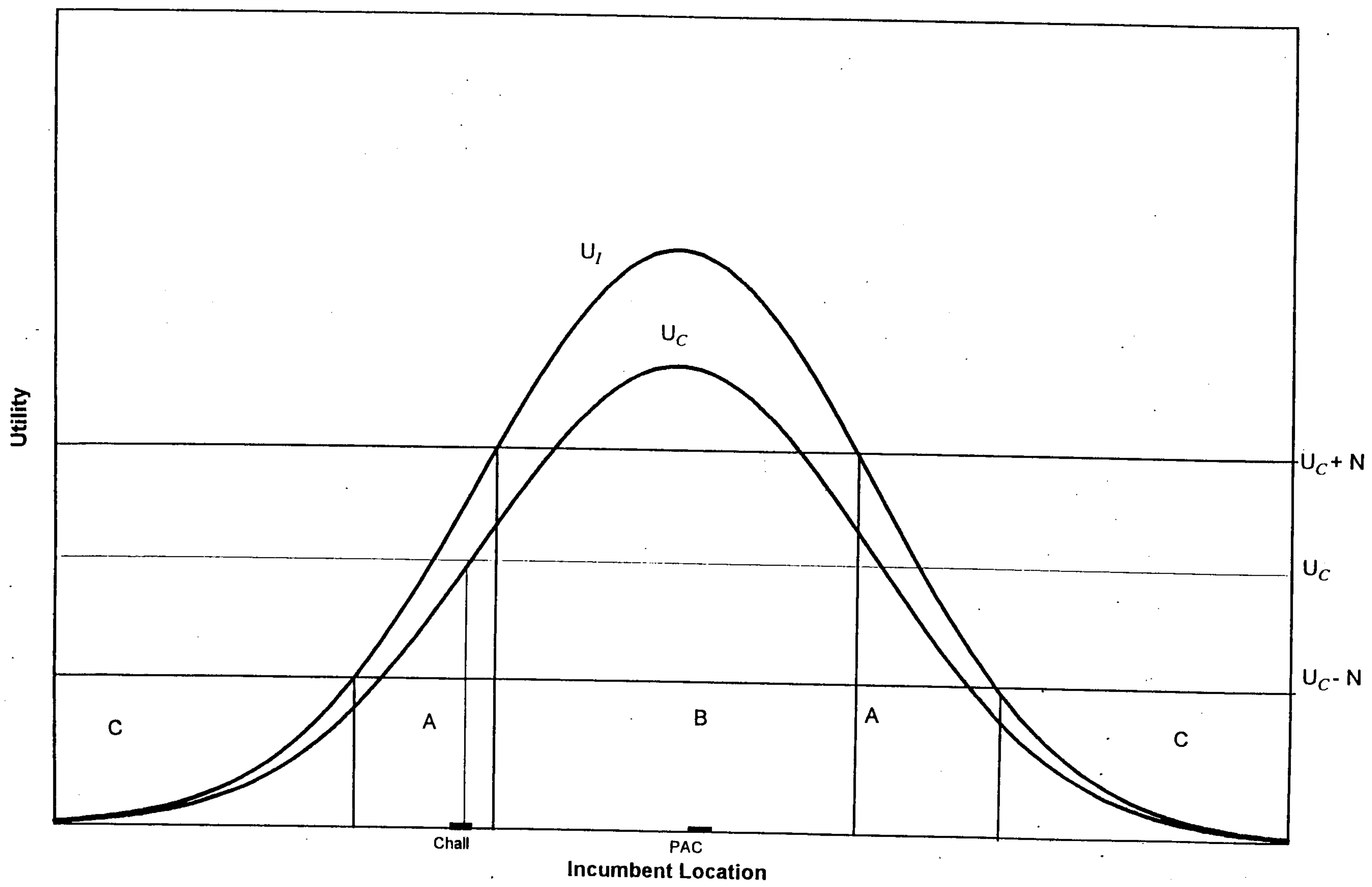
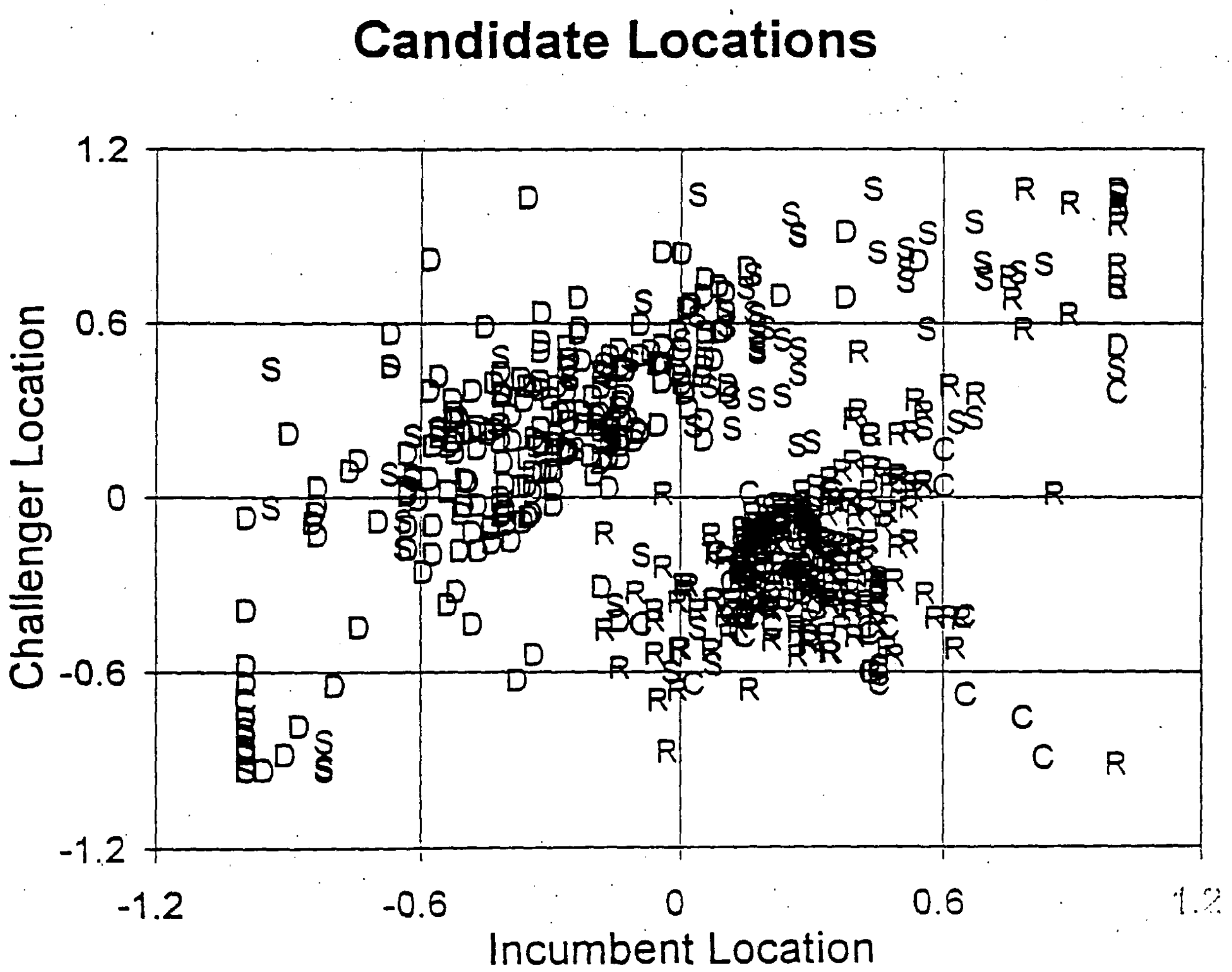


Figure 3

Contribution Pattern from 1984 Election

Actual:	AAAAAACCAACACAAACAAAAACCAAACAAAAAAAAAIAAACAAAAAAAA
Predicted:	ACACAACCAACAAAAAACAACAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
Actual:	AAAAAAAAAAAAAAAAACAAAAAAACICCACCAACAACICACACAAACAA
Predicted:	AAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAACAAAAACAAAAAAAAA
Actual:	IIIIAAIIIIIAIIIIIIIIIIAIIIAIACCIIIAICACCCCACCCACCC
Predicted:	AIIIIIIIIIIAIIIIIIIIIAIIAAAAAAAAAAAAAAAAAAAAAAAAAA
Actual:	AIAIIAIAAAIIIAAIAIAAIAIAAACAAAAAAAAAAAAAAAAAAAAAAA
Predicted:	AIAIAAIIAAIAAAAAIIAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
Actual:	AIAIIAIIAAIAIIAIIIAAIAIIAAIIAAAAIAACAACIAAAAIAACCA
Predicted:	AIAIIAIIAAIAIIAAIIIAIAIIAAIIAAAAAAAAAAAAAAAAAAAAAA
Actual:	AAAAAACAAAAAAAAAAAAACAIAAAAIAIIAAAIAIIAAIAIAIIAAAAA
Predicted:	AAAAAAAAAAAAAAAAAAAAIAIIAIIIAIAIAIAIAAAIAIAAAAAAAA
Actual:	AAAAAACCCAAAACAACIAAAAAIIIIIIAIIAIAIIAIIAIIIIAAIAA
Predicted:	ACACAACCAAAAAAAAAAAAIAIIIIIIIIIIIIIIIIIIAIAAAAAAAA
Actual:	AIAIAAAAAAAAAAAAAIIAAIAIIIIAIAIAIAIAAIAAAAACAAACCAA
Predicted:	AAAIAAAAAAAAAAAAAIIAAIAIIAIIIAAAAAIAAAAAIAAAAAAAAAA
Actual:	CCACAACCACCACCCACICCAAAIAAIIAAAAIIAIAAIIAIAIIIAIAI
Predicted:	ACACAACCCACAACACCCAAAAAAAAIIAAAAAIAAAAAIAIAAAAAAAA
Actual:	CCCCACCCCACCACCACAAACAAIIIIIAIIIIIAIIIIIAIIIIIAIII
Predicted:	CCCCCACCCACAACACCCAAAAAIAIIIAIAIIIAIIAAIAIAAAAAAAA

Figure 4



Candidate Locations
1.2
0.6
0
-0.6
-1.2
Challenger Location
-1.2
-0.6
0
0.6
1.2
Incumbent Location

Figure 5

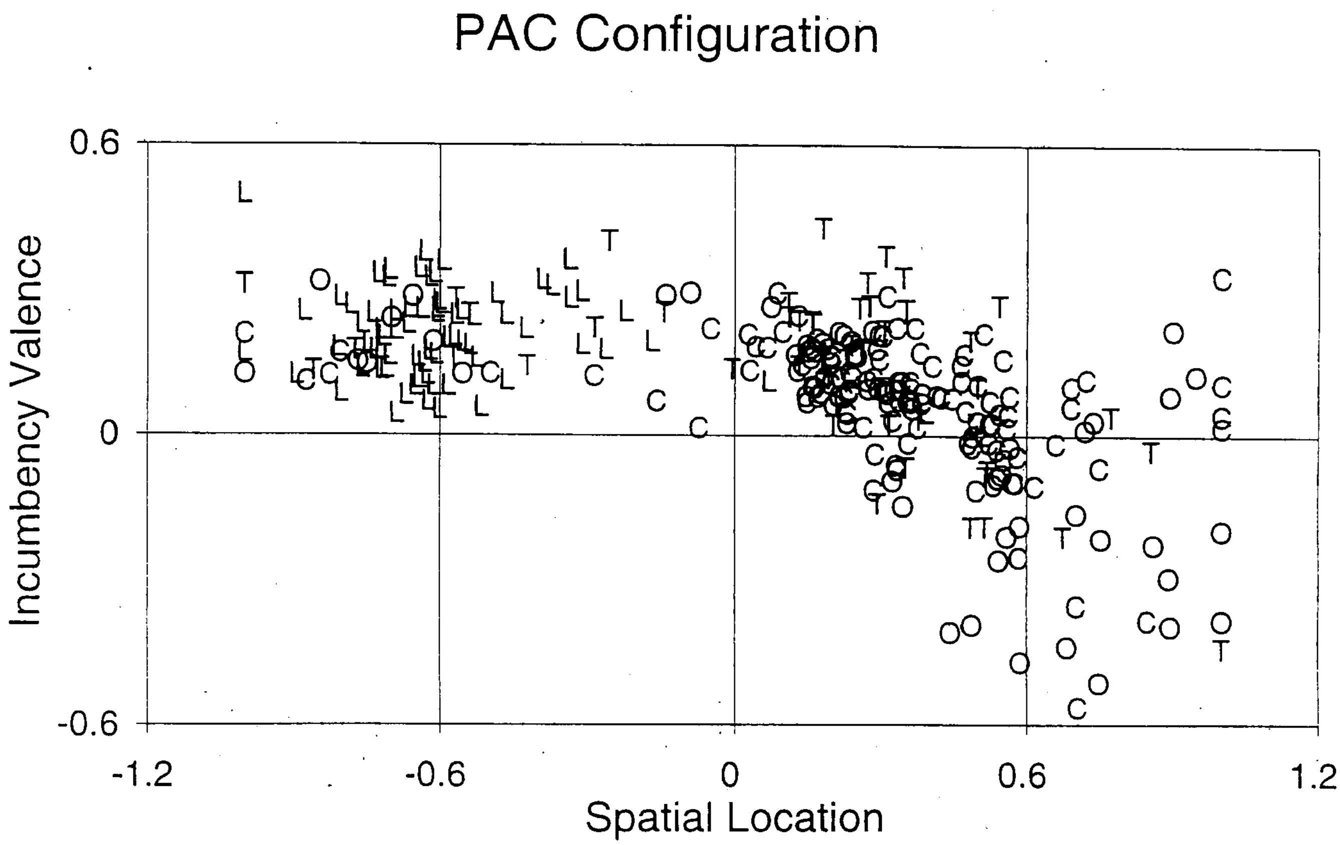
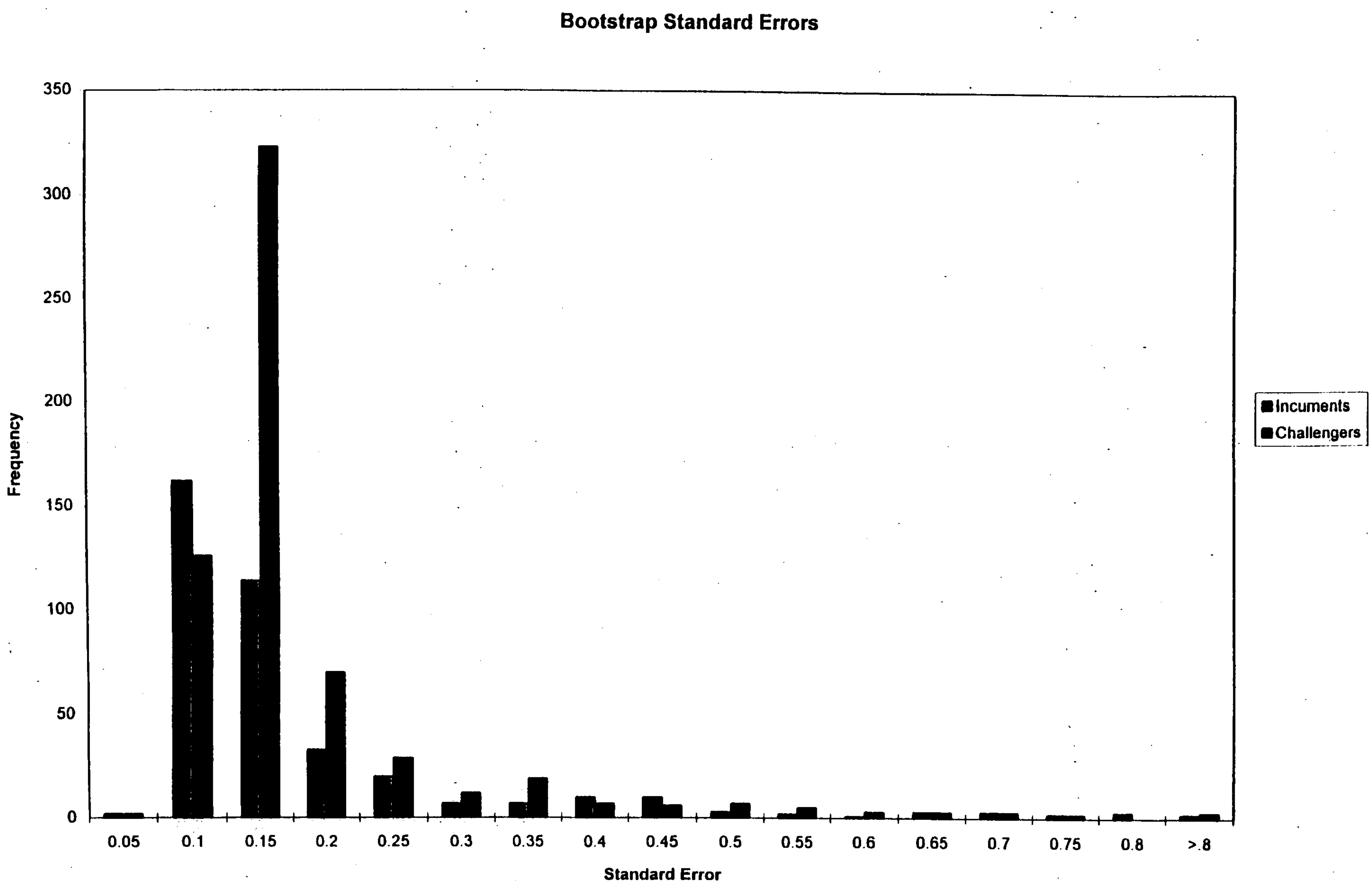

PAC Configuration
0.6
0
-0.6
Incumbency Valence
-1.2
-0.6
0
0.6
1.2
Spatial Location

Figure A1


Bootstrap Standard Errors
Frequency
350
300
250
200
150
100
50
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
0.8
>.8
Standard Error
Incuments
Challengers

Notes

[1] Previous empirical studies of candidate competition include those by Enelow and Hinich (1984), Hinich and Munger (1994), and Londregan and Romer (1993). Morton (1994) finds support for the incomplete information theories in her experiments.

[2] See Morton and Cameron (1992) for a review of this literature. Other important papers include Austen-Smith (1987), Baron (1989, 1994), and Hinich and Munger (1994, chs. 9 and 10).

[3] Contributions to both candidates are extremely rare (Sabato, 1984; Poole and Romer, 1985; McCarty and Rothenberg, 1994). When they do occur they are typically asymmetric in that one contribution is much larger than the other. In these two-contribution cases, we treat the larger contribution as indicating the PAC's preference.

[4] By estimating a single ideological position for each PAC, we are implicitly assuming that each PAC is behaving as a unitary actor. However, Wright (1985) argues that much of PAC behavior may be driven by organizational tensions caused by heterogeneous preferences among its members, such as those between local chapters and the national offices of trade associations. Unfortunately, it would be impossible to estimate a model of the sort described in this paper with heterogeneous preferences within each PAC.

[5] Because we are only considering the final stage of the candidate/contributor game, z_{jkI} and z_{jkC} will be taken as givens to the PACs. Given our assumptions about timing, we can ignore the strategic interaction of interest groups and candidate locations in order to facilitate estimation of the model.

[6] Since our work utilizes the logistic distribution which has a fixed variance, $1/\beta$ serves the role of adjusting the variance of the error term.

[7] This model may also be estimated on open seat races by eliminating the incumbency bias parameter.

[8] Using the actual expenditures or number of contributions that PACs actually made creates simultaneity problems.

[9] Ideally, we would measure the probability of a pivotal contribution based on expectations of the vote shares rather than on the vote shares themselves. Unfortunately, such polling data is typically not available for a large sample of congressional districts.

[10] Obviously, α_i relates only to the number of contributions, not their size.

[11] Note that N_{ij}, α_i, and γ are not identified independent of β because β determines the highest value the utility function can take. This problem is mitigated in estimation by the non-linear specification of N_{ij} and the alternating estimation algorithm discussed in the next section. However, in interpreting coefficients it is important to note that higher values of N_{ij}, α_i, and γ are associated with higher values of β.

[12] This is due to the assumption that the error terms are independent and identically distributed across PACs and candidates.

[13] Geometric mean probability is defined as $\exp(\ln L/pq)$. It is a much more conservative measure of fit than the simple mean likelihood because it penalizes low probability choices.

[14] While over-prediction of the modal response is a common problem in multinomial logit models, PAC-NOMINATE may be especially susceptible. Note from Figure 2 that a typical contest may have as many

as four cutting lines and the abstention choice borders all four. Since classification errors are typically made near the cutting lines, it should be expected that most errors involve abstention.

[15] The overprediction of abstenstion may also suggests that the classification performance of the model may have been lowered by the exclusive of races where challengers recieved few contributions. The excluded races had a high proportion of abstenstions which would have most certainly led to a high percentage of correct classifications.

[16] Recall that β is a weight applied to the deterministic portion of the utility function so that as β increases, utility is less noisy.