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THE SPENDING GAME: MONEY, VOTES, AND INCUMBENCY IN CONGRESSIONAL ELECTIONS[†*]

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Abstract

This paper takes a game-theoretic approach to the analysis of the spending-votes relationship in Congressional elections to reinvestigate the surprisingly weak effects of incumbent spending measured in previous studies. Rather than focusing narrowly on the impact of spending on electoral outcomes, we attempt to take account of the reciprocal effect of (anticipated) closeness on spending using several statistical approaches. We also offer improvements in the specification and measurement of the vote equation, by using a better measure of district party strength adjusted for year-effects, and by including a variable that measures the heat of the campaign in terms of total spending by the incumbents and challengers. The latter measure partially corrects for the simultaneously determined (and highly positively correlated) levels of incumbent and challenger spending. A more rigorous multiequation simultaneous equations model, identified by uncorrelated errors, provides even more leverage for sorting out the effects of incumbent and challenger spending on votes. That analysis indicates (in a complete turnaround from findings reported elsewhere) that incumbent spending effects are highly significant and of a magnitude that is, if anything, greater than challenger spending effects. The paper concludes by using a game theoretic model to estimate the effect of anticipated closeness on spending, and to estimate differences in campaign financing costs between incumbents and challengers.

Keywords: Elections, Incumbency, Campaign Spending, Congress, Game theory, Methodology

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Introduction

It is commonly believed that the increased cost of congressional campaigning has corrupted congressional politics. Some of the argument goes roughly like this: Candidates must spend lavishly to win over congressional voters. Hustling the necessary cash from contributors in return for access, incumbents are generally able to outspend any challenger that might threaten them. Thus, they almost always win reelection. Aware that incumbents are protected by their cash advantage, potential opponents rarely offer more than token challenges. This process perpetuates a system whereby most congressional races are not seriously contested.

Although the forgoing argument has a familiar resonance, it is by no means the consensus position within political science. While political scientists generally express concern about the role of money in politics and about the incumbency advantage, they are not agreed that the problem of money and the problem of incumbency are connected in the simple manner we have described. Instead, one finds a prevailing political science orthodoxy to the effect that incumbents accrue their advantage "free" from the visibility of their performance, with little added gain from their campaign spending. Challengers, on the other hand, can gain the necessary visibility only by spending, but only rarely are able to spend enough to win.

The reason why incumbent spending is not held to be very important in congressional elections is that scholars have not been able to prove convincingly its statistical contribution. The initial findings in this regard are infamous. Performing OLS regression on the district vote presents the odd result that while challenger spending matters, incumbent spending does not. As first shown by Gary Jacobson (1978, 1980, 1985) in his pioneering work on the electoral effects of campaign spending, challenger spending shows a positive effect on the challenger's vote margin; but the coefficient for incumbent spending either shows up as quite weak, near zero, or even with the wrong sign.

An obvious possibility, recognized by Jacobson and subsequent observers, is that the OLS findings are biased due to the reciprocal nature of the relationship between spending and the vote. Candidate spending decisions are a function of the perceived vote margin, with candidates spending more when the election gets close. As challengers see their chances improve, they spend more. Thus, to the extent that the underlying source of a challenger's better chances is not perfectly observable, the relationship between the challenger vote and challenger spending is biased upward, exaggerating any challenger spending effect on the vote. For incumbents the bias is in the opposite direction. As incumbents see the challenger's chances improve, they also spend more. The relationship between the incumbent vote and incumbent spending is biased downward, working against the hypothesis that incumbent spending garners votes.

This situation begs for a game-theoretic analysis in which the spending decisions of the incumbent and challenger are simultaneously determined as equilibrium strategies of a non-cooperative game. The insights of this approach to modelling the spending-votes issue can shed light on the nature of the simultaneity bias that arises when the strategic interations between incumbent and challenger behavior are ignored. If successful, these insights can be used to correct for the inherent biases in past findings and to identify more precisely the relative importance of incumbent and challenger spending. We follow this general approach here, discussing and comparatively evaluating several different methodological techniques for embedding the subtle strategic implications of game-theoretic/equilibrium analysis into statistical models for estimating the spending-votes relationship.

One potential correction for the simultaneity bias that has been tried elsewhere (Jacobson 1985, Green and Krasno 1988 and 1990, Bartels 1992) is to perform two-stage least squares or some other simultaneous equation technique that estimates effects when simultaneity bias is suspected. This requires the exploitation of one or more instrumental variables that affect incumbent spending but not the vote directly; and, similarly, one or more independent variables that affect challenger spending but not the vote directly. Accordingly, to correct for the potential simultaneity bias, Jacobson performed a two-stage analysis to supplement his OLS findings. Unfortunately, the instrumental variables that Jacobson found available were not strongly related to spending, thus leaving the statistical verdict in doubt. Still, the statistically weak 2SLS result was similar to the OLS verdict–a strong spending effect for challengers but not for incumbents.

From the triangulation of his OLS and 2SLS estimates, Jacobson concludes cautiously that while incumbent spending probably matters somewhat, it matters decidedly less than challenger spending. Jacobson's rationale for this potentially dissonant result is that incumbents already enjoy an advantage in recognition and voter approval before spending starts. Challengers need to spend to catch up. But incumbent visibility readily approaches a ceiling, beyond which more spending would attract few additional voters (Jacobson, 1978, 1982, 1985, 1990).

If incumbent spending matters less than challenger spending, this asymmetry carries important implications regarding the consequences of potential reforms. In particular,

any suggestion of spending limits (for example, as part of public financing of campaigns) brings the charge that the scheme would only offer further electoral protection to incumbents (Jacobson, 1985). The charge is that any plausible spending limit would stifle potentially winnable challenges from achieving their potential, while offering little discernible handicap to the already advantaged incumbents.

Jacobson's thesis of limited incumbent spending effects has attracted spirited challengers, most notably Green and Krasno (1988, 1990). Green and Krasno find different results using lagged incumbent spending as an instrument for current incumbent spending. The justification is that lagged spending, under earlier campaign conditions, reflects the incumbent's "propensity to spend." With lagged spending as an instrument for incumbent spending, Green and Krasno's 2SLS estimates triumphantly show effects for incumbent spending that rival in magnitude those for challenger spending. In response, Green and Krasno's methodology has drawn vigorous critiques from Jacobson (1990) and from Abramowitz (1991). The proper statistical verdict regarding the role of incumbent spending in congressional elections hardly seems settled.

Apart from strictly statistical considerations, let us mull the theoretical plausibly of the two different scenarios–one where the effect of challenger spending dominates and the other where incumbent spending matters perhaps as much as if not more than challenger spending. As part of our deliberations, let us examine the plausibility of the two arguments in terms of what we know about voters, about candidates, and about campaign spending decisions.

First, does our knowledge of the electorate reveal why campaign spending should be particularly ineffective if conducted by incumbent House members? Jacobson's argument is that spending adds little to the voters' already rich storehouse of information about the incumbent. Yet according to well-known survey evidence of voter information (e.g., Stokes and Miller, 1966), congressional incumbents are in fact largely invisible to their constituencies and certainly would stay that way if they did not campaign. Certainly incumbents face no obvious ceiling in terms of voter knowledge or media exposure.

We can also ask whether a greater spending effect for challengers is plausible, given what we know about the political capabilities of challengers and incumbents. If one gave the average incumbent and the average challenger each say $100,000 to spend, who could win the most votes with their new money? According to a wealth of evidence (Jacobson, 1989), the pool of congressional challengers is weak and getting weaker; Meanwhile, incumbents show their capability by getting elected in the first place. One can easily imagine that with a reputed political expertise far greater than that of their often amateur competition, incumbents ought to be able to spend their money more—rather than less—efficiently than challengers.

Finally, consider the spending behavior of challengers and incumbents. Suppose that incumbent spending truly does not matter. Then, the obvious question is why do incumbents spend at all, even with ample war chests? In fact, apart from private usage, why would incumbents amass war chests at all? Not only would we need to ask why incum-

bents spend so much; we would also have to ask why challengers do not spend more. If challengers gain votes by spending and incumbents are largely helpless at stopping them, why do not challengers simply spend incumbents into defeat?

Of course there are long-standing arguments on the other side of this question to offer a rebuttal. First, no matter how uninformed voters are of incumbents, voter information about challengers is even less, leading to the inference that well-targeted challenger spending could produce rapid electoral gains. Second, although challengers may generally be too weak, ineffectual, or unattractive to spend effectively, it may only be the most qualified challengers who are given the monetary resources to spend. Finally, if incumbent spending truly is effective, why do not incumbents spend even more from their rich war chests to drown out the challenger? If the effect of incumbent spending is as strong as for challengers, it might seem that incumbents ought to generate an even more lopsided incumbent advantage in terms of campaign spending.

This paper attempts to solve this riddle of incumbent spending. Toward this end, this paper offers several unique features:

- We analyze congressional district election results over two decades, spanning the years from 1972 to 1990. We pool this data into two separate data sets: one for the districts of the 1970s; the other for the 1980s. As an innovation, we utilize district presidential voting as an indicator of district-level partisanship independent of the congressional race.

- Utilizing the perspective from game theory, we examine the supply side of the money equation, to see how anticipated election results drive campaign spending. This analysis of spending is used to develop further insights for the reverse demand side of spending.

- Statistically, we present a new way to identify the vote model—not in terms of instruments for spending variables, which may be a futile quest—but instead by making assumptions about the covariances of the error terms. Derived from our game theoretical results, we obtain the conditions when the simultaneity bias should be stronger and weaker, and estimate the spending effects under the different conditions.

We argue that our reexamination of the evidence shows strong circumstantial support for the position that incumbent spending matters at least as much as challenger spending in House elections. The reason why such evidence has been elusive, we argue, is that the statistical strength of the reverse causal flow from the expected vote to spending levels—which is the source of the mischievous bias–has been seriously underestimated.

1 Open Seats: Spending Effects and the Measurement of Par

The analysis begins with an investigation of spending effects for open seats—those with no incumbent running. We start there for two reasons. First, since effects of spending for open seats should be about equal for both Republican and Democratic candidates (neither is the incumbent), open seats should provide unbiased estimates of the potential effect parameters for challengers and incumbents in incumbent races. Second, we exploit our open seat analysis to obtain estimates of a baseline we call "Par." Par is the expected vote independent of candidate considerations–given district partisanship ("normal vote"), the election year's partisan trend ("national short term forces"), and equal Republican and Democratic spending effects.

As a reflector of district partisanship, the district-level presidential vote is the major component of Par. Because the presidential vote is a steadier predictor of district partisanship (and hence the House vote) in the North than in the South, we restrict our statistical analysis to Northern districts, excluding both South and Border states. For the 1970s, the one presidential vote measure that predicts the congressional vote well, regardless of election year, is the Carter-Ford 1976 vote. For the 1980s, the Dukakis-Bush 1988 vote serves this purpose.

Par represents a particular baseline: the expected congressional vote, given the district's relevant presidential voting history and the election-year partisan trend, for an open seat where Democratic and Republican spending levels are balanced.[1] Table 1 shows how this measure was created, first for the 1970s. For all northern open seats, 1972-1980, we regressed the percent Democratic on the Carter 1976 percentage, four election-year dummies, and the net difference between the log of Democratic spending and the log of Republican spending. This equation provides an open seat vote prediction from the combination of Par and campaign spending. Par is the open-seat equation prediction, with the estimated effect of spending subtracted from it. For the 1980s, Par is created similarly, using the 1988 Democratic presidential vote.[2]

Note that the spending effect is modeled as a linear effect of logged spending on the two-party vote division. This specification allows the marginal effect of the next dollar to diminish with the amount already spent. By the usual criteria of best fitting R squared, lower standard error of estimate, etc., logged spending outperforms raw spending as a vote predictor. The one source of untidiness is how to adjust the log of spending when a candidate spends nothing or very little. The case of "no spending" (the log of zero is minus infinity) can be dealt with by assigning one dollar of spending. Still, increments of spending in the lesser range can affect the coefficients disproportionately. We adopt Green and Krasno's (1990) solution, measuring the spending variable as the log of the candidate's spending plus $5000 (in 1978 dollars). To maintain a comparable monetary scale for different election years, we measure spending in terms of constant (1978) dollars.

Some intriguing side-evidence suggests that Par is a very accurate reflection of district-to-district differences in partisanship, namely that with Par in the equation, the lagged (t-1) congressional vote does not even make a statistically significant contribution to the open-seat vote. If one knows the presidential vote (for 1976 for the 1970s; 1988 for the 1980s) plus the election year, the districts congressional election history does not help to predict the open-seat congressional vote. Evidently, all relevant information about district partisanship is contained in Par. If Par were a leaky measure of district partisanship, partisanship would be reflected by the district's congressional election history.

Not to be lost in the shuffle of our discussion of Par are the estimated effects of spending by open seat candidates. With separate coefficients for Republican and Democratic spending, both spending coefficients are quite statistically significant. Although the coefficient is higher for Republican spending, we treat the two spending effects as equal for the measurement of Par, utilizing the net difference in logged spending.

What should we make of the magnitude of the spending effects where the log of spending shows a coefficient of about 4.0? Figure 1 is intended to provide some guidance. Figure 1a shows the relationship between the actual vote and Par for the 1970s. Par serves as a baseline, so where the vote is higher than Par, the Democratic candidate did better than expected; where the vote is lower than Par, the Republican candidate performed better than the Par baseline. Note both a strong fit and that the dominant party in one-party districts tended to outperform even Par. This latter result is a product of the dominant party's edge in campaign spending.

Figure 1-b shows how the relationship between Par and the projected vote with spending effects removed. (The term b*Log Spending Difference is subtracted from the actual vote.) Without spending churning the vote, the fit with par improves slightly, with the spending-neutral vote moving in the direction of Par. With spending effects neutralized, the open-seat vote tends to revert to the normal vote.

The clearest demonstration of the importance of spending for open seats is to show the hypothetical vote if one party spent virtually nothing. Figure 1-c shows the projected vote if each Republican candidate spent no more than the nominal cushion of $5000. Figure 1-d shows the projected vote if each Democratic candidate spent only $5000. With each nonspending scenario, the nonspending party would perform worse than Par in all but a handful of districts. Most nonspenders would lose. Clearly, spending money is required to become a competitive candidate for an open seat.

2 OLS Analysis of Spending for Incumbent Seats

When the incumbent is one of the candidates, the two spending variables must be challenger spending and incumbent spending rather than simply Republican spending and Democratic spending. For reasons mentioned, OLS estimates for incumbent and challenger spending are seriously biased. Still, we present a brief demonstration of OLS

results using Par as a control. The usual setup for modeling the vote in incumbent races is to model the challenger's vote as the dependent variable (Jacobson, 1978.1980; Green and Krasno, 1988, 1990; Bartels, 1992). We chose to model the incumbent's vote. Obviously this makes no substantive difference, being a matter of relative convenience. We model the incumbent vote because when an incumbent runs, the vote is predictable from the incumbent's history as a vote-getter. The challenger is almost always a fresh draw with no visible track record.

As for open seats, we can model the incumbent-contested vote by pooling district data across each of two decades. Par is now conceptualized as Par for the incumbent party rather than for the Democrats. The incumbent's recent vote appeal is measured as the incumbent's "Net Vote" in the previous election. The Net vote is simply the incumbent's vote percent minus Par for the particular election.The lagged Net Vote (LNV) represents the net attractiveness of the two major party candidates in the prior election, relative to the normal vote and election trend. Incumbents' Net Vote almost always is positive, indicating that incumbents are better than average candidates. But the Net Vote also reflects the challenger's appeal as well. In roughly equal amounts, the lagged Net Vote (LNV) reflects both the ghost vote appeal of the failed prior challenger, usually replaced, and the incumbent's vote appeal, which is usually quite stable.[3]

Much of the unexplained variance in the current vote is the contribution of the new challenger. We estimate current challenger quality only crudely, using Jacobson's dichotomous measure, whether he or she held prior political office. Since we have no measure of prior office for challengers in 1990, the year 1990 is omitted from our incumbent race analysis. Another consideration for omitting 1990 is some modest evidence of an actual decline (not end) to the incumbency advantage in 1990, compared to earlier years. Results for 1990 may be less clearly generalizable.

We also control for time trends of incumbent success by inclusion of a simple linear time trend in the incumbent share of the vote. While it is well known that incumbent's have enjoyed steadily larger average margins of victory, it is also known that they have spent steadily more as well, while average challenger spending levels have been nearly constant. Controlling for a time trend, independently of expenditure, allows us to at least partially separate out incumbency *spending* advantages from changes in other factors that might affect margin of victory.

Table 2 presents our OLS results. Six equations are presented: We analyze veteran incumbent races and freshman races separately. For each type of race, we present results separately by decade and also with the two decades-worth of data pooled together.

Notably, Table 2 shows some OLS coefficients for incumbent spending with the correct sign but none statistically significant. This is the typical pattern found. We obtain nearly significant incumbent-spending effect for freshman incumbents. Still, when the data are broken down even to the level of decade, results are spotty. For veteran incumbents, spending has the right sign in the 1970s but not the 1980s.

We measure a strong time trend in the margin of victory. On average, incumbents receive roughly $\frac{1}{2}$ of a percentage point more in each congressional election beginning in 1972, controlling for trends in other variables such as average spending levels. But these numbers should be interpreted with caution, since they are OLS estimates. As we will see later, these coefficients diminish substantially as we correct for problems of OLS (such as simultaneity bias).

The details of this instability are unimportant, however, because all OLS estimates are so clearly biased. Our task is to improve on the OLS estimates. Note also that even when Table 2 presents significant coefficients for incumbent spending, the asymmetry of estimated effects for incumbents and challengers remains.

3 2SLS Analysis of Spending for Incumbent Seats

Given our data for the 1970s and the 1980s, we can replicate Green and Krasno's two-stage least squares analysis on a much larger data set. Like Green and Krasno, we use the incumbent's lagged expenditures as the instrument for current incumbent spending. Table 3 presents these results. The first three columns include the same independent variables as in the OLS equations. Column 1 is for the 1970s, column 2 is for the 1980s, column 3 for the pooled 1970s-1980s data set.

These 2SLS estimates present a striking contrast to the OLS results. For the 2SLS analysis, the coefficients for incumbent spending approach those for challenger spending and are statistically significant. Remarkably, the 2SLS equations using lagged incumbent spending actually explains more variance in the incumbent vote than do the comparable OLS equation using current incumbent spending. It should be noted that the incumbent spending coefficients approach the challenger spending coefficients despite the handicap of an uneven playing field. While the IE coefficient is the presumably unbiased 2SLS estimate, the CE coefficient is still the biased OLS estimate that exaggerates the negative effect of challenger spending.

Still, the Krasno-Green specification has its own weaknesses. The basic problem is that there is simultaneity between *three* variables—vote, incumbent spending, challenger spending—not only two variables. Our basic point in this paper is that, because of this, what is needed is a *three-equation system* which links together these three endogenous variables. The 2SLS approach is better than nothing, but ignores the strategic interaction between challenger and incumbent spending.

There are many reasons why challenger spending should be an endogenous variable, some of which are quite subtle. For example, just as current incumbent spending is affected by the current campaign, so too the lagged incumbent spending is a function of the dynamics of the previous campaign. Abramowitz suggests that the instrument of lagged spending presents a subtle source of bias in favor of incumbent spending, due to challenger effects. His argument is that incumbent spending at time t-1 reflects the

strength of the t-1 challenge. For instance, a strong challenger at t-1 provokes incumbent spending while also suppressing the lagged vote for the incumbent. When the quality of the challenge reverts to its normal strength (as an expectation) at time t, the incumbent's vote also reverts to normal. The result is that incumbents would gain over their lagged vote when lagged spending is high, even if their spending has no effect.

This problem can be illustrated by the simple inclusion of two additional variables into the equation—whether the prior challenger held elected office and the prior challenger's logged spending. These two variables offer indirect indicators of the strength of the prior challenger's campaign. Note what happens to the 2SLS estimates of the incumbent spending coefficients when these two new variables enter the equation. The coefficients for incumbent spending decline dramatically both in terms of magnitude and statistical significance. The time trend, which was insignificant (but the right sign) before, is now significant, although smaller in magnitude than the OLS estimate. Meanwhile, as reflectors of lagged challenger quality, lagged challenger spending show positive significant coefficients. With the previous vote (as the lagged Net Vote) held constant, prior challenger strength means a higher current vote percent for the incumbent. These variations on Green and Krasno's 2SLS theme do not necessarily mean that incumbent spending is a weak electoral force. The problem may lie deep within the underlying statistical model. It may simply be that lagged incumbent spending is not a proper instrument for current spending. Moreover, it is likely the case that continued search for a simple answer in the form of new instrumental variables would be futile.

4 The Heat of the Campaign

As a further illustration of the incomplete specification of the vote- spending relationship, we introduce a variable which at least partially accounts for the jointly determined levels of incumbent and challenger spending. A well-known feature of the spending data is that incumbent and challenger spending tend to track each other. There are many plausible explanations for this. For example, as we will see later on, a simple game theoretic model of spending predicts that incumbent spending and challenger spending should be highly correlated, simply because (in game-theory jargon) their reaction functions are upward sloping: the closer the election is anticipated to be, then the more you should spend. A similar logic holds for your opponent, thereby inducing a correlation in spending patterns. The presence of unobserved variables indicating vulnerability of the incumbent points in the same direction. Challengers mount bigger campaigns when incumbents are weak and the chances of ousting the incumbent are relatively large. Incumbents spend to defend themselves from such attacks.

Thus, campaigns can be arrayed on a dimension corresponding to how heated they are, and closeness of the outcome should be significantly related to how hotly contested the race is. A natural measure for the heat of the campaign is the total amount spent by the two candidates. Will the heat of the campaign tend to help the incumbent, help the challenger, or have a neutral effect? We argue that for both statistical and substantive

reasons, we should be able to measure a clear effect of heat that favors the challenger. Statistically, this follows from the left-out variables relating to incumbent vulnerability. Since heated campaigns are likely to be correlated with (unobserved) incumbent vulnerability, omission of the "heat" variable will tend to bias the effect of incumbent spending downward and bias the effect of challenger spending upward. Second, even holding vulnerability constant, there are reasons to believe that challengers benefit and incumbents suffer from a spending race. Challengers need a big race to overcome the name-recognition problem and to get their message out. Even an incumbent's defensive spending may have some residual value to a relatively unknown challenger, for whom bad press may be better than no press at all. A high-visibility campaign might also be interpreted by some voters as a signal that "something must be wrong" with the incumbent.

As a rough cut at accounting for this myriad of effects, which to a large extent involve the joint determination of incumbent and challenger spending, we include a "heat" variable: log of total spending. The results are shown in Table 4. The variable is significant, with the expected sign: hotter races hurt incumbents. But more important, this heat variable changes the coefficients on incumbent spending and challenger spending in rather dramatic ways, and leads to estimates that would seem to belie any paradoxical relationship between incumbent spending and the vote.

There is further evidence that this is not just an artifact. The result is actually quite robust to specification. For example, recall that the Green-Krasno estimates were obtained by arbitrarily adding $5000 of spending for both candidates. Without this ad hoc correction, the estimates for incumbent spending are very weak, almost like the OLS estimates. However, if one controls for the heat of the campaign, then the ad hoc correction is not needed to get the large incumbent spending effect. In fact, if anything, correction with the Green-Krasno constant waters down both the incumbent spending effect and the "heat-of-the-campaign" effect. We report the results of the heat equations with and without the Green-Krasno correction in Table 4. That table also shows that regardless of whether the Green-Krasno adjustment is used, the inclusion of the total spending variable essentially nullifies any effect of the instrumental variable approach on the estimates. While the R-square does go up with the inclusion of the instrumental variable (a somewhat unusual phenomenon), the magnitude of the coefficient on incumbent spending actually goes down. What we have done above goes further than 2SLS in the direction of correcting for simultaneity problems, but fails to do it in the context of a carefully specified three equation model that explicitly links vote with the two spending variables. Could there be another statistical approach? Actually, we have ignored an important aspect of our data. We do have rich instruments for estimating the reverse effect—of the vote on spending. In the next section, we use estimates of the effects of the vote on spending as leverage for our relationship of interest—the effect of spending on the vote.

5 Estimation by the Uncorrelated Errors Assumption

The great frustration to estimating spending effects is the scarcity of plausible instruments for the spending variables. But this approach of using "exclusion restrictions" to identify a simultaneous system is not the only available alternative. A different method of indentification places restrictions on the covariances of the residuals (Hausman and Taylor, 1983).

In this section, we utilize a zero-covariance restriction for the disturbance terms or, simply, "uncorrelated errors." The zero covariance refers to the assumed lack of correlation across the residuals in the structural equations. This is permits identification of the 3-equation system.

This solution of identification via zero covariance among disturbance terms of endogenous variables is discussed in advanced treatments of the identification problem (e.g., Fisher, 1966, chapters 3, 4; Rothenberg, 1973, chapters 4-5) and gets mention in most econometric texts. (e.g., Goldberger, 1991: 361-2; Johnston, 1963: 248-9; Maddala, 1977: 226-8; Malinvaud, 1966: 528-38; See also Heise, 1975: 181-2 and Hanuchek and Jackson, 1977: 271-6. For a political science example, see Erikson, 1982.) Applied to our problem, the key assumptions are that the disturbance terms for incumbent spending and challenger spending are each uncorrelated with the disturbance term for the vote division—in other words that there are no unmeasured sources of spurious correlation between spending and the vote. The plausible assumption that spending is largely a function of the *anticipated* vote is turned from a research handicap to a source of analytical leverage. While every variable that affects the vote is a likely cause of spending levels, the effect on spending presumably is indirect via the vote. Meanwhile, unmeasured variables that might affect spending directly are not likely to affect the vote directly.

Figure 2 presents a simple schematic view or, "causal model" underlying our discussion. Certain exogenous variables—Par, the Incumbent's Lagged Net Vote, and whether the current challenger held elected office[4] are used to predict the incumbent's vote percent. Only indirectly, do these variables affect candidate spending. Meanwhile spending and the vote are reciprocally related. The stronger the incumbent's (anticipated) vote, the less the spending by either challenger or incumbent. Challenger spending hurts the incumbent vote, while incumbent spending helps. The figure also notes the possibility of additional sources of covariance between the two spending variables besides the (anticipated) vote. Incumbent and challenger spending could correlate, for instance, due to variation in the local media markets which affect the efficiency with which candidates can translates money into votes. But the model assumes that the incumbent's vote does not correlate with the two spending variables except via the two feedback process of votes and spending on each other.

The model shown in Figure 2 allows for the easy estimation of the effect of the vote on spending. The coefficients are (roughly) the ratios the exogenous variables' indirect

effects on spending to their direct effects on the vote. Note that these estimates do not include information regarding the correlation or covariance between spending and the vote. The spending-vote correlations represent some combination of the effect of anticipated vote on spending plus effects of spending on the vote plus a small portion due to the correlation of spending disturbance terms. The uncorrelated errors assumption allows us to work backward to estimate the spending-on-votes effects from the variables' correlations (or covariances) and the reverse vote-on-spending effects.

The full set of estimates for the model were obtained via maximum likelihood techniques, using the simultaneous equation program EQS. The results are shown in Table 5. Quite similar estimates are obtained for the 1970s, the 1980s, and the pooled sample.

The coefficients for spending effects present a reversal of the OLS results. For veteran races, incumbent spending affects the vote with a statistically significant coefficient of about 3.0; challenger spending affects the vote weakly with a small insignificant coefficient of about -0.5. For freshman races, the estimated effects are even more asymmetrical, with a coefficient that approaches double digits for incumbents and an insignificant positive coefficient (wrong sign) for challengers. Meanwhile, we see that the (anticipated) vote is a powerful influence on spending by incumbents (whether freshman or veterans) and, especially, by challengers.

Table 5 also informs us about the relationship between spending trends and margin of victory trends over the two-decade span studied here. We estimate no significant "time effect" on incumbent vote margins, but highly significant time trends in the incumbent spending equation. This suggests that the observed increases in incumbency advantage over the last two decades can be attributed almost entirely to higher levels of incumbent spending (n.b. challenger spending has stayed nearly constant). This is consistent with the 2SLS results (Table 3, column 3).

Since the models of Table 5 are overidentified (due to the multiplicity of vote predictors), the fit of the observed covariances to their predicted values provides a test of the overall fit of each model in Table 5. These tests are best understood in terms of the fit when covariances are standardized to correlations. For all the models of Table 5, the mean (absolute) residual correlation (predicted minus actual for the unconstrained correlations only) was a mere .02. While a χ^2 test reveals that even these low values show up as statistically significant for the veteran equations (difficult to avoid with the large N's), the freshman equations are all non-significant. In general, the low residual correlations mean that the total effects of the vote predictors (Par, LNV, Prior Office, and time) correlate with the spending variables in the proportions expected, given their correlations with the incumbent vote.

Why does the uncorrelated errors solution give such asymmetric coefficients for the two spending variables? To provide some intuition, consider a simplified presentation where the exogenous variables are collapsed into a single variable, X–the predicted vote based on the three instruments (par, netlag, prior office), excluding the time trend. Now, with only four variables, we examine the connection between the observed correlations

and the estimated paths. For the full sample of veteran incumbent races, Figure 3a shows the correlations among X, IV, IE, and CE. Figure 3b shows the resultant standardized "path coefficients."[5]

In standardized form, the estimated effect of the vote on a the two spending variables are ratios of correlations:

$$\hat{p}_{IE,IV} = \frac{r_{IE,X}}{r_{IV,X}} = -.529\ ; \qquad \hat{p}_{CE,IV} = \frac{r_{CE,X}}{r_{IV,X}} = -.779$$

With the paths from the vote to spending so easily estimated, the estimated paths of interest from the spending to the vote are, as a rough approximation, the difference between the path coefficient and the correlation coefficient. The $IV - IE$ correlation is far less negative ($-.365$) than if the sole source were the estimated $-.528$ path from IV to IE. The ML solution accounts for this difference with a positive positive effect (standardized path $= +.205$) of IE on IV. Meanwhile, the $IV - CE$ correlation of $-.750$ is about the size expected from the estimated $-.779$ path from IV to CE alone, leaving little room for a reverse CE on IV effect.

Note how we obtain a positive estimated effect of incumbent spending on the incumbent vote and a much milder negative effect of challenger spending on the vote. The residual $IE - IV$ correlation is positive once the 2SLS estimate of IV on IE is taken into account. The obvious inference is that a positive effect of IE on IV is responsible, although as with all correlation or covariance evidence, spuriousness (correlated errors) is also a possibility. The residual $CE - IV$ correlation is about the magnitude expected from the 2SLS estimate of the IV on CE effect. This suggests only a minor effect of CE on IV, or a major effect masked by significant suppressor variables (correlated errors).

Possibly the main lesson from this exercise is the demonstration that the statistically dominant effects are from the (anticipated) vote to spending. The substantively important effects of spending on the vote are almost drowned by the stronger causal currents from anticipated vote to spending. Assuming we now have the correct model, we can account for the disparity between the uncorrelated errors and OLS findings as due a massive pair of voting on spending effects that only the uncorrelated errors solution can adequately measure.

These new results depart from the OLS estimates to a degree that is unsettling. Our new estimates say that incumbent spending matters but challenger spending does not. Is this result any more believable than the opposite OLS result that challenger spending matters but incumbent spending does not? While we may have shifted the burden of statistical proof in favor of incumbent spending, the validity of our new estimates depend on the accuracy of the identifying assumptions. It is imperative to critically evaluate the plausibility of the uncorrelated errors assumption that identified the full set of equations of the simultaneous equations model; and we must also examine the features of the simultaneous equations model itself.

First, is the uncorrelated errors assumption plausible? It might appear that our reach for the uncorrelated errors solution is nothing more than a desperate lunge for any statistical assumption that gives answers without regard to plausibility. In fact, the uncorrelated errors assumption is very plausible theory in the context of our substantive discussion. Consider that the assumption would be violated if some unmeasured variable(s) were causing both incumbent spending and pro-incumbent voting and/or both challenger spending and pro-incumbent voting independent of the effects of votes and spending on each other. A positive $IE - IV$ residual correlation would exaggerate the IE on IV effect; a positive $CE - IV$ residual correlation would mute the CE-on-IV effect. Spending certainly responds to omitted district-level variables but are such variables also related to voting for the incumbent. Omitted spending variables might be indirectly related to the partisan vote via some connection with district income, education, or urbanism. But any such connections would be expected to work in one direction for Democratic-held districts and the opposite for Republican-held districts. It seems unlikely that variables that contribute to candidate spending and the vote for incumbents of one particular party would also contribute substantially to the vote of incumbents of the opposite political party. To the extent such variables exist, their effects would probably be slight.

What then about the simultaneity assumptions themselves? Just as one can argue that OLS analysis of the vote equation ignores the candidates' responsiveness to the unmeasured causes of the vote, one can also argue that the uncorrelated errors solution gives candidates too much credit for anticipating perturbations of the vote arising from variables that the analyst does not measure. The question is: how much does candidate spending respond to intangible vote sources that we analysts are unable to incorporate in our models? Suppose that the individual candidate's perception of the vote is:

$$\hat{IV}_C = IV + u_C \tag{1}$$

where u_C represents a random disturbance term. This contrasts with the analyst's equation:

$$\hat{IV}_A = IV + u_A \tag{2}$$

where $\hat{IV}_A$ represents the vote foreseeable from measurable variables such as Par (partisanship plus national trend), the Lagged Net Vote (prior deviation from Par), whether the challenger held previous office, plus incumbent spending and challenger spending, and u_A represents the unobserved component, mainly the overall quality of the challenger's campaign plus any deviation of the incumbent's vote appeal from that inferable from the incumbent's recent track record. Transposed,

$$IV = \hat{IV}_A - u_A \tag{3}$$

Suppose candidates see u_A less clearly than they do the more visible $\hat{IV}_A$:

$$\hat{IV}_C = \hat{IV}_A - b_C u_A + u_C$$

where b_C lies between 0 and 1. If b_C is zero, then the OLS estimate of the spending effect on the vote is unbiased as there is no simultaneity problem. If b_C is 1.0, then the uncorrelated error estimate of the spending effect on the vote is unbiased. For values of b_C between these extremes, the spending coefficients will be between the extremes of the OLS and uncorrelated errors estimates.

We cannot directly estimate the coefficient b_C (or u_C, which is of peripheral interest). But for any assumed value of b_C we can estimate the two coefficients representing spending effects on the vote. The various projections are shown in Figure 4. Of particular interest is the value of b_C that generates equal coefficients for incumbent spending and challenger spending. This point[6] is where b_C is .64. In other words, if candidates can anticipate the analyst's error term with at least sixty-four percent of the accuracy that they anticipate tangible sources, then incumbent spending has just as much effect on the vote as does spending by challengers. With b_C set to 0.64, the vote equation is:

IV =	1.65 (IE)	-1.65 (CE)	+.88 (Par)	+.55 (LNV)	-3.59 (PO)	+0.08 (Year)
	(7.65)	(7.65)	(32.38)	(24.17)	(-9.28)	(2.06)

The mean absolute residual correlation for this model supports its plausibility.

One could also allow b_C to vary by type of candidate. The most plausible variation is a higher b_C for incumbents than challengers, since incumbents are arguably better equipped to sense intangible sources of the vote. The statistical implications are as follows: For incumbents, the higher the assumed b_C, the stronger the estimated effect of incumbent spending; but for challengers, the higher the assumed b_C, the milder the estimated effect of challenger spending. Thus, assuming a b_C gap augments both the IE and CE coefficients. For instance, in the extreme where b_C equals 1.00 for incumbent but 0.00 for their challengers, both (veteran) coefficients are strong: 3.92 for IC and -5.17 for CE.

One can go a step further and find the b_C values that deliver IE and CE coefficients that match the coefficients for open seat candidate spending. In Table 1, the estimated effects of open seat candidate spending cluster in the range of 4.0. Estimated (veteran) coefficients of 4.0 and -4.0 for IE and CE can be obtained by assuming b_C values of 1.00 for IE and 0.23 for CE. We might be tempted to accept these estimates because of their plausibility, but unfortunately they provide a poor fit with the data, with a mean (absolute value) residual correlation of .09. In general, the greater the b_C gap we hypothesize, the worse the fit—suggesting that we are imposing an incorrect model.

Obviously we have not exhausted the directions for statistical investigation. For instance, we can vary the assumed covariance of the disturbance term. As a sensitivity

analysis, we explored some alternative identifying restrictions besides the standard zero covariance restriction. The concern is the possibility of a delicate knife-edge assumption, with even slight deviations from zero covariance tilting estimates in new directions. Happily, this fear turned out to be unfounded. We moved the IE-IV and CE-IV residual correlations as far from zero as + or −.20, while imposing the standard assumption that $b_C = 1.00$. While the magnitudes of the coefficients changed slightly (as would be expected), we consistently found that incumbent spending effects were *greater* in magnitude than challenger spending effects.

As a further robustness check, we can exclude some variables from the vote equations or assume that certain predictors to the vote equation affect spending directly. For example, there is a case for deleting Lagged Net Vote from the analysis entirely, on the grounds that it incorporates spending effects from the previous election.[7] Doing so raises both spending effects slightly.

To summarize this section, identification of the set of simultaneous equations with the help of the uncorrelated errors method leads to the inference that incumbent spending matters a lot, as much if not more than challenger spending. The analysis also suggests very powerful effects of anticipated vote on spending decisions. With this in mind, we next examine in more detail how the anticipated vote influences spending decisions.

6 Using Game Theory to Estimate Spending Equations

While the uncorrelated errors model goes a long way toward sorting out the simultaneity problem, the details of the strategic interaction between the two competing candidates is left unmodelled. We do this below, by modifying some assumptions of that model regarding how the candidates form their expectations about the probability of winning as a function of how much they and their opponent spends.

The basic game theory model is a very simple 2-person spending game between an incumbent (I) and a challenger (C). Both candidates find winning valuable and wish to maximize the probability of winning. The probability of winning is determined by the usual suspects: district characteristics, short-term forces, candidate characteristics, campaign spending, and chance. Treating the first three categories of variables as exogenously fixed, we summarize the effects of campaign spending and chance by a simple function, P, which denotes the incumbent's probability of winning as a function of incumbent expenditures and challenger expenditures.

Raising campaign resources is costly to the candidates. A similar idea is explored by Ansolabehere (1990). Promises must be made, issue positions must be compromised, and (perhaps worst of all) seemingly endless, boring, fundraisers must be attended. This formally represented by cost functions for the incumbent and the challenger. These

two functions might be different, reflecting cost advantages, scale economies, and other differences in fundraising costs that might exists between incumbents and challengers.

The formal structure is a game between I and C, which we analyze in the Normal form. The game consists of three parts, the set of players, the strategy sets for each player, and the payoff functions.

$\mathcal{I} = \{1, 2\}$ the set of players, (Incumbent = 1, Challenger = 2)

$S_1 = S_2 = \Re^+$ the strategy sets (Non-negative campaign expenditures)

$$\left.\begin{array}{l} U_I : S_1 \times S_2 \rightarrow \Re \\ U_C : S_1 \times S_2 \rightarrow \Re \end{array}\right\} \text{Payoff functions}$$

We assume that the payoff functions for i depend on the value of winning, V_i, the probability of the incumbent winning as a function of how much each candidate spends, $P(S_1, S_2)$, and the cost of candidate i of spending S_i on the campaign.

$$\begin{aligned} U_1(S_1, S_2) &= V_1 P(S_1, S_2) - C_1(S_1) \\ U_2(S_1, S_2) &= V_2(1 - P(S_1, S_2)) - C_2(S_2) \end{aligned}$$

We also assume on P and C are twice continuously differentiable, $C_i' > 0$, $C_i'' > 0$, $\lim_{S_i \rightarrow \infty} C_i''(S_i) = \infty$, $\frac{\partial P}{\partial S_1} > 0$, $\frac{\partial P}{\partial S_2} < 0$, $V_1 \frac{\partial^2 P}{\partial S_1^2} - C_1'' < 0$, $-V_2 \frac{\partial^2 P}{\partial S_2^2} - C_1'' < 0$. These assumptions guarantee that the spending level ("best response") of a candidate to the opponent's campaign spending level is always unique.

An equilibrium is a pair of spending levels, $S^* = (S_1^*, S_2^*)$ such that:

$$\begin{aligned} S_1^* &\in \arg\max_{S_1 \geq 0} U_1(S_1, S_2^*) \\ S_2^* &\in \arg\max_{S_2 \geq 0} U_2(S_1^*, S_2) \end{aligned}$$

It is easy to show that a Nash equilibrium is characterized by the following.
For the incumbent ($i = 1$):

(a) $S_1^* = 0$ if $V_1 \frac{\partial P}{\partial S_1}(0, S_2^*) - C_1'(0) \leq 0$

(b) $S_1^* > 0$ is the unique solution to $V_1 \frac{\partial P}{\partial S_1}(S_1^*, S_2^*) - C_1'(S_1^*) = 0$

if $V_1 \frac{\partial P}{\partial S_1}(0, S_2^*) - C_1'(0) > 0$.

Similarly for the challenger:

(a) $S_2^* = 0$ if $V_2 \frac{\partial P}{\partial S_2}(S_1^*, 0) - C_1'(0) \leq 0$

(b) $S_2^* > 0$ is the unique solution to $V_2 \frac{\partial P}{\partial S_2}(S_1^*, S_2^*) - C_2'(S_2^*) = 0$

if $-V_1 \frac{\partial P}{\partial S_2}(S_1^*, 0) - C_2'(0) > 0$.

In other words, there are two possible kinds of equilibria, the first where at least one candidate spends nothing and the second where both candidates spend strictly positive amounts. In the latter kind of equilibrium, each candidate spends up to the point at which the expected value of an extra dollar spent on the campaign $\left(\pm V_i \frac{\partial P}{\partial S_i}\right)$ equals the marginal cost of raising that extra dollar (C_i').

We obtain a parametric, estimable form of the above equations by assuming that fundraising costs are quadratic in the log of spending, for all spending above some level of "free spending." That is, on average, candidates come into the campaign with some amount of money-in-hand (such as an incumbent's war chest or party money for the challenger), so, the cost functions look like:

$$\begin{aligned} C_1(IE) &= \frac{1}{2} K_I (IE - F_I)^2 \\ C_2(CE) &= \frac{1}{2} K_C (CE - F_C)^2 \end{aligned}$$

where S_1 is rewritten as IE and S_2 is rewritten as CE.

Differences in the free-money parameters (F_I and F_C) and the cost parameters (K_I and K_C) reflect differences between incumbents and challengers in their fundraising costs. Given this specification, the marginal cost function on the left hand side of equations 4 and 5 become:

$$\begin{aligned} MC_I(IE) &= K_I (IE - F_I) \\ MC_C(CE) &= K_C (CE - F_C) \end{aligned}$$

The specification of the $P(\cdot)$ function provides the linkage between the vote equation and the two spending equations. The vote equation is a reduced form specification of the *technological* relationship between spending and votes, controlling for whatever exogenous variables might be relevant. As is apparent from the earlier sections, there are a variety of ways to obtain a reduced form specification. Here, we use the basic Green-Krasno 2SLS model of the vote equation (Table 3, Column 3), excluding the heat-of--the-campaign variable and lagged challenger variables. (Similar estimates are obtained under the other model specifications.) Predicted values from the equation provide an instrumental variable measure of the candidates' anticipated vote. The assumption is

that candidates' estimated $\hat{IE}_C$ as actual IE plus a disturbance u_C. We use our estimate $\hat{IE}_A$ as an instrument for unobserved $\hat{IE}_C$. The assumption that the candidates believe the actual vote to be their predicted vote $\hat{IE}$ plus a Normally distributed error term gives us a parametric estimate of the probability of winning as a function of spending. Formally, we can write this estimated probability of winning function in the following way:

$$P = \Phi\left(\frac{\hat{IV} - 50}{\sigma}\right)$$

Where Φ is the unit Normal CDF and $\hat{IV}$ is a function of spending and exogenous variables. Note that this estimated probability of winning function has an additional parameter, σ, which corresponds to the candidates' beliefs about the error of the anticipated vote, $\hat{IV}$. In the analysis and the estimation below, we assume that σ is the same for all candidates, and select value of σ that provides the best fit of the spending equations.

This specification of the probability of winning function, yields a closed form solution to the left hand side of equations 4 and 5 (the same for both candidates) by partially differentiating this probability of winning function by IE and CE, respectively. This gives us:

$$K_I(IE - F_I) = \frac{\beta_I}{\sqrt{2\Pi}\sigma}\phi\left(\frac{\hat{IV}-50}{\sigma}\right) \qquad (4')$$

$$K_C(IE - F_C) = \frac{-\beta_C}{\sqrt{2\Pi}\sigma}\phi\left(\frac{\hat{IV}-50}{\sigma}\right) \qquad (5')$$

where β_I and β_C are the coefficients on incumbent and challenger spending, respectively, from the vote equation. Rearranging terms gives two equations, which are linear in the estimated Normal density evaluated at $\hat{IV}-50$ (a variable we call DENS), plus a constant term, and nonlinear in σ:

$$IE = F_I + \frac{\beta_I}{\sqrt{2\pi}\sigma K_I}\Phi\left(\frac{\hat{IV}-50}{\sigma}\right) \qquad (4'')$$

$$CE = F_C - \frac{\beta_C}{\sqrt{2\pi}\sigma K_C}\Phi\left(\frac{\hat{IV}-50}{\sigma}\right) \qquad (5'')$$

These two equations indicate that, for a given value of σ, we can recover estimates of the cost parameters by running a regression between DENS and IE and (separately) between DENS and CE. From these, together with the estimates of the direct effect of spending on votes obtained from the reduced form vote equation, we can then back out estimates

the cost parameters, K_I and K_C, and the free-money parameters, F_I and F_C. We also include in these regressions a time trend for both the constant term and the coefficient on DENS, denoted t and $t*$ DENS, respectively. We do this for a grid of values of σ, and obtain an estimate of σ as the value that provides the best fitting regressions. The results of the two-step estimation procedure are reported in Table 6.

There are at least seven notable features of these estimates. First, incumbents come in with much more free money than challengers do. Second, the challenger spending equation fits better than the incumbent's equation (R^2 of .81 compared to .40). Third, the best-fitting value of σ is 13, which is higher than the standard error of the regression which produced the values of predicted vote. Fourth, when spending matters the most ($I\hat{V} = 50$), predicted spending by challengers and incumbents are nearly equal. Fifth, the incumbents' quadratic cost parameter is estimated to be significantly higher than the challengers' cost parameter (.028 vs. .016). These cost parameters are backed out from the estimates of the DENS coefficients, together with the estimates of β_I and β_C from Table 3, column 3. Sixth, there is no measurable time trend in challenger free money, but there is a highly significant time trend in the coefficient on DENS. This may reflect lower marginal costs of raising money for challenger, and also bears out the observation by Jacobson that challengers, considered as a group, are much more careful targeting big spending campaigns where they are most likely to yield a victory. The final observation about Table 6 is that the time trend for incumbents is different from that for the challengers. There is a massive shift in incumbent *free money*, representing a more than fourfold increase from $31,000 in 1974 to $127,000 in 1988, perhaps reflecting larger cash balances carried over across campaigns. But there is no change in the responsiveness of incumbents to the anticipated closeness of the race since the coefficient on $t*$DENS is not significantly different from 0.

These findings are largely consistent with conventional wisdom, with the possible exception of the fifth one. On the surface of it, that finding suggests that marginal cost of raising money increases much more steeply for incumbents than for challengers. One possible explanation for this might be that incumbents, by virtue of already having a lot of money to start with, have pretty much exhausted their cheap sources of campaign financing, while many challengers, starting from nothing, initially have relatively easy access to "cheap money" from disgruntled contributors that are outside the incumbent's core constituency. However this story is not very believable. More likely is that our current specification of the spending equations, simple as it is, is still missing some key determinants of incumbent spending.

A scatter-plot of spending and predicted vote sheds some light on what might be missing from the incumbent spending equation. In figure 5a, one can see the very close fit of challenger spending to the DENS transformation of predicted vote. Figure 5b, the corresponding graph using incumbent spending, looks much different. Particularly striking is the inelasticity of incumbent spending with respect to the anticipated closeness of the election. There are several directions to look for an explanation for this. This may reflect the fact that many incumbents spend heavily even in comfortable reelection years,

possibly to scare off future challengers, and possibly because of overstuffed war chests. It may also reflect heavy spending in response to a strong challenge in the primaries, a phenomenon that presumably occurs more often in "safe" districts. Another possibility is that the cost/payoff functions are not specified correctly. In particular, costs may decrease (and the value of winning increase) in the probability of victory. Contributors prefer to give money to winners; likely winners have a long "life expectancy," so winning is more valuable for them. In any event, all this points to the need to look at the dynamic strategic incentives of incumbents much more carefully (as, for example in Goldenberg, et al., 1986), and to look at more elaborate specifications of the cost/payoff functions of the candidates, something we plan to take up in future research.

7 Strategic Interactions and Nonlinearities

The results from the previous section indicates that for strategic reasons the effect of (anticipated) vote on spending is nonlinear. This is reflected in the shape of the scatter plots in figure 5. In both marginal and (very) safe districts, the relationship between anticipated vote and spending is small (the slope is close to 0). In intermediate districts, we find spending is most responsive to anticipated vote, for both incumbents and challengers. As the marginal impact of the vote on logged spending varies, so does the bias of the OLS estimate of the reverse effect of spending on the vote. Where the vote margin has the strongest effect on spending as an endogenous variable, the greater should be the bias in the OLS estimates of the spending variables. The worst OLS estimates of spending effects should be for intermediate districts. The least amount of bias should show up where the vote is competitive or very safe.[8]

To test this hypothesis, we measured the marginality-safety of the expected vote margin from an OLS regression of the vote for veteran incumbents on the usual exogenous variables (excluding spending): Par, the Lagged Net Vote, and whether the challenger had served in prior office. Using this index, we divided the expected vote for the incumbent at broad intervals, with cut points of 52%, 57%, 62%, 67%, 72%, 77%, 82%, 87%, and 92%. Within each interval, we ran a separate OLS regression, predicting vote as a function of spending only. The results are shown in Table 7. For very competitive districts ($< 52\%$) the coefficient estimates on the spending variables are almost indistinguishable from the estimates from 2SLS. As we move into less competitive districts, there is a monotonic departure from the 2SLS estimates. Incumbent spending seems to be less important. This lends further support that incumbent spending matters, this time for a select group of competitive districts using conventional OLS estimates. Of course, it is these marginal districts where the effect of spending (or policies to limit spending) is decisive on outcomes.

8 Spending and Incumbency

At this writing, Congress is considering campaign spending reform that would in some fashion reduce the overall level of campaign spending while increasing the equity of incumbent and challenger spending levels. One goal that underlines this reform effort is the reduction of incumbents' electoral advantage. In this section, we briefly address how our research may contribute to evaluating the consequences of spending reform.

Whether reform would actually help to level the playing field of incumbent vs. challenger competition depends on the relative efficiency with which incumbents and challengers win votes from spending dollars. If, as political science orthodoxy has it, only spending by challengers matters very much, then the incumbents' electoral advantage comes from other sources. If only challengers gain much from spending, then incumbents must have an even larger advantage before spending is taken into account. If so, general limits on spending would actually hurt challengers more than incumbents.

But suppose that incumbent spending and challenger spending are at parity in terms of their effects on the vote. Or suppose that incumbent spending matters even more than challenger spending. At least the former and quite possibly the latter seem likely from our analysis. What are the implications for understanding the incumbents' electoral advantage and for possible spending reform?

Suppose equal effects of incumbent and challenger spending. With equal effectiveness for incumbent and challenger spending, the edge goes to the candidate who spends the most. In most instances, this is the incumbent rather than the challenger. On average, incumbents spend about one logged unit of thousand dollars more than their challengers. From our estimates, this spending gap could account for about two percentage points of the vote out of a net incumbency advantage of about 7 points.[9] However, this spending gap is concentrated mainly in safe seats where it goes largely wasted. In races that are otherwise competitive, challengers already approximate the incumbent's level of spending. Thus, any reform that creates parity in incumbent and challenger spending would affect wins and losses mainly by augmenting the slim chances of likely losers.

But suppose a larger effect for incumbent than challenger spending.[10] Incumbents would gain both from spending more and spending more effectively. Assuming the estimates of Table 5 are correct, the spending advantage by incumbents would fully account for the incumbency advantage. [Subtract out all effects of spending and incumbents would on average perform little better than Par, and no better than new (pre-incumbent) winners do compared to Par.]

Next, consider the implications of reform if incumbent spending is more effective than challenger spending.[11] With less spending making incumbents less visible, their vote would revert toward a party line vote. Their fate would be determined more by the factors beyond their control that comprise our Par measure—district partisanship plus short-term forces. Severe spending limits could induce the defeat of popular incumbents who currently depend on heavy spending to overcome adverse district partisanship. Chal-

lenger victories, while more frequent, would not reflect the triumph of the challengers' "personal vote" so much as short-run partisan forces working against marginal incumbents.

While this paper has argued that incumbent spending matters at least as much as challenger spending, its evidence does not allow a confident statement regarding whether incumbent spending matters even more than challenger spending. The precise answer of the relative effects of incumbent and challenger spending is clearly important for understanding why incumbents generally win and also for its implication for reform of the campaign spending game.

9 Conclusions

The paper is an attempt to take a fresh look at the relationships between incumbent spending, challenger spending, and the vote by attempting to incorporate strategic elements into the statistical models. Our interest was motivated by widespread skepticism about and puzzling evidence concerning the impact of incumbent spending on the vote. The results here lead us to a tentative conclusion. We have presented a variety of evidence, using diverse statistical approaches, that point to significant and large effects of incumbent spending, rivalling and perhaps surpassing the effects of challenger spending. We have also looked at the reverse effect of anticipated vote on spending and found that a statistical model based on the spending game between incumbents and challengers accounts very well for challenger spending, and generates some new questions about the determinants of incumbent spending. It seems clear that further progress in this direction necessitates the use of models that can disentangle very severe simultaneity problems. It is equally clear that there are many thorny issues that need to be looked at more deeply, but in the same spirit as here, by incorporating into the statistical models strategic elements of congressional campaigning.

Table 1

Predicting the Open Seat Vote from District Presidential Voting, the Election Year, and Candidate Spending: Northern Districts 1972-1990

	(1)	(2)		(3)	(4)
Dependent Var. = % Democrat	1972-80			1982-90	
Log of Dem. Spending	3.15‡			4.16‡	
	(4.41)			(6.39)	
Log of Rep. Spending	-4.61‡			-4.89‡	
	(-6.98)			(-2.10)	
Log Dem.Spending minus Log Rep. Spend		3.97‡			4.50‡
		(6.90)			(8.28)
Dem. Pres. Vote, 1976	0.74‡	0.77‡			
	(11.00)	(12.00)			
Dem. Pres. Vote, 1988				0.49‡	0.50‡
				(6.19)	(6.53)
Election Year					
1974	8.20‡	8.34‡	1984	-3.89*	-4.22*
	(5.53)	(6.90)		(-1.96)	(-2.17)
1976	6.73‡	6.96‡	1986	-1.43	-2.00
	(4.35)	(4.47)		(-0.76)	(-1.22)
1978	3.87	2.40	1988	-2.28	-2.85
	(1.82)	(1.53)		(-1.12)	(-1.47)
1980	1.68	1.47	1990	-0.51	-1.33
	(1.61)	(1.61)		(-0.25)	(-0.73)
Constant	12.55†	10.04†		38.54‡	-28.95‡
	(3.21)	(3.10)		(3.53)	(-7.32)
Adjusted R squared	.791	.788		.783	.784
Standard err. of est.	5.94	5.99		6.00	5.99
Number of cases	(168)	(168)		(102)	(102)

Notes: Log of Dem. Spending, Log of Rep. Spending = Natural Log of Candidate Spending plus $5,000; all in constant (1978) dollars.

T-values in parentheses. * = Signif. at .05; †=.01, ‡ = .001.

"Boxed components of equations = "Par" for the decade.

Table 2

OLS Estimates of Spending Effects on the Incumbent's Vote Percentage

	Veterans			Freshmen		
	1974-80	1982-88	Pooled 70s,80s	1974-80	1982-88	Pooled 70s,80s
Log of Incumbent Spending	0.43 (1.16)	-0.41 (-1.22)	-0.06 (-0.23)	1.28 (1.26)	0.44 (1.33)	1.20 (1.42)
Log of Challenger Spending	-4.52‡ (-19.15)	-2.78‡ (-15.18)	-3.59‡ (-23.85)	-5.18‡ (-11.05)	-3.31‡ (-5.84)	-4.63‡ (-12.50)
Par	0.56‡ (17.93)	0.79‡ (17.74)	0.63‡ (26.10)	0.42‡ (4.93)	0.86‡ (5.89)	0.49‡ (6.67)
Lagged Net Vote	0.36‡ (11.00)	0.36‡ (12.46)	0.37‡ (16.72)	0.33‡ (4.12)	0.06 (0.48)	0.19† (3.08)
Challenger's Prior Office	-0.77 (-1.49)	-1.86‡ (-3.57)	-1.19‡ (-3.72)	-2.00* (-2.04)	-1.27 (-1.10)	-1.84* (-2.35)
Time	0.34† (3.46)	0.25* (2.82)	0.26‡ (7.11)	0.28 (1.27)	0.71† (2.67)	0.15 (1.43)
Intercept	71.05‡ (14.14)	51.65‡ (10.03)	63.90‡ (17.91)	80.56‡ (6.26)	40.59* (2.21)	72.40‡ (6.81)
Adjusted R^2	.754	.740	.744	.658	.741	.660
Stand. err. of Est.	5.43	4.55	5.11	5.91	4.90	5.79
Number of Cases	(705)	(612)	(1317)	(192)	(90)	(282)

Note: Log of Dem. Spending, Log of Rep. Spending = Natural Log of Candidate Spending plus $5,000; all in constant (1978) dollars.

T-values in parentheses. * = Signif. at .05; †=.01, ‡ = .001.

Table 3
2SLS Estimates of Spending Effects on Veteran Incumbents' Vote Percentage

	1974-80	1982-88	Pooled 70s,80s	1974-80	1982-88	Pooled 70s,80s
Log of Incumbent Spending	3.41‡ (5.75)	1.50‡ (3.84)	2.48‡ (6.02)	1.27* (2.35)	0.59 (1.22)	0.85* (2.30)
Log of Challenger Spending	-5.29‡ (-20.22)	-3.13‡ (-15.93)	-4.13‡ (-25.13)	-4.94‡ (-19.87)	-3.18‡ (-16.43)	-4.01‡ (-25.37)
Par	0.61‡ (19.26)	0.84‡ (18.45)	0.69‡ (27.54)	0.70‡ (20.71)	0.92‡ (19.16)	0.76‡ (29.28)
Lagged Net Vote	0.39‡ (12.12)	0.39‡ (13.16)	0.40‡ (18.09)	0.50‡ (14.32)	0.50‡ (13.85)	0.52‡ (20.41)
Challenger's Prior Office	-1.04* (-2.05)	-2.14‡ (-4.10)	-1.48‡ (-3.99)	-1.08* (-2.16)	-1.90‡ (-3.71)	-1.36‡ (-3.75)
Lagged Log of Chall. Spending				1.83‡ (7.79)	1.20‡ (5.67)	1.54‡ (9.68)
Lagged Chall. Prior Office				0.46 (0.94)	-0.08 (-0.17)	0.24 (0.70)
Time	0.11 (1.10)	0.13 (1.34)	0.06 (1.36)	0.27† (2.61)	-0.12 (-1.25)	0.15‡ (3.51)
Intercept	43.32‡ (6.61)	31.24‡ (4.60)	38.20‡ (8.03)	38.75‡ (5.80)	24.35‡ (3.47)	33.66‡ (9.68)
Adjusted R^2	.765	.743	.751	.778	.753	.764
Standard err. of Est.	5.32	4.53	5.05	5.17	4.37	4.92
Number of cases	(702)	(612)	(1314)	(702)	(612)	(1314)

Note: Log of Dem. Spending, Log of Rep. Spending = Natural Log of Candidate Spending plus $5,000; all in constant (1978) dollars.

T-values in parentheses. * = Signif. at .05; †=.01, ‡ = .001.

Table 4
Effects of Total Spending

	Green-Krasno adjustment (+$5,000)				No Adjustment (+$1)			
	OLS		2SLS		OLS		2SLS	
Log of Incumbent Spending	-0.06 (-0.23)	2.24 (2.61)	2.48 (6.02)	4.08 (8.21)	-1.03 (-14.01)	2.60 (7.06)	1.27 (3.13)	4.14 (9.85)
Log of Challenger Spending	-3.59 (-23.85)	-2.86 (-9.69)	-4.13 (-25.13)	-3.61 (-19.34)	-1.03 (-4.75)	-0.43 (-7.20)	-0.88 (-15.08)	-0.62 (-10.93)
Par	0.63 (26.10)	0.63 (26.07)	0.69 (27.54)	0.68 (27.76)	0.73 (27.02)	0.61 (25.56)	0.81 (27.43)	0.76 (27.68)
Lagged Net Vote	0.37 (16.72)	0.37 (16.74)	0.40 (18.09)	0.40 (18.26)	0.47 (19.36)	0.41 (17.43)	0.52 (20.32)	0.48 (20.00)
Challenger's Prior Office	-1.19 (-3.72)	-1.19 (-3.22)	-1.48 (-3.99)	-1.48 (-4.03)	-2.47 (-5.98)	-1.71 (-4.49)	-3.03 (-7.17)	-2.49 (-6.34)
Time	0.26 (7.11)	0.27 (7.29)	0.06 (0.36)	0.07 (1.54)	0.27 (6.62)	0.36 9.33)	0.05 (0.99)	0.36 (7.71)
Intercept	63.90 (17.91)	65.71 (18.18)	38.20‡ (8.03)	39.95 (8.38)	39.28 (3.30)	68.89 (17.85)	10.23 (1.88)	31.49 (6.04)
Log Total Spending		-3.01 (-2.86)		-2.13 (-5.62)		-5.96 (-12.95)		-4.52 (-15.06)
Adjusted R^2	.744	.746	.751	.757	.667	.713	.673	.721
SEE	5.11	5.10	5.05	4.99	5.75	5.41	5.79	5.34
N	1317	1317	1314	1314	1317	1317	1314	1314

Note: T-values in parenthesis. Veteran incumbent races only.

Table 5
Uncorrelated Error Estimates of Spending Equations

Veteran Incumbents, 1970s:

IE = -.04*IV + .10*T + e; S.E.E. = .62
(-15.77) (9.11)

CE = -.10*IV + .06*T + e; S.E.E. = .76
(-29.57) (4.30)

IV= 3.56*IE + 12*CE + 1.04*Par + .75*LNV -3.97*PO -.17*T + e; S.E.E = 7.62
(5.25) (.23) (17.21) (14.08) (-5.44) (-1.12)
$\chi^2 = 17.48$, d.f. = 4, $p = .002$, $|\overline{r - \hat{r}}| = .02$

Veteran Incumbents, 1980s:

IE = -.05*IV + .08*T + e; S.E.E. = .58
(-13.28) (6.94)

CE = -.11*IV + .02*T + e; S.E.E. = .74
(-20.39) (1.31)

IV= 2.17*IE -.37*CE + 1.10*Par + .58*LNV -5.00*PO + .06*T + e; S.E.E. = 5.65
(3.92) (-1.14) (16.95) (14.69) (-7.82) (.48)
$\chi^2 = 30.26$, d.f. = 4, $p < .001$, $|\overline{r - \hat{r}}| = .02$

Veteran Incumbents, Pooled 1970s, 1980s:

IE = -.04*IV + .09*T + e; S.E.E. = .60
(-20.86) (25.87)

CE = -.10*IV + .03 + e; S.E.E. = .83
(-34.17) (5.93)

IV = 2.98*IE -.16*CE + 1.01*Par + .68*LNV -4.41*PO + -.05*T + e; S.E.E. = 6.57
(6.68) (-.56) (24.83) (20.50) (-8.97) (-.81)
$\chi^2 = 45.74$, d.f. = 4, $p < .001$, $|\overline{r - \hat{r}}| = .02$

Freshman Incumbents, 1970s:

IE = -.04*IV + 0.09*T + e; S.E.E. = .49
(-6.34) (4.62)

CE = -.10*IV + -0.00*T e; S.E.E. = .78
(-10.25) (-0.06)

IV = 7.73*IE -0.70*CE + .98*Par + 0.55*LNV -4.63*PO + .30*T + e; S.E.E = 8.05
(3.05) (-0.54) (6.02) (4.06) (-3.05) (.85)
$\chi^2 = 3.95$, d.f. = 4, $p = .41$, $|\overline{r - \hat{r}}| = .01$

Freshman Incumbents, 1980s:

IE = -.05*IV + 0.14*T e; S.E.E. = .49
(-7.24) (5.66)

CE = -.14*IV + .10*T e; S.E.E. = .90
(-10.85) (2.38)

IV = 7.81*IE + .62*CE + 1.01*Par + .59*LNV -3.37*PO + .14*T + e; S.E.E = 7.72
(2.71) (.46) (5.24) (3.85) (-1.77) (.31)
$\chi^2 = 8.99$, d.f. = 4, $p = .06$, $|\overline{r - \hat{r}}| = .03$

Freshman Incumbents, Pooled 1970s, 1980s:

IE = -.04*IV + .09*T + e; S.E.E. = .50
(-9.68) (12.30)

CE = -.11*IV + .03*T + e; S.E.E. = .84
(-14.97) (2.84)

IV = 9.21*IE + .29*CE + 1.29*Par + .65*LNV -4.76*PO + -.58*T e; S.E.E = 9.49
(4.11) (.20) (7.24) (5.48) (-3.49) (-2.58)
$\chi^2 = 3.06$, d.f. = 4, $p = .55$, $|\overline{r - \hat{r}}| = .01$

Table 6

Cost Estimates from Spending Equations

	Challengers	Incumbents
Constant	8.50 (157.6)	10.48 (180.2)
Dens	7.97 (35.10)	2.75 (11.29)
T	-.01 (.97)	.18 (13.91)
$T*$ Dens	.51 (9.16)	-.01 (.21)
Adjusted R^2	.81	.40
Free Money 1974	0	31,000
Free Money 1988	0	127,000
Quadratic Cost Coefficent	.016	.028
N	1314	1314

Note: T-values in parentheses. Free money estimates correspond to F_C and F_I. The quadratic cost coefficents correspond to K_C and K_I. The dependent variables are log of challenger spending and log of incumbent spending (using the $5000 correction).

Table 7

OLS Estimates of Spending Effects for Pooled Veteran Sample, by Predicted Incumbent Vote Margin

	<52	52-57	57-62	62-67	68-72	72-77	77-82	82-87	87-92
Log of Incumbent Spending	4.82† (2.88)	2.32† (2.77)	1.71† (2.89)	0.95* (1.97)	-0.69 (-1.72)	0.74 (1.57)	-0.80 (-1.01)	-0.03 (-0.03)	1.53 (1.51)
Log of Challenger Spending	-3.99† (-3.11)	-4.04‡ (-6.86)	-5.03‡ (-12.44)	-4.14‡ (-13.67)	-3.34‡ (-12.41)	-3.73‡ (-9.21)	-1.84* (-2.39)	-2.82 (-1.58)	-0.33 (-5.2)
Adjusted R^2	.250	.282	.456	.388	.353	.314	.092	.014	.022
Stand. Err. of Est.	4.18	5.11	5.26	5.49	5.16	4.66	4.61	3.76	3.15
N	32	120	210	331	329	185	82	87	92

Note: Log of Dem. Spending, Log of Rep. Spending = Natural Log of Candidate Spending plus $5,000; all in constant (1978) dollars.

T-values in parentheses. * = Signif. at .05; † .01; ‡ .001

Predicted Incumbent Vote Margin from OLS Equation predicting Incumbent Vote from Par, Lagged Net Vote, Time, and Prior Office—for pooled Veteran Incumbents.

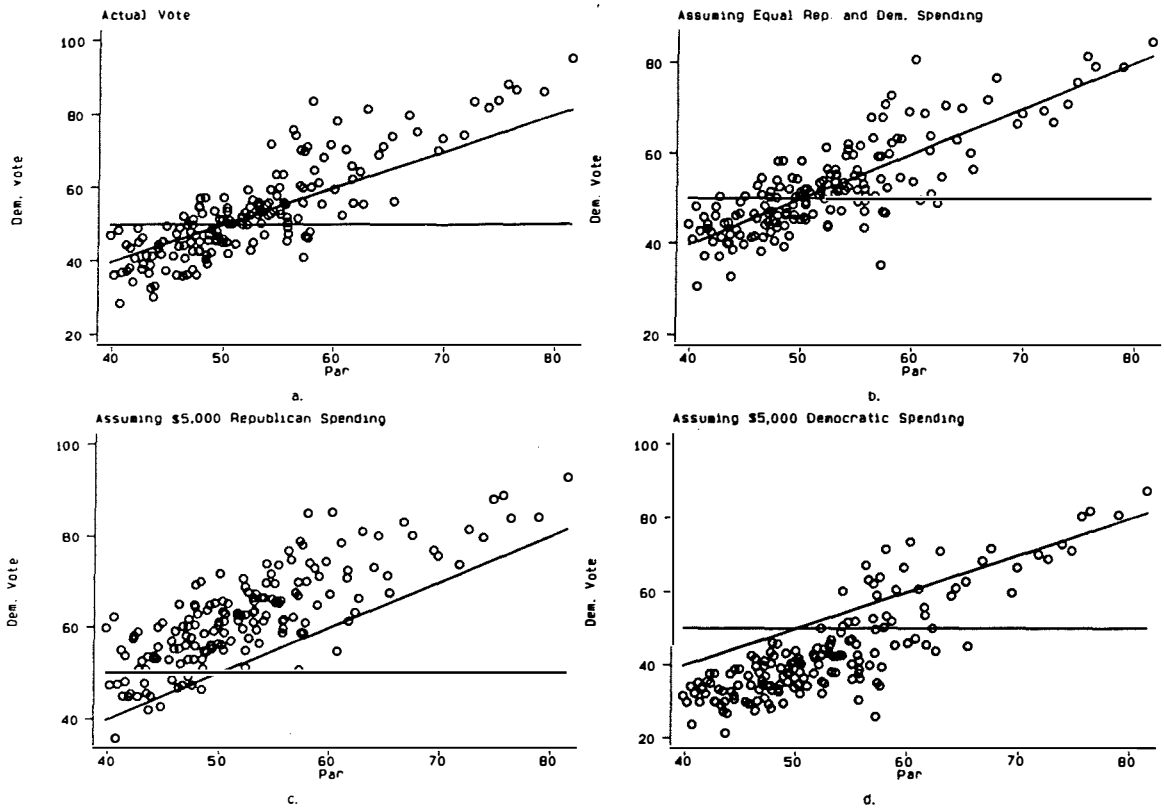


Fig. 1. Spending Effects for Open Seats in the 1970's

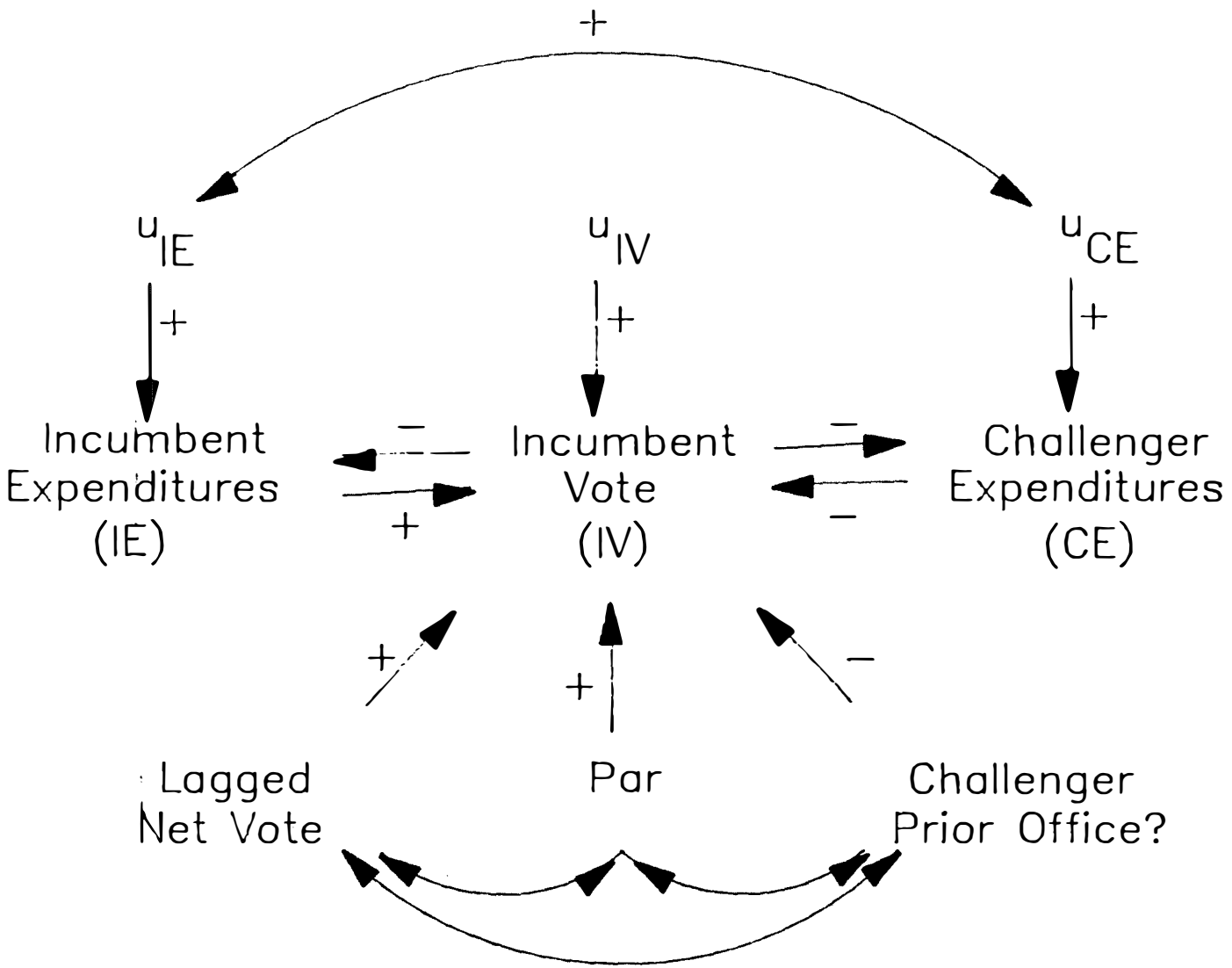
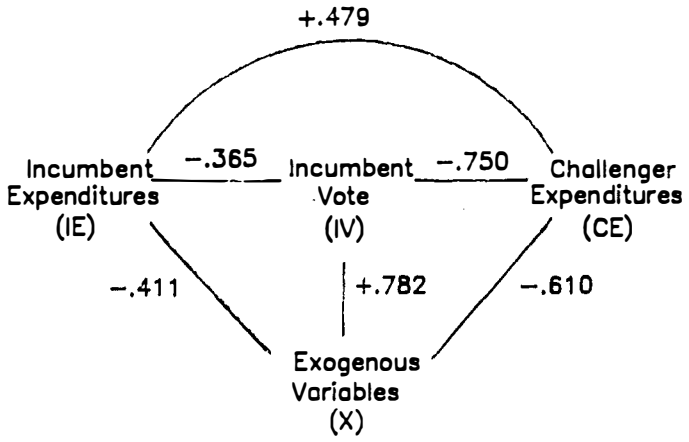
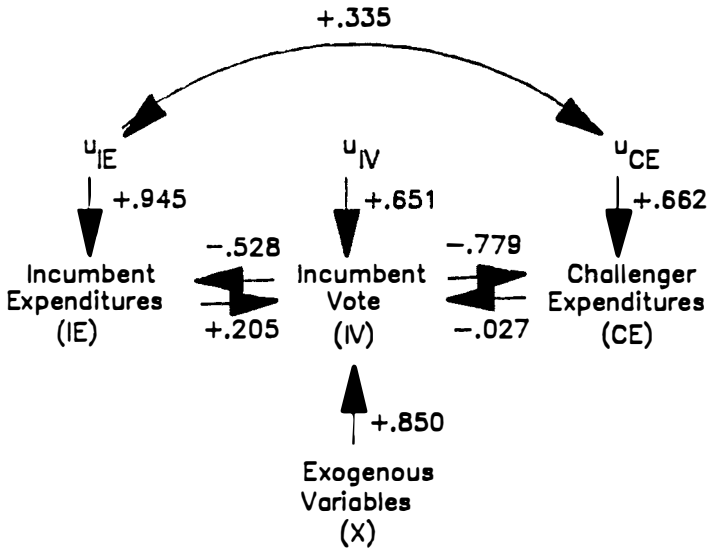


Fig. 2. A Causal Model of the Vote–Spending System



a.

Correlations



b.

Estimated Standardized Effects

Fig. 3. A Simplified Standardized Path Model

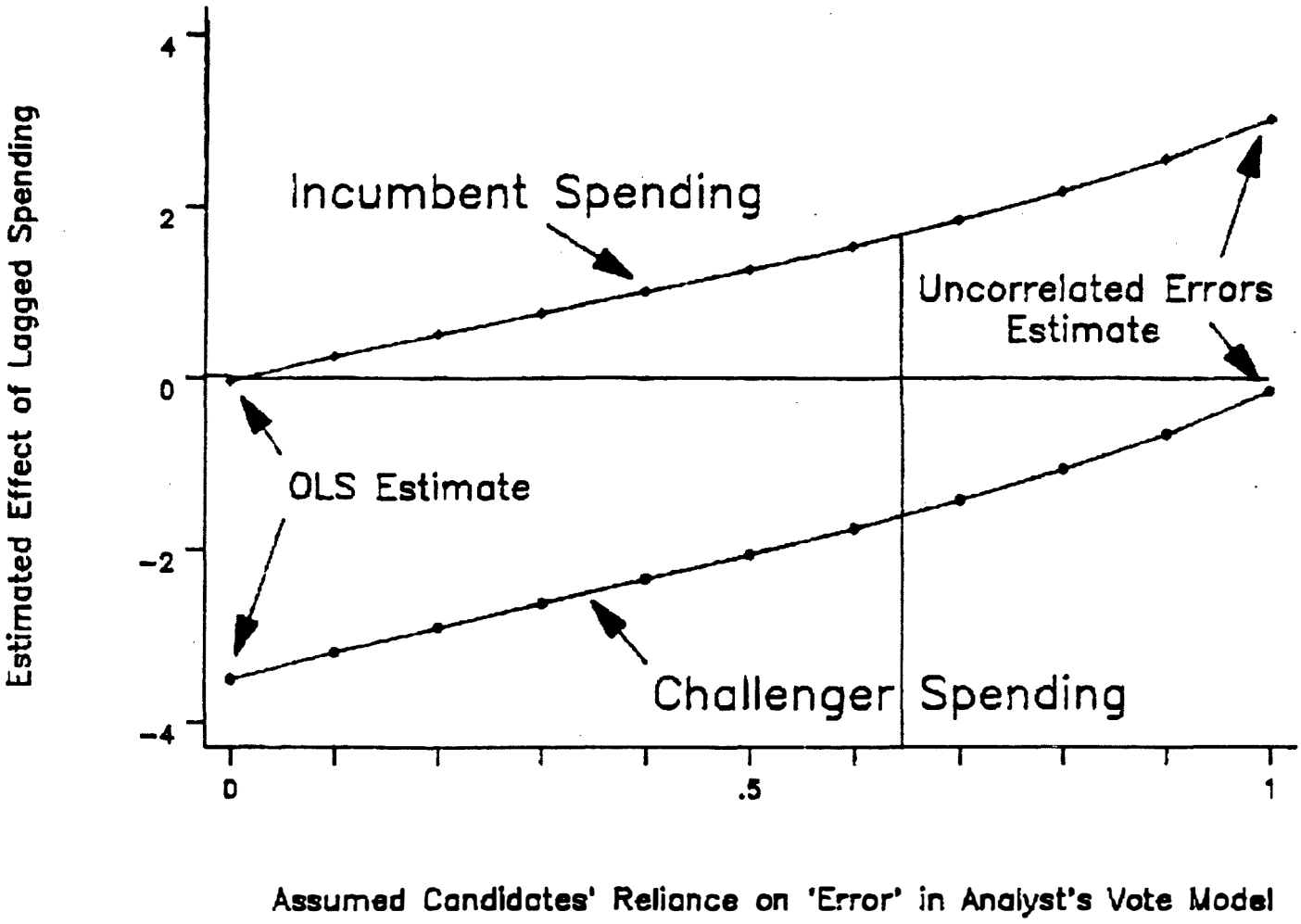


Fig. 4. Spending Effects by Assumptions About Candidate Knowledge

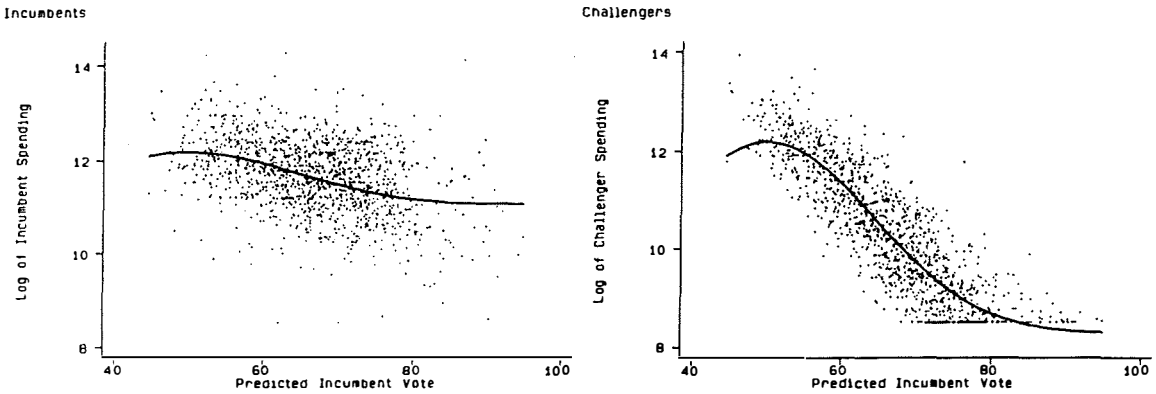


Fig. 5. Incumbent and Challenger Spending by Predicted Vote

Endnotes

† This Working Paper replaces Working Paper 806 ("The Puzzle of Incumbent Spending in Congressional Elections").

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1. Obviously there are many variations in how we could measure Par. For instance, we could (as in Erikson, 1990) disregard spending entirely for the measurement of Par. Of course we could modify the exact functional form of spending effects. The practical consequences are minimal. Besides controlling for district partisanship via presidential voting, the most crucial consideration is the proper adjustment of election-year effects.

2. The presidential vote for other election years (1972, 1980 for the 1970; 1984 for the 1980s) does not add significantly to the prediction of the open seat vote within the decade. For the 1980s, the 1984 presidential vote could easily be substituted for the 1988 vote. For northern districts, the two vote measures correlate at +.97.

3. The lagged Net vote represents a composite of the popularity of the current incumbent at time t-1 minus the popularity of the t-1 challenger. Lagged Net vote also absorbs some of the effects of spending at t-1. To the extent incumbent popularity is autoregressive, lagged incumbent popularity (I) affects the incumbent's current popularity with an unknown coefficient b_{VI} (of a size that may approach 1.0). Statistically, the observed coefficient for lagged net vote should be:

$$\hat{b} = b_{IV.I} * \frac{\text{Var } (I)}{\text{Var } (I) + \text{Var } (C')}$$

where I and C' stand for incumbent popularity and challenger popularity (in vote units) respectively. If both popularity variances are about equal, then the observed b ought to be about half of the autoregressive coefficient for the incumbent's popularity. The observed b is actually about .40, suggesting a strong autoregressive component to lagged Net vote.

4. Strictly speaking the prior office variable is not truly exogenous, since a close race attracts more qualified challengers, like prior office-holders. Omitting the prior office variable makes virtually no difference for the uncorrelated errors analysis.

5. The correlations can be interpreted in terms of "path equations" of the form:

$$r_{ij} = p_{ji} + \sum p_{jk} r_{ik}$$

where i is the independent variable, j is the dependent variable, and the k variables are the other variables in the system. For example, with IV as the dependent variable.

$$r_{IV,CE} = \hat{p}_{IV,CE} + \hat{p}_{IV,IE} r_{IE} + \hat{p}_{IV,X} r_{X,CE}$$

Alternatively, with CE as the dependent variable,

$$r_{IV,CE} = \hat{p}_{CE,IV} + \hat{p}_{CE,U_{CE}} r_{U_{CE},IV}$$

For Figure 3, these identities follow exactly, because the system of equations is exactly identified. The full model (Figure 2), however, is overidentified.

6. For the Freshman equation, the point where the two spending effects are equalized (at $+3.35, -3.35$) is a b_C of 0.34.

7. Specifically, the potential problem with Lagged Net Vote is as follows. The incumbent's (stable) taste for spending will repeat in successive elections. Therefore, $t-1$ taste for spending will contribute to the $t-1$ vote and also to incumbent spending at time t, with further reverberations for challenger spending. This distorts the covariances between LNV and contemporary spending, which enter into the estimates of the IE and CE effects. With LNV excluded (and $b_C = 0.00$), the (veteran) coefficients are 3.08 for IE and -0.75 for challengers.

8. This discussion ignores the possible increases in spending efficiency accompanying reduced spending, for example, from reduced advertising rates for candidates who voluntarily keep within new spending limits.

9. Strictly speaking, the advantage from incumbency per se is the share of the vote gained strictly from being the incumbent. Most of the incumbency advantage of about 7 percentage points derives from a gain in net vote of 6.7 percentage points between the first win (as a nonincumbent) and the first reelection as a freshman incumbent. Following the freshman year, the gain in the net vote from one election to the next slows to 0.1 percentage points.

10. Our discussion conservatively assumes that spending effects are short-term rather than even partially cumulative. If spending effects carry over from one election to the next, any incumbent edge from spending is magnified even further.

11. There is one way that high spending can help challengers even when incumbent spending generally is the more effective. Spending by incumbents or challengers can magnify the unpredictability of voter responses, which gets reflected in an increased *variance* of the district vote around its expectation. The result of increased variance would be more election upsets. This may be partly captured in the heat variable.

References

Abramowitz, Alan I. 1991. "Incumbency, Campaign Spending, and the Decline of Competition in the U.S. House Elections." *Journal of Politics*, 53:34–56.

Ansolabehere, Stephen. 1990. "Winning is Easy, but it Sure Ain't Cheap." Unpublished manuscript.

Bartels, Larry. 1992. "Instruments and 'Quassi-Instrumental' Varables." In James Stimson, ed., *Political Analysis II.* Ann Arbor: University of Michigan Press.

Erikson, Robert S. 1982. "The 'Uncorrelated Errors' Approach to the Problem of Causal Feedback." *Journal of Politics* 44:863–881.

Erikson, Robert S. 1990. "Estimating the Incumbency Advantage in Congressional Elections." Mimeo.

Fisher, Franklin M. 1966. *The Identification Problem in Econometrics.* New York: Academic Press.

Goldberger, Arthur S. 1991. *A Course in Econometrics.* Cambridge: Harvard University Press.

Goldenberg, Edie N., Michael W. Traugott, and Frank R. Banmgartner. 1986. "Preemptive and Reactive Spending in U.S. House Races." *Political Behavior*, 8:3-20.

Green, Donald P., and Jonathan S. Krasno. 1988. "Salvation for the Spendthrift Incumbent: Reestimating the Effects of Campaign Spending in House Elections." *American Journal of Political Science*, 32:884–907.

Green, Donald P., and Jonathan S. Krasno. 1990. "Rebuttal to Jacobson's 'New Evidence for Old Arguments'." *American Journal of Political Science*, 34:363–372.

Hanushek, Eric A., and John E. Jackson. 1977. *Statistical Methods for Social Scientists.* New York: Academic Press.

Hausman, J. A. and W. E. Taylor. 1983. "Identification in Linear Simultaneous Equations Models with Covariance Restrictions: An Instrumental Variables Interpretation." *Econometrica*, 51:1527-49.

Heise, David B. 1975. *Causal Analysis.* New York: Wiley.

Jacobson, Gary C. 1978. "The Effects of Campaign Spending in Congressional Elections." *American Political Science Review*, 72:469–491.

Jacobson, Gary C. 1980. *Money in Congressional Elections.* New Haven: Yale University Press.

Jacobson, Gary C. 1985. "Money and Votes Reconsidered: Congressional Elections, 1972-1982." *Public Choice*, 7:7–62.

Jacobson, Gary C. 1989. "Strategic Politicians and the Dynamics of House Elections – 1946–1986" *American Political Science Review*, 83:773–93.

Jacobson, Gary C. 1990. "The Effects of Campaign Spending in House Elections: New Evidence for Old Arguments." *American Journal of Political Science*, 34:334–362.

Jacobson, Gary C. 1993. "The Misallocation of Resources in House Campaigns." In L. C. Dodd and B. I. Oppenhimer, eds., *Congress Reconsidered*, 5th edition. Washington D. C., Congressional Quarterly.

Johnston, J. 1963. *Econometric Methods*, 248-249. New York: McGraw-Hill.

Maddala, G. S. 1977. *Econometrics.* New York, McGraw-Hill.

Malinvaud, E. 1966. *Statistical Methods of Econometrics.* Chicago: Rand McNally.

Rothenberg, Thomas S. 1973. *Efficient Estimation with a Prior Information.* New Haven: Yale University Press.

Stokes, Donald E., and Warren E. Miller. 1966. "Party Government and the Saliency of Congress." In Angus Campbell, et al., *Elections and the Political Order.* New York: Wiley.