Estimating the Effect of Campaign Spending on Senate Election Outcomes Using Instrumental Variables

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To examine the traditional view that challenger spending is more effective than incumbent spending, I reestimate the effects of spending using instrumental variables that affect a candidate's ability to raise campaign funds, such as candidate wealth levels. When the endogeneity of candidate spending levels is properly taken into account, the marginal effects of incumbent and challenger spending are roughly equal. In contrast to previous research showing that, because of higher marginal returns to challenger spending, the incumbent's spending advantage cannot explain high incumbent reelection rates, this article shows that in an average Senate election the incumbent's spending advantage yields a 6% increase in the incumbent's vote share. That incumbent spending wins elections has direct implications regarding the consequences of campaign finance reform. My findings imply that equalizing spending levels may significantly increase incumbent defeat rates, and caps on candidate spending may improve the chances of challengers.

In American congressional elections incumbents routinely win reelection. Even in the 1994 Republican landslide, change in the partisan makeup of Congress occurred mainly through open seats switching from the Democrats to the Republicans. A common explanation for high congressional reelection rates is the large campaign spending advantage enjoyed by incumbents. It is widely believed that challenger spending is very important, but there is surprisingly little evidence in the academic literature that incumbent campaign spending has an important effect on congressional election outcomes. In light of the substantial effort incumbents devote to fundraising, as well as some nagging methodological questions about existing academic studies, the effect of incumbent spending on election outcomes remains an unresolved issue.

Accurately measuring how incumbent spending leads to votes is of obvious importance. Politicians want to win elections, and so if money matters, then this will influence their behavior. If campaign spending effects are trivial, then concerns about politicians being purchased by contributions from PACs and other "special interests" are probably exaggerated. Accurate measurement of the effect of campaign spending is essential for evaluating the effects of campaign finance reforms. Finally, most of the academic literature on campaign finance has yielded a provocative finding that fuels additional investigation: For given spending levels, incumbent campaign spending appears to have much smaller marginal returns than challenger spending.

This article measures the effect of campaign spending on Senate election outcomes. I begin by briefly reviewing the academic literature. A key issue in estimating the effect of campaign spending is that campaign spending levels respond to expectations about the closeness of the election. Most research ignores this or downplays its significance. After reviewing the existing studies, I present a model of Senate election outcomes and describe instrumental variables that can be used to estimate the effects of spending. I argue that contrary to a view often expressed (Jacobson 1985, 1990), valid instruments can be found to permit the identification of a two-stage least-squares model of the effect of campaign expenditures on election outcomes. The major innovation here is the use of a new set of instrumental variables that permits consistent estimation of the effects of candidate spending. This study employs instrumental variables which shift a candidate's cost of funds, such as candidate wealth levels. If variables such as candidate wealth levels do not have a direct influence on election outcomes, then they can be used to obtain consistent estimates of the effects of spending. Following a description of the model and data, I report the results of model estimation. Ordinary least-squares (OLS) and two-stage least-squares (TSLS) estimation of a standard model of Senate election outcomes produce very different results. OLS estimation confirms the conventional view that incumbent spending has a lower marginal effect than challenger spending, while TSLS estimation shows the marginal effects of spending by challenger and incumbent to be both statistically equivalent and substantively important. The article concludes with an examination of the implications of the findings. I consider, among other things, how my results regarding campaign spending in Senate elections relate to the more general issue of when campaign spending may be more or less effective.

REVIEW OF THE LITERATURE

Over the past two decades, there have been numerous attempts to measure the effects of spending on election outcomes. Most authors have assumed that candidate spending levels may be viewed as exogenous (among others, see Abramowitz 1988, 1991; Ansolabehere 1990; Caldeira and Patterson 1982; Giertz and Sullivan

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This research was supported by a National Science Foundation dissertation fellowship and by the Institution for Social and Policy Studies. An earlier version of this paper was chapter 1 of my dissertation (Massachusetts Institute of Technology, 1993). I am very grateful to Steve Ansolabehere, Donald Green, Morris Fiorina, Bill Keech, Jim Poterba, Jim Snyder, and Charles Stewart for comments on the earlier version of this work. I also thank the anonymous reviewers for many very helpful suggestions.

1977; Glantz, Abramowitz, and Burkhart 1976; Grier 1989; Kenny and McBurnett 1992; Levitt 1994; Lott and Warner 1974; Shepard 1977; Silberman and Yokum 1978; Thomas 1989; Welch 1974). The canonical example of work in this literature is a regression of a candidate's vote level on some function of the candidate's spending levels and other variables relevant to the election outcome.[1] The basic differences among studies are use of alternative functional forms for converting spending into votes (linear, quadratic, and logarithmic functions are used) and analysis of different types of campaigns (the U.S. House is most common). The model specification in many of the earliest studies focuses on partisan differences and restricts the marginal effects of challenger spending and incumbent spending to be identical. When this assumption was relaxed, the central finding of this literature was uncovered: Challenger spending has much greater marginal returns than incumbent spending; the effects of the latter are small and often not statistically significant (e.g., Abramowitz 1988; Jacobson 1980, 1985, 1990). The result that challenger spending is important while incumbent spending is not has been verified consistently by OLS regressions. Jacobson (1985, 23) summarizes the findings of numerous academic studies: "The idea that the challenger's spending level is what matters for election results is repeatedly supported. Indeed, it is supported by results from almost every set of elections where the question has been tested."

The result that incumbent spending has little or no effect on the incumbent's election chances, and in some studies actually appears to reduce the incumbent's expected vote, has provoked two responses. The first is attempts to explain why these findings make sense theoretically. The second is a few attempts to improve the empirical methods to correct for possible endogeneity of campaign spending.

Gary Jacobson provides the main theoretical explanation for the relative ineffectiveness of incumbent spending. He argues that attempts by both the challenger and the incumbent to influence the voters are subject to decreasing returns. Since the incumbent begins with the built-in advantages of staff and free mailings, any spending by the incumbent is an addition to already high levels of campaign activity. What is more, even before spending the first dollar, the incumbent is well known to the voters, so any additional communication will add relatively little to their knowledge. Challengers, in contrast, are generally unknown and so benefit greatly from campaign exposure (Jacobson 1978, 1990).

Jacobson's theory, originally developed to explain differences in the effectiveness of spending by incumbents and challengers in U.S. House elections, can be applied to Senate elections to generate predictions about Senate incumbent and challenger spending effects. First, roughly speaking, Senate incumbents are at least as well known as House incumbents, so we should expect incumbent spending to have minimal effect. Second, since the level of voter knowledge of Senate incumbents is greater than the level of voter knowledge of Senate challengers, we would expect incumbent spending to be less effective than challenger spending. These expectations are in fact confirmed by existing work on Senate elections (Abramowitz 1988; Jacobson 1985).

Jacobson's explanation for observed differences in the effectiveness of spending is straightforward and appealing, but there are grounds for skepticism. First, while senators are relatively well known, they have the opportunity to spend money to address new issues or concerns, some of which may not have arisen in previous years. Second, campaigning not only informs the voters about oneself but also brings to light damning information about one's opponent. When the voters do not know much about the challenger, this gives the incumbent a great opportunity to use money to "define" the challenger.

In theory, incumbent spending may be *more* effective than challenger spending. Incumbents typically have advantages in organization and expertise that make their expenditures more efficient and therefore more effective dollar for dollar than those of challengers. If this is an important consideration, then the marginal effect of spending by the incumbent may be *greater* than the marginal effect of challenger spending. A final reason for skepticism is that the actual behavior of incumbents, who are political professionals, appears to contradict the premise that incumbent campaign spending has little effect. If incumbents are sensible, then it is hard to explain their substantial fundraising efforts.[2]

It is possible that Jacobson has constructed an ingenious theoretical explanation for a nonexistent fact. The true effects of spending may be mismeasured due to methodological problems that result when spending levels are treated as exogenous variables. There are a number of reasons to suspect that regressions which assume spending is exogenous yield biased coefficients. Some reasons to expect that spending levels are influenced by electoral conditions include: (1) As the probability of victory rises, it is easier for a candidate to raise money; (2) if the election looks close, supporters are more likely to contribute to the candidates; and (3) if the incumbent becomes sure of victory, the incumbent scales back fundraising activity. For these reasons and others, if there are factors influencing the election outcome that are not captured in a single-equation regression model, then the effects of spending on election outcomes will be biased due to correlation between the spending levels and the regression error.[3]

[1] For an analysis using survey evidence, see Kenny and McBurnett (1992).

[2] This common argument can be refuted if it is believed that the marginal cost of raising funds for the incumbent is very low, since the large amounts of money raised can be easily reconciled with low marginal benefits. Anecdotal evidence suggests otherwise; politicians find raising money distasteful and time consuming. Consider the view of Hubert Humphrey, who called raising funds "a disgusting, degrading, demeaning experience" (Jacobson 1978, 475).

[3] For a game theoretic model showing formally how omitted explanatory variables will lead to biased estimation, as well as how variables

Most of the empirical literature ignores or dismisses the issue of the endogeneity of spending levels, although several studies attempt to correct for possible biases. Attention has been focused on elections to the U.S. House. As part of his seminal work estimating the effects of campaign expenditures, Jacobson (1978) attempted to estimate a TSLS model of spending in House elections.[4] A recent paper estimating the effects of campaign spending using an instrumental variables approach is an important study of U.S. House elections by Green and Krasno (1988).[5] Their work has heightened debate, as the results call into question the conventional view that incumbent spending is less important than challenger spending.

Green and Krasno show that, in contrast to the usual OLS findings, incumbent spending effects are statistically significant and roughly equal to challenger spending effects. This is a welcome finding for those who suspect that incumbent spending is important, but several methodological questions have been raised regarding their study.[6] Most important, because of a lack of instrumental variables, they assume that challenger spending is exogenous, and only incumbent spending is endogenous. If this assumption is false, then inconsistent estimates of both challenger and incumbent spending effects will result.

Nearly all the research on Senate elections relies on OLS regressions.[7] Jacobson (1985) analyzes six years of Senate elections, presenting regression results separately for each year. He finds that challenger spending has strong and statistically significant effects on candidate vote totals, while incumbent spending effects are smaller and rarely statistically significant. Abramowitz (1988) estimates a model of Senate elections which includes many explanatory variables omitted from Jacobson's regressions and pools the results of seven years of Senate elections. Like Jacobson, he finds that challenger spending has strong and statistically significant effects. He shows that while incumbent spending is significant at the .05 level, the marginal effect of challenger spending is approximately three times that of incumbent spending.[8]

This article reestimates the effect of campaign spending on Senate election outcomes and extends the literature in several ways. First, it improves upon some of the best existing work by treating both challenger and incumbent spending as endogenous. Second, it employs a new set of instrumental variables. Estimation will focus on variables, such as candidate wealth levels, that make raising campaign funds easier or harder for the candidate. These instrumental variables avoid some of the problems that called earlier work into question. In addition, this study attempts to ensure the accuracy of the regression results by performing formal statistical tests of the assumptions underlying the instrumental variable regressions, as well as by undertaking several different regressions to establish the robustness of the findings.

DATA AND METHODS

In the following two subsections, I first present a model of Senate election outcomes and describe the data. I then discuss the instrumental variables used to estimate the model.

Election Outcome Model and Data

Data were collected for all Senate elections occurring in 1974 through 1992. After eliminating open seats and elections for which there were missing variables, 229 elections remained.[9] The model estimated had the basic form:

$$Incumbent\ Vote\ \% = \alpha + \beta_1 \log(Spend_c) + \beta_2 \log(Spend_i) + \beta_3 Z + E,$$

where $Spend_c$ is *Challenger Spending*; $Spend_i$ is *Incumbent Spending*; Z is a vector of variables capturing political conditions, economic conditions, and other factors thought to be important to the Senate election outcome; B_3 is a vector of coefficients; and E is an error term.

In all regressions, the variable on the left-hand side is the incumbent's percentage of the two-party vote (*Incumbent Vote Share*). In addition to candidate spending levels, a number of variables are included on the right-hand side. These measure the effects of challenger quality and partisan, ideological, and economic conditions on the incumbent's percentage of the

that affect a candidate's "cost of campaign funds" function can be used as instrumental variables, see Gerber (1993). Due to the various ways spending levels may be influenced by expectations regarding the election, it is not possible to predict the bias in OLS regression coefficients. A downward bias in the incumbent spending coefficients can easily follow if incumbents vary their fundraising intensity according to whether their reelection appears safe.

[4] This study can be criticized on the grounds that the excluded variables, such as the challenger's political party, and the strength of the challenger's political party in the district, are not excludable from a regression of candidate vote percent on spending levels. Jacobson has conceded that this is a problem (Jacobson 1985, 32). In 1985, Jacobson updates his 1978 work using a similar methodology.

[5] See also Kenny and McBurnett (1994).

[6] For a discussion, see Jacobson (1990) and Abramowitz (1991).

[7] I am aware of two attempts in the literature to estimate a two-stage model of Senate election outcomes. Jacobson (1978) performs the regressions described in footnote 4 for House elections using Senate election data. Stewart (1989) also estimates a model of Senate election outcomes. In his study, variables relating to the quality of the challenger, state ideological orientation, and special conditions regarding the incumbent, such as scandal or poor health, are omitted from the election prediction model to permit estimation of spending effects. The use of omitted variables such as those listed above as instrumental variables is inappropriate because they have demonstrated explanatory value in the election prediction model and therefore will be correlated with the error in the regression explaining the Senate election outcome.

[8] For another OLS analysis of Senate elections, see Grier (1989), who uses a functional form for spending effects different from that of Abramowitz and Jacobson. Grier's findings are similar to those of Abramowitz. Grier concludes that the net effect of spending in Senate elections (1978–84) was to increase challenger vote shares by around 3%.

[9] The measure of ideological distance of the incumbent from the ideological outlook of the state and the partisan makeup of the state's electorate were not available for Alaska or Hawaii, so these states were excluded from analysis.

vote. This model format is familiar in the literature. The remainder of this section briefly discusses the variables.

To capture the influence of economic conditions on the election outcome, the variables used were *State Unemployment Levels* in the election year and state unemployment levels in the election year interacted with a dummy variable that is coded as one when the incumbent was from the same party as the president (*State Employment Level *Incumbent in Governing Party*). It was expected that bad local economic conditions would help all challengers, and it would help them more if they were not from the president's party.

To measure challenger quality, the level of political experience was used.[10] Challengers were divided into five groups according to whether they had been (1) a state *Governor*, (2) a *U.S. Representative*, (3) a *Major State or Local Official*, such as attorney general or mayor of an important city, such as Pittsburgh or Indianapolis, (4) a *Minor Public Official*, such as member of a city council or a state legislature, or (5) held no previous elected office.[11]

Several variables relating to state political conditions and characteristics of incumbent senators were taken from Abramowitz's study. Abramowitz based measures of a state's partisan and ideological orientation on work by Wright, Erikson, and McIver (1985), who compiled data on state-level partisan and ideological orientation from CBS News-*New York Times* surveys conducted between 1974 and 1982.[12] The difference in the percentage of Democrats and the percentage of Republicans in each state was used to capture partisan differences across states (*State Partisanship*). An updated version of Abramowitz's measure of the *Ideological Distance* between the voting record of incumbents and the ideological leanings of their state is also included in the model.[13]

Dummy variables were included to account for special conditions that may affect the Senate race.[14] Several types of special condition were isolated. A "scandal" involves allegations of illegal activity by the incumbent (*Incumbent Scandal*). Examples are Senator Jepson, who belonged to a "health spa" used for prostitution, and Senator Brooke, who misreported his financial worth in divorce proceedings and may have been involved in Medicaid fraud. A "controversy" is an incident that raises questions about the honesty, judgment, or competence of the incumbent (*Incumbent Controversy*). Examples are Senator Hartke's excessive foreign travel and Senator Andrews's medical malpractice suit. A "health" problem occurs when the incumbent's ability to function in office appears in question (*Incumbent Health*). Examples are senators Goldwater, Dominick, and Magnuson, all of whom had difficulty walking.

Several challengers were distinguished as "celebrities" if they were well known for some reason other than politics (*Celebrity Challenger*).[15] These challengers were the astronauts Schmitt and Lousma, U.N. Representative Moynihan, Vietnam POW Thorsness, and S. I. Hayakawa, a university president made famous by a confrontation with student demonstrators.

Dummy variables were included for each party for each year in order to assess the influence of partisan tides and swings in feeling toward or away from incumbents.

The logarithm of candidate spending levels, measured in real 1974 dollars per voter, were included in the election outcome model.[16] The exact form for the spending variables is natural log (real spending per voter +.01). The constant .01 was added to real spending per voter before taking the logarithm due to the fact that, for very low spending levels, the log transformation sends the value to negative infinity.[17] The logarithmic functional form was selected, since it is a simple function consistent with the desirable features that candidate spending should have positive returns at all observed levels and should exhibit decreasing returns as the most critical tasks are attended to with the first expenditures.[18]

Instrumental Variables Used for Estimation of Spending Effects

Three instrumental variables were selected to estimate the model. The objective was to find variables likely to influence campaign spending without directly affecting the election itself. The first instrumental variable is based on a measure of *Challenger Wealth*. Richer

[10] Use of political experience as a proxy for challenger quality is a common practice in the literature on congressional elections. See, for example, Bianco (1984), Born (1986), and Jacobson and Kernell (1981).

[11] It is possible that the challenger quality variable is endogenous, if the challenger's decision to run responds to electoral weakness of the incumbent. While this may be a problem, it may be minor for two reasons. First, candidates enter well in advance of the election, and therefore entry cannot respond to factors that develop nearer the election. Second, as Squire (1991) has argued, since Senate seats are very scarce, it is difficult to time one's run; there likely will be only a few opportunities and many potential challengers.

[12] Restricting analysis to a subsample that more closely overlaps the Wright, Erikson, and McIver survey data would not alter any conclusions of this paper.

[13] This variable, which is calculated according to a formula based on voting record ratings by Americans for Democratic Action (ADA), Americans for Constitutional Action (ACA), and state ideological rankings based upon the survey data, is detailed in Abramowitz (1988).

[14] The classification of scandal, health, and controversy is similar to that used by Abramowitz (1988), with some updating for recent events, such as the savings and loan scandal's "Keating five."

[15] Westlye (1991) isolates a set of candidates for this distinction. Abramowitz (1988) also distinguishes a similar set of candidates.

[16] This treatment follows Jacobson (1985) and Grier (1989), who use spending per voter in their analysis of Senate elections. Abramowitz (1988) assumes that there are economies of scale and adjusts the denominator of the spending variable.

[17] The $5,000 added to spending levels in House elections by Green and Krasno (1988) is of very similar magnitude to an addition of $10,000 per million voters in a Senate election. Qualitatively similar TSLS results were obtained when different small constants were used.

[18] Several other functional forms were analyzed as well. The major finding of the estimation—that TSLS equalizes the marginal spending effects of incumbent and challenger spending, and that the marginal spending effects for both challenger and incumbent increase substantially over the OLS coefficients when reestimated by TSLS—held for all functional forms tested.

challengers have more money to spend on their Senate race. This variable was generated by reading through the descriptions of the upcoming Senate races contained each election year in the *Congressional Quarterly* election preview issue. Challengers were categorized as wealthy or not based upon the description.

Challenger wealth was set equal to 0 if the *Congressional Quarterly* election preview listed the challenger's occupation or former occupation as, for example, a public sector job, teacher, military, or lawyer. Challenger wealth was set to 1 if the description indicated a real estate developer, an independent business owner or president of a business, a banker, a top executive, or used terms such as "wealthy," "independently wealthy," "millionaire," or "heir." Overall, challengers' contributions to their own campaign constitute about 8% of total challenger spending. This spending is concentrated in a subset of races, and those classified as wealthy account for a large portion of challenger self-financing.[19] The mean level of real campaign spending per voter in 1974 dollars by a rich challenger was around 60% greater than the mean level of spending for other challengers.[20]

The second instrumental variable was based on state voting age population (*State Population*). If holding the office of senator allows incumbents to raise a fixed sum independent of their state population, then senators from small states can raise large sums per capita, while those from populous states will have more difficulty raising the same amount per capita. The next two paragraphs discuss reasons to expect that per-capita contributions from both individuals and PACs vary inversely with state size. Empirical evidence shows that campaign spending per capita is lower in populous states.

Senators raise many individual contributions from out of state. There is no systematic accounting of the geographic origins of campaign money, but there is some evidence of its importance. The *Washington Post* found that, in the 1984 Senate elections, 16% of all individual contributors of more than $200 were from out of state (Sorauf 1992, 47). Senators exploit this source of campaign funds: "Unlike most House incumbents, [senators] can and do raise large sums from individuals in other states. They offer much greater eminence than do House members, and some even cultivate the well-tailored, photogenic manner of celebrities. Their campaigns are the classic locus of the well-brokered reception in which the senator flies in for cocktails, smiles, handshakes, a few words, and a covey of $1000 checks" (Sorauf 1992, 90). If the fee for an appearance is not a function of the population of the senator's home state, then the amount raised per voter will vary inversely with state population.

In addition to out-of-state individual contributions, the amount raised from "investor PACs" (those classified by the FEC as trade, membership, and health organizations, corporations, labor unions, and cooperatives) does not increase with the population size of the senator's state (Snyder 1989, 1990). The favors a senator can deliver to an interest group are a function of the senator's political influence, and each senator gets only one vote, regardless of state size. The implication is that, in per-voter terms, a senator from a small state has much more to sell than a senator from a populous state.[21]

Population is a valid instrument if it is correlated with candidate spending levels but does not directly affect Senate election outcomes. Early regression analysis by Hibbing and Brandes (1983) suggested that population is inversely correlated with incumbent vote shares in Senate elections. More recent work by Westlye (1991) and Krasno (1994), however, vigorously contests this view. While both recognize the theoretical possibility that incumbents from smaller states may outperform incumbents from larger states, Westlye and Krasno show that there is no relationship between population and vote share, with the possible exception of the very largest states (e.g., California, New York, Texas). To confirm that my findings were not contaminated by any possible problems with using population as an instrument, I examined robustness by excluding the largest states from the sample. The results were unchanged.[22]

The third instrumental variable was based on *Lagged Spending* by Senate incumbents and challengers.[23] The exact variable used was the sum of spending by the incumbent and challenger in the *previous* Senate election in the state. Due to the staggered nature of Senate elections, the previous race and the current race rarely involve the same incumbent or challenger. The variable is therefore free from the criticism that might be applied to lagged spending by the same candidate, namely, that specific candidate attributes are correlated with both the regression error and past fundraising levels. Lagged spending should be correlated with the included spending variables for the current election, however, since candidates from the same states may face similar fundraising environments.

Table 1 shows summary statistics for the variables used in the empirical analysis.

[19] The FEC final reports for 1990 and 1992 show that wealthy challengers accounted for a large portion of candidate self-financing. For contested Senate races in which an incumbent ran, total unpaid loans and contributions amounted to $11.9 million. Spending by those that *Congressional Quarterly* described as affluent or rich (12% of all candidates) was $8.4 million. This implies that the latter accounted for about 70% of all candidate self-financing.

[20] In the regression results reported later, it is possible that the instrumental variable indicating challenger wealth should be divided by the state voting age population. It was found that dividing the wealth variable by state population had no significant effect on the results.

[21] A final reason that spending varies inversely with state population is that the legal limits on contributions are fixed sums, not scaled to state population.

[22] In Table 3, column 2, I present the TSLS coefficient estimates for the effect of incumbent and challenger campaign spending, based on the complete sample. The coefficients are 6.46 and −6.00 (n = 229), respectively. When the sample was restricted to states with a population of less than 6 million, the coefficients were 6.78 and −7.00 (n = 142); for 8 million or less, 7.05 and −6.61 (n = 148); for 10 million or less, 6.88 and −6.71 (n = 152). All coefficients were significant at the 5% or 1% level.

[23] This is not the variable used by Green and Krasno (1988), who selected a candidate's own lagged spending.

TABLE 1. Sample Statistics for Model Variables

Variable	Mean	Standard Deviation
Incumbent Vote Share	58.95	9.22
Incumbent Spending (1974$)	.57	.56
Challenger Spending (1974$)	.30	.40
State Partisanship	3.93	16.59
Ideological Distance	27.76	15.41
State Unemployment Level	6.62	2.11
State Unemployment Level, Incumbent in Governing Party	3.15	3.42
State Population (in millions)	3.60	3.72
Lagged Spending	1.01	1.02
	Observations Where the Variable Is 1	
	Percentage	Number
Challenger Wealth	14%	32
Governor	4.4%	10
U.S. Representative	20.1%	46
Major State or Local Official	17.9%	41
Minor Public Official	20.1%	46
Incumbent Scandal	3.1%	7
Incumbent Controversy	6.6%	15
Incumbent Health Problem	2.2%	5
Celebrity Challenger	3.1%	7

Note: There are 229 observations for all variables except lagged spending, where $N = 156$.

ESTIMATION RESULTS

This section reports the results of estimation of the Senate election model. First, I examine the results of OLS regression. I then present the results of instrumental variable estimation.

OLS Estimation Results

Table 2 reports the OLS estimation of the Senate election model for both the full sample of 229 elections and the subsample of 156 elections for which lagged spending was available. The OLS regressions show that, for any given level of spending, challenger spending has roughly twice the marginal effect of incumbent spending. To get some perspective on the coefficient magnitudes in Table 2, I examine the effect on the incumbent's share of the vote of a small change in candidate spending levels. Consider the effect of increasing spending by $300,000 in a state with a voting age population of 3 million. Since the marginal return decreases as spending increases, base levels must be specified for calculating the marginal effects. Table 1 shows that the mean value of spending per voter in 1974 dollars was 57 cents for incumbents, while the mean value for challengers was only about half that, 30 cents per voter. Using these figures as a base level, the coefficient estimates from Table 2, column 2 imply that adding 10 cents per voter to challenger spending, holding all other variables fixed, reduces the incumbent's share of the vote by 1.13%. A 10-cents-per-voter increase in incumbent spending, holding all other variables fixed, raises the incumbent's vote share by .33%. The marginal benefit is lower for the incumbent than for the challenger for two reasons. First, the coefficient estimates in Table 2 indicate that, for any given level of spending, an additional dollar is only half as effective for the incumbent as for the challenger. Second, since the benefits from campaign spending exhibit decreasing returns to scale (i.e., the logarithmic function is concave), and incumbents typically have a larger campaign budget than challengers, any spending boost by incumbents is operating at a "flatter" portion of the curve relating money spent to votes received, and so yields fewer votes.

Using the mean values of incumbent and challenger spending and the OLS regression coefficients, the total effect of candidate spending on Senate elections was also calculated. The average incumbent outspent the average challenger nearly two to one, but this larger campaign budget was more than offset by the higher marginal return to challenger spending. The total effect of campaign spending was a 4.97% reduction in the incumbent's vote share.[24]

A formal test of the hypothesis that the coefficients on challenger and incumbent spending are of equal magnitude was performed for the regressions reported in Table 2. An F-test of the restriction that challenger and incumbent spending effects are of equal size was rejected at the .01 level.

The regressions show that, for any given level of candidate spending, incumbent spending has a smaller marginal effect than challenger spending, but the marginal effect is in the intuitively expected direction and is statistically significant. These results are close to those found in Abramowitz (1988) but different from those reported by Jacobson (1985), who finds incumbent spending statistically insignificant.[25]

The preliminary conclusion from OLS regressions is that, for Senate elections, the extreme form of the incumbency spending problem, where incumbent spending has no effect, does not exist. Incumbent spending helps, but at any given level of spending, it is only about half as effective as challenger spending. If the arguments regarding the endogeneity of spending made earlier are correct, however, then OLS does not provide consistent estimates of the model. In order to

[24] The total effect of campaign spending captures how much the vote total differs from a hypothetical election in which campaign spending played no role. It is calculated as the product of the coefficient on incumbent spending times the value of the spending variable for the average incumbent minus the .01 dollars per voter base level of spending used in constructing the variable plus the product of the coefficient on challenger spending times the value of the spending variable for the average challenger, with challenger's spending level adjusted in the same manner as for the incumbent. The exact calculation of the total effect of campaign spending is $2.19*(4.06) + (-4.04)*(3.43) = -4.97$.

[25] Replicating Jacobson's (1985) OLS regressions showed that the main reason for the difference between the Table 3 results and his is Jacobson's treatment of very low spending races. Jacobson regressed the incumbent vote percentage on incumbent spending, challenger spending, and a dummy variable indicating whether the challenger was a Democrat. Jacobson adds only $1.00 to the raw spending totals, and then takes the log of spending, leading to very large negative values for spending levels near zero, and a poorer fitting model.

TABLE 2. OLS Regressions of the Effects of Campaign Spending

	Dependent Variable for All Specifications Is Incumbent Share of Two-party Vote			
Independent Variable	(1)	(2)	(3)	(4)
Challenger Spending	−5.32***	−4.04***	−5.31***	−3.94***
	(.47)	(.46)	(.57)	(.58)
Incumbent Spending	2.58**	2.19**	2.78**	1.99*
	(.75)	(.69)	(.92)	(.82)
Governor	—	−2.63	—	−1.75
		(1.94)		(3.52)
U.S. Representative	—	−3.91***	—	−3.35**
		(1.02)		(1.26)
Major State or Local Official	—	−3.38**	—	−1.89
		(1.13)		(1.47)
Minor Public Official	—	−.86	—	.11
		(1.11)		(1.55)
State Unemployment Level	—	−.45	—	−.61
		(.29)		(.39)
State Unemployment Level, Incumbent in Governing Party	—	.23	—	.20
		(.42)		(.51)
Incumbent Scandal	—	−6.35*	—	−6.55*
		(2.69)		(2.82)
Incumbent Controversy	—	−3.65*	—	−6.42**
		(1.50)		(1.84)
Incumbent Health	—	−5.77*	—	−6.57
		(2.56)		(3.53)
Ideological Distance	—	−.03	—	−.03
		(.03)		(.04)
State Partisanship	—	.12***	—	.13**
		(.03)		(.04)
Number of observations	229	229	156	156
R^2	.57	.67	.55	.67

Note: Year and party dummy variables are included in all regressions. Columns 1 and 2 use the full sample, and columns 3 and 4 use the subsample for which lagged spending was available. *$p < .05$, **$p < .01$, ***$p < .001$. Standard errors are in parentheses.

get accurate measurement of the effect of spending on the incumbent's vote percentage, the estimation technique should account for the endogeneity of the spending variables.

Table 3 reports the results of TSLS estimation of the Senate election model. The instruments used in the first-stage regressions for the second-stage estimation results shown in columns 1 and 2 were the challenger wealth variable and voting age population; all three instrumental variables were used in the first-stage regressions for the second-stage results shown in columns 3 and 4.[26] Table 4 reports the reduced form estimation of the candidate spending levels.

Reestimation using instrumental variables shows an increase in the campaign spending coefficients for both challenger and incumbent, as well as an especially large increase in the effect of incumbent spending. In Table 3, column 2 shows that the marginal effects of incumbent and challenger spending are roughly equal, in contrast to the OLS results. The hypothesis that the coefficients are equal cannot be rejected even at the .10 level. One possible objection to the regressions reported in Table 3 is that the instruments may not be exogenous.[27] In order to test the assumption of exogeneity of the instruments, a test of the overidentifying restrictions was performed. The hypothesis that the instruments were exogenous could not be rejected at even the .10 level.[28]

[26] Specification tests to detect heteroscedasticity and autocorrelation were also performed. Comparing the standard error produced by OLS to those generated by White's (1980) heteroscedasticity robust estimator revealed very little evidence of heteroscedasticity. Some senators appear in the data set more than once, raising the possibility of autocorrelated errors. To explore this possibility, the correlation between residuals and six-year lagged residuals was examined. Standard tests for autocorrelation could not reject the null hypothesis of no autocorrelation, even at the .10 level.

[27] Wealthy candidates may be attractive to voters if their wealth reduces the chances of corruption, or they may be unattractive if they appear out of touch with the concerns of average people or if wealth inspires resentment. The overall importance of these effects is likely to be small, and the net direction is unclear. It should be noted that among the large body of empirical work on Senate elections, it seems that candidate wealth has never been included as an explanatory variable. Some objections may also be raised regarding the use of population as an instrument, especially if there are scale economies that are not accounted for in the model linking campaign spending to election results. It is not clear that there are important scale economies to spending, and the evidence sometimes taken to indicate their existence (spending is lower in larger states) may be sensibly explained by variation in the supply of funds available to Senate candidates.

[28] A formal test of endogeneity of spending levels was performed

TABLE 3. TSLS Regressions of the Effects of Campaign Spending

	Dependent Variable for All Specifications Is Incumbent Share of Two-Party Vote			
Independent Variable	(1)	(2)	(3)	(4)
Challenger Spending	−6.50**	−6.00**	−6.92*	−5.57*
	(2.08)	(1.88)	(2.95)	(2.68)
Incumbent Spending	7.44**	6.47**	8.78**	6.06*
	(2.27)	(2.04)	(3.30)	(2.90)
Governor	—	−2.25	—	−1.22
		(3.24)		(5.45)
U.S. Representative	—	−2.87	—	−2.11
		(2.02)		(3.42)
Major State or Local Official	—	−2.44	—	−1.15
		(1.64)		(2.56)
Minor Public Official	—	−.23	—	.67
		(1.30)		(1.95)
State Unemployment Level	—	−.41	—	−.48
		(.36)		(.49)
State Unemployment Level, Incumbent in Governing Party	—	.35	—	.01
		(.58)		(.81)
Incumbent Scandal	—	−6.40*	—	−6.44*
		(2.67)		(3.05)
Incumbent Controversy	—	−4.59*	—	−6.64*
		(2.02)		(3.20)
Incumbent Health	—	−4.02	—	−5.89
		(3.44)		(4.36)
Ideological Distance	—	−.05	—	−.07
		(.04)		(.05)
State Partisanship	—	.12*	—	.12*
		(.05)		(.06)
Number of observations	229	229	156	156
R^2	.46	.60	.41	.61

Note: Year and party dummy variables are included in all regressions. Columns 1 and 2 use the full sample, and columns 3 and 4 use the subsample for which lagged spending was available. R^2 is from the second stage regression. *$p < .05$, **$p < .01$. Standard errors are in parentheses.

Briefly examining the reduced form regressions presented in Table 4, the challenger wealth, voting age population, and lagged spending variables all had the expected signs. There was a statistically significant positive relationship between challenger spending and challenger wealth. Both incumbent and challenger spending showed a statistically significant positive relationship with lagged spending, and negative relationship with voting age population. One interesting finding is the large effect of challenger political experience on challenger spending levels. Political troubles for the incumbent due to controversies are also strongly associated with high levels of spending for both candidates.

The regressions in Table 3 show that, for any given level of spending, incumbent and challenger spending have similar marginal effects on Senate elections. These new regression coefficients can be used to recalculate the effects of spending an additional 10 cents per voter by challengers and incumbents, as well as the total effect of candidate spending on Senate election outcomes. Again, the base levels are 57 cents per voter for incumbents and 30 cents per voter for challengers. The results in Table 3, column 2, imply that increasing challenger spending by 10 cents per voter leads to a 1.69% decrease in the incumbent's vote percentage, while a similar increase by incumbents increases their vote percentage by 1.00%. In contrast to the OLS estimates, when we correct for endogeneity bias, we find that for any given level of spending, campaign spending by the incumbent and challenger have similar effects. Yet, raising spending levels a fixed amount still benefits the challenger more than the incumbent. This stems from the fact that the average incumbent has a much larger campaign budget than the average challenger, and the return to additional spending falls as the total amount spent increases.

Recalculation of the total effect of spending shows that the new coefficient estimates reverse the earlier conclusions about the influence of candidate spending on Senate elections. Contrary to the findings based on the OLS regression coefficients, the overall effect of campaign spending strongly favors the incumbent. Us-

using a regression-based version of the Hausman-Wu (Hausman 1983) specification test. The fitted values from a regression of incumbent spending and challenger spending on the instruments were included, along with incumbent spending and challenger spending in an OLS regression of the incumbent vote share model. Under the null hypothesis that incumbent and challenger spending are exogenous, the coefficients on the fitted variables should be zero. The F-test of the exclusion restriction is distributed $F(2,192)$ under the null hypothesis that spending levels are exogenous, and the null is rejected at the .01 level. The test was performed using the challenger wealth variable, voting age population, and lagged spending.

TABLE 4. Reduced Form Regressions for Candidate Spending Levels

	Dependent Variable			
Independent Variable	Challenger Spending	Incumbent Spending	Challenger Spending	Incumbent Spending
Challenger Wealthy	.79***	.13	.66**	.09
	(.20)	(.13)	(.26)	(.16)
State Population	−1.00***	−1.14***	−.74**	−.99***
	(.02)	(.13)	(.27)	(.17)
Lagged Spending	—	—	.16**	.12***
			(.05)	(.03)
Governor	1.73***	.61**	2.39***	.87**
	(.36)	(.23)	(.54)	(.33)
U.S. Representative	1.22***	.38**	1.41***	.27
	(.20)	(.13)	(.26)	(.16)
Major State or Local Official	.68**	.16	.86**	.17
	(.21)	(.14)	(.27)	(.16)
Minor Public Official	.23	.03	.33	−.04
	(.20)	(.13)	(.27)	(.17)
State Unemployment Level	−.08	−.03	−.05	−.02
	(.05)	(.04)	(.07)	(.04)
State Unemployment Level, Incumbent in Governing Party	−.07	−.02	−.09	.04
	(.09)	(.06)	(.12)	(.07)
Incumbent Scandal	−.16	−.16	−.52	−.29
	(.42)	(.27)	(.47)	(.29)
Incumbent Controversy	.76*	.55**	1.13**	.60**
	(.30)	(.19)	(.42)	(.26)
Incumbent Health	.64	−.19	.55	−.08
	(.48)	(.31)	(.65)	(.40)
Ideological Distance	.009	.010**	.005	.013**
	(.005)	(.003)	(.007)	(.004)
State Partisanship	−.022**	−.010**	−.016*	−.005
	(.006)	(.004)	(.008)	(.004)
Number of observations	229	229	156	156
R^2	.49	.57	.52	.61

Note: Year and party dummy variables are included in all regressions. Columns 1 and 2 use the full sample, and columns 3 and 4 use the subsample for which lagged spending was available. *$p < .05$, **$p < .01$, ***$p < .001$. Standard errors are in parentheses.

ing mean incumbent and challenger spending levels and the new regression coefficients, the total effect of spending is to boost the incumbent vote by 6.28%, in sharp contrast to the OLS figure of a 4.97% reduction. This reversal is due to the fact that, when endogeneity is taken into account, for each level of campaign spending the incumbent and challenger are roughly equally effective (i.e., the regression coefficients are of the same magnitude), rather than incumbent spending being only about half as effective as challenger spending. Since typical incumbents spend much more than their opponents, the larger campaign budget of incumbents translates into a large electoral advantage. The OLS coefficients, in contrast, imply that the advantage of the incumbent's larger campaign budget is outweighed by the greater effectiveness of challenger spending.

CONCLUSIONS AND FUTURE RESEARCH

Upon showing that the marginal effect of challenger spending in Senate elections is much larger than that of incumbent spending, Abramowitz (1988, 397) noted: "The most important conclusion about the effects of campaign spending remains secure." The main finding of this article is that the traditional view of incumbent campaign spending does not hold up when OLS regressions are reestimated using an instrumental variables approach. In fact, after taking the endogeneity of spending into account, the marginal effects of incumbent and challenger spending are statistically equivalent. This result is very robust to changes in the set of instruments. The assumptions underlying the TSLS estimation hold up very well; standard statistical tests confirm the endogeneity of candidate spending levels and the exogeneity of the instruments.

In evaluating the implications of the empirical findings, it is important to remember that Senate elections differ from other types of elections. The article's results clearly oppose the traditional view of the relative importance of incumbent and challenger spending in Senate elections. Do the findings also cast doubt on the standard theory for why incumbent spending should matter less than challenger spending?

Jacobson's original theoretical explanation for the ineffectiveness of incumbent spending and the effectiveness of challenger spending applies more forcefully to the House than the Senate. The standard argument

about the relative effectiveness of spending must be modified slightly to apply more closely to the informational environment in Senate elections. It may be that since the difference in voter information about Senate incumbents and challengers prior to the campaign is smaller than the difference between House incumbents and challengers, we should expect more equal spending effects for Senate candidates. If we suppose that Senate challengers are as well known as incumbents, then Jacobson's theory would lead us to expect no difference at all in the effect of challenger and incumbent spending. This reasoning leads to an alternative interpretation of the TSLS results for Senate elections; the findings oppose the empirically derived "rule" that incumbent spending is relatively unimportant in general and in Senate elections in particular, but the results may be consistent with the more general theory that the level of voter familiarity determines when campaign spending does and does not matter.

In fact, the findings contradict not only the generality that incumbent spending is less effective than challenger spending but also the conventional theory for why this may hold. On the first count, informational differences between House and Senate elections cannot explain the empirical finding that spending by Senate challengers and incumbents has the same effect. It is true that the voter information gap is smaller for Senate than for House candidates, but voter familiarity with Senate challengers appears to have been overestimated in early work based on the 1978 CPS/NES sample (Mann and Wolfinger 1980). The level of voter familiarity with Senate incumbents is similar to that for House incumbents, while Senate challengers are in many cases better known than the typical House challenger but often not as well known as the Senate incumbent (Westlye 1991). Thus, the informational advantage of incumbents is smaller in Senate elections, but they appear to enjoy a definite edge. This would lead to a prediction that estimates of spending effects in Senate elections might show a smaller relative advantage for challenger spending over incumbent spending than that observed in House elections, but not no advantage at all.

On the second count, I find that spending by Senate candidates, including incumbents, is very effective. According to the conventional explanation, spending by House incumbents does not increase their vote share because they are already well known. Accordingly, since Senate incumbents and, for the sake of argument let us stipulate Senate challengers, are also well known, spending by Senate candidates should have only minimal effect on the vote. On the contrary, I find that spending by both the challenger and the incumbent has large and statistically significant effects on vote shares.

To sum up, the results indicate that OLS underestimates the effectiveness of incumbent spending in Senate elections. What is more, the new estimates are not easily unified with the standard theory used to explain the difference in the effectiveness of incumbent and challenger spending levels. This implies that the contrary results of some previous work may follow from failure to account for endogeneity of spending levels, rather than from unique characteristics of Senate elections.

The finding that incumbent spending wins elections has important implications for recent American politics. Campaign finance, and specifically the level of incumbent spending, is a potentially critical factor in the competitiveness of congressional elections. The finding that incumbent spending effects are important also requires reconsideration of the consequences of campaign finance reform. The debate typically turns on what happens to challengers and neglects incumbents. Spending limits that apply to both are seen as severely biased in favor of incumbents. As Jacobson (1980, 186) argues, "campaign spending does have an important effect on who wins [congressional elections] and it is the amount spent by challengers (and other disadvantaged candidates) that actually makes the difference. Spending limits, if they have any effect at all on competition, can only work to the detriment of the challenger." In a companion paper, I conduct simulations of policy alternatives and show that, when the new estimates of incumbent spending effects are used, the conclusions inspired by the traditional view of campaign spending need major revision (Gerber 1993). For example, spending caps, even if set lower than some challengers' campaign spending levels, can significantly increase the chances of challenger victory.

Important issues remain to be addressed. First, the mechanism by which campaign spending influences vote totals is summarized here by a reduced form relationship. This may be a useful approximation of a complicated process, but additional work that attempts to isolate cases in which spending may have greater or lesser effect on election outcomes could lead to important new insights into the role of money in elections.[29] One useful direction would be to study variations in resource allocation by candidates, which would permit analysis of when different kinds of spending are most effective.[30] Finally, this paper estimates one equation in a multiequation system. Another area for research is to extend current work to examine in detail the sources of candidate funds. The goal of such analysis would be to construct and estimate a full system model linking contributors' and candidates' decisions.

[29] Exactly how campaign spending leads to more votes is an ongoing research question. Some theoretical work emphasizes the role of campaign spending in conveying information about the policy positions of the candidate and the opposition when voters are risk averse. Others have included campaign expenditures in the voter's utility function directly. See Hinich and Munger (1989) for a discussion of this literature. Alternative models presumably could emphasize credibility of communications and signalling considerations, as well as the component of spending that does not involve communication with the voters.

[30] Relatively little is known about how money is spent. This is due at least in part to difficulties in interpreting candidate expenditure reports, which allow substantial discretion in how expenditures are categorized (personal communication with Robert Biersack, statistician at the Federal Election Commission).

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