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Campaign spending and Senate elections, 1978–84

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1. Introduction

Nowhere is the gap between political rhetoric and empirical evidence more evident than on the issue of political campaign expenditures. While pundits decry high levels of spending, mainly by incumbents, and lobby for the public financing of all campaigns to promote fairness, most of the empirical literature indicates that campaign spending by incumbents has a negligible, or perverse, effect on their share of the vote. Taken literally, this result implies that expenditure limitations would enhance the already high rate of incumbent re-election that advocates argue is *caused* by expenditure differentials.

Scholars like Jacobson (1978, 1984) do not take their counter-intuitive results at face value, arguing that simultaneity, or some other statistical problem, causes the perverse findings. Yet, the use of more sophisticated techniques still produces results which imply that incumbent expenditures do not matter for election outcomes, and Jabobson eventually classifies proposals for campaign spending limits as "incumbent protection."

In this paper I report results showing that incumbent expenditures have a positive and significant effect on votes in the re-election campaigns of incumbent Senators. In addition, I argue that the simultaneity problem described by Jacobson is not theoretically inevitable, and present a statistical specification test that does not reject the validity of Ordinary Least Squares (OLS) in this dataset.

Section 2 briefly reviews the existing empirical literature and Section 3 explains and summarizes the data used in the paper. Sections 4 and 5 report and interpret the econometric results, while Section 6 examines the biggest campaign spenders. Section 7 demonstrates why Jacobson's Senate results differ so dramatically from mine, and Section 8 addresses the simultaneity issue. Section 9 discusses some difference between House and Senate elections found in recent research, and offers some concluding observations.

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2. Previous work

Empirical work on money in politics falls into three basic categories, (1) the characteristics of politicians that attract campaign contributions from various interest groups (see Grier and Munger, 1986; Poole and Romer, 1984; Wright, 1985); (2) the effect of interest group money on Congressional voting results for particular pieces of legislation (see Chappell, 1981; Durden and Silberman, 1976); and the classification of interest here, (3) the effect of campaign expenditure on election outcomes.

Welch (1974, 1981) was one of the first empirical investigators of the money-votes issue. His early work generated comments by Silberman (1976) and Giertz and Sullivan (1977). These papers all used party affiliation to organize the data. That is, the dependent variable was the percentage of votes received by the candidate of one particular party. While the studies consistently showed that Democratic party candidates were helped by Democratic spending and hurt by Republican spending, there was disagreement about the proper specification of the spending variable(s), and the correct functional form of the equation. Silberman collapsed spending by both candidates into a single variable, the ratio of Republican to Democratic spending. Welch pointed out that this type of variable makes an implicit assumption that the effect of spending on votes is the same for each political party, a fact that he felt was not supported by the data. The fact that campaign spending has no upper limit while vote percent is capped at 100% led researchers to experiment with functional forms from linear to log-linear to quadratic, with the latter two assumed superior because they allow diminishing returns to additional spending.[1]

Throughout these studies, the functional form and spending symmetry restrictions were debated and chosen without the benefit of much statistical testing. However the basic innovation in the literature was the discovery of another imported untested restriction in these models. Jacobson (1978) pointed out that using a party classification to measure the effect of spending on votes implies that incumbent and challenger expenditures have the same effect on votes. In two separate studies, Jacobson (1978, 1984) demonstrated that this was not the case in a series of regressions on House and Senate elections held from 1972 through 1982. He reports the result that incumbent spending, ceteris paribus, has a zero or positive statistical association with the challenger's percentage of the vote, while challenger spending is positive and statistically significant.[2] Recognizing that politicians would probably not systematically raise and spend millions of dollars against their best interests, Jacobson and others do not accept these perverse results at face value. Rather, they employ a variety of arguments to the effect that there is some systematic statistical problem with ordinary least squares (OLS), e.g., collinearity or simultaneous equations bias, that produces the "wrong" result. However, more sophisticated techniques do not seem to improve matters. Jacobson confesses that correcting for OLS bias with two stages least squares produces estimated coefficients that are often larger than the ones supposedly overestimated by OLS.[3] The literature has degenerated into arguments about whose identifying restrictions are the best, or even if any identification is possible. Section 8 contains a detailed discussion of possible bias in OLS estimators as well as other potential statistical problems. Now I turn to my empirical work, where the results differ from those of Jacobson.

3. Sample and model

This study focuses on Senate elections for several reasons. First is the fact that in most cases Senate elections cover a wider geographic area containing a much larger population than do House elections, and spending on mass advertising should be more important because of the lack of personal contact. Second, the high spending levels in recent Senate elections have produced the popular charges that money is buying elections followed by predictable calls for public financing of political campaigns.

The empirical model follows the lead of the existing literature in its simplicity. The incumbent's percent of the vote is regressed on campaign spending and other variables designed to measure exogenous factors in the election. The percent of the vote the incumbent received in the previous election and a dummy variable to control for scandal are included in the regressions below, while other factors like party affiliation and tenure in office were considered but not reported here due to their consistent insignificance. The incumbent's previous vote total is a way to control for different levels of incumbent "brand name," developed via past advertising expenditure and political accomplishments.

The dataset covers the four elections from 1978 through 1984. Observations are on elected incumbent Senators. I have excluded unopposed Senators because their percentage of the vote cannot be directly affected by any of the independent variables. Appointed Senators are also excluded because there is no data on the percent of the vote they received in the last election.

There were 135 individual Senate elections from 1978 through 1984. Subtracting 29 open-seat elections, 2 appointed incumbents and 3 incumbents who were unopposed in their re-election campaigns, 101 observations remain for analysis. Summary statistics on the voting and expenditure variables are presented in Table 1. Note that there is a great deal of variation in the spending patterns of individual candidates, both challengers and incumbents. In all the cross-sections, the standard deviations of the spending variables are large relative to their means.

As described above, the exact functional form of the spending – vote relation is not pinned down by the existing literature. Below I estimate linear and

Table 1. Data summary[a]

Variable[b]	Mean	Standard deviation	Minimum	Maximum
A. 1978 (N=20)				
%Vote	56.15	12.16	34.00	83.00
Incumbent$	292.28	219.13	60.89	968.32
Challenger$	138.88	123.86	0.00	465.93
B. 1980 (N=24)				
%Vote	56.00	10.44	39.00	78.00
Incumbent$	379.05	539.78	54.15	2626.09
Challenger$	242.14	355.68	1.13	1461.33
C. 1982 (N=29)				
%Vote	59.21	7.60	46.00	82.00
Incumbent$	361.26	300.05	0.00	1191.04
Challenger$	238.15	246.05	0.00	906.98
D. 1984 (N=28)				
%Vote	64.11	9.91	44.00	80.00
Incumbent$	476.89	346.17	64.28	1228.46
Challenger$	159.62	182.02	0.00	687.07
E. 1978–1984 (N=101)				
%Vote	59.19	10.34	34.00	83.00
Incumbent$	383.98	371.42	0.00	2626.09
Challenger$	197.67	244.85	0.00	1461.33

[a] Date are for races where an incumbent faced opposition in his re-election campaign.
[b] %Vote is the incumbent's percentage of the vote. Incumbent$ and Challenger$ are measured in 1972 dollars spent per thousand persons in the state.

Campaign spending data are from the Almanac of American Politics.
Vote percentages are from the Congressional Quarterly Almanac.
Population is from the Statistical Abstact of the U.S.
Spending is deflated by the GNP price deflator (1972 = 100).

quadratic expenditure functions over the full sample and the 1978–80 and 1982–84 subperiods.

4. Empirical results

The regression results are reported in Table 2. Here INT is the intercept, D8284 is an intercept shift dummy variable for the second half of the sample (it equals 1.0 for elections held in 1982 and 1984), $\%\mathrm{VOTE}_{-1}$ is the lagged dependent variable, and SCANDAL is a dummy variable equal to 1.0 once in each cross-section.[4] This variable is taken from the election surveys in the Congressional

Table 2. Campaign spending and Senate incumbent re-election percentages from 1978 through 1984

EQ.	INT	D8284	%VOTE$_{-1}$	SCANDAL	CHAL$	CHAL$2	INC$	INC$2	$\bar{R}^2$
A. 1978–84 (N=101)									
1.	46.4	4.17	0.212	−8.73	−0.0305	–	0.0104	–	.44
	(9.75)	(2.63)	(2.80)	(2.17)	(6.51)		(3.38)		
2.	48.3	4.37	0.192	−11.42	−0.0760	0.000059	0.0287	−0.0000159	.55
	(10.95)	(2.99)	(2.81)	(3.12)	(7.65)	(5.07)	(5.01)	(4.26)	
B. 1978–80 (N=44)									
3.	43.2	–	0.273	−14.81	−0.0337	–	0.0120	–	.37
	(4.29)		(1.65)	(2.23)	(4.06)		(2.25)		
4.	54.1	–	0.147	−14.95	−0.0877	0.000072	0.0223	−0.0000159	.49
	(5.35)		(0.95)	(2.5)	(4.99)	(3.41)	(2.47)	(2.83)	
C. 1982–84 (N=57)									
5.	51.4	–	0.200	−3.41	−0.0304	–	0.0098	–	.42
	(9.69)		(2.51)	(0.62)	(5.13)		(2.66)		
6.	53.1	–	0.198	−9.84	−0.0802	0.000067	0.0212	−0.0000073	.55
	(10.61)		(2.85)	(1.92)	(6.12)	(4.15)	(2.14)	(0.99)	

Observations are on elected incumbents who are running for re-election against an opponent.

%VOTE$_{-1}$ is a lagged dependent variable, CHAL$ and INC$ are real spending per thousand of population in 1972 dollars by challengers and incumbents respectively. Scandal is a dummy variable from CQ noting the one incumbent hurt most by exogenous scandal in each campaign.

Numbers in parentheses are T-statistics.

Quarterly Almanac, and picks out the one incumbent in each election most tainted by exogenous naughtiness.[5] CHAL$ is challenger spending measured in 1972 dollars divided by thousands of population. INC$ is incumbent spending similarly measured. CHAL$^{2} and INC$^{2} are the squares of the spending variables necessary to estimate a quadratic expenditure function.

The linear model (equation 1) displays the commonsense, but previously elusive, result that challenger spending hurts and incumbent spending helps the re-election propects of incumbent Senators. The coefficients on CHAL$ and INC$ are both significant at the 0.01 level. Equations 3 and 5 of Table 2 show that this basic result holds up in each half of the sample. Equation 2 is the quadratic expenditure model, and it also conforms to intuition by showing that both challenger and incumbent spending exhibit diminishing returns. Here each of the four expenditure coefficients are significant at the 0.01 level. Again equations 4 and 6 reproduce this model in the two subperiods. Note that in equation 6 the coefficient on squared incumbent expenditure is insignificant.

The dummy variable D8284 indicates a significant intercept shift of about 4 percentage points in the second half of the sample; %VOTE$_{-1}$ consistently has a positive coefficient, though its significance level is higher in second half of the sample, while SCANDAL has a persistent negative effect that appears larger in the first half of the sample. Over the full sample the quadratic equation explains 58% of the variation in voting.

These equations also give strong support to the notion that incumbents start with a significant built-in advantage over challengers. Using the intercept and %VOTE$_{-1}$ coefficients from equation 2, and 1984 data, the average incumbent starts with almost 64% of the vote (1984 mean of %VOTE$_{-1}$ = 59.2).

Part of this headstart must surely be attributed to the institutionalized campaign resources available to incumbent legislators. Paid staff, the franking privilege, and a television network are unpriced electoral assets that are denied to challengers. Measuring the marginal effects of these factors on elections are beyond the scope of this paper, but it is important to note that they exist. Interestingly most campaign reform proposals ignore these institutional advantages of incumbents.

A 0.20 coefficient on %VOTE$_{-1}$ implies that every 5 percentage points the incumbent gains in an election will be worth an additional 1 percentage point in the next election. This probably occurs by discouraging future well-qualified opponents.[6] This 20% rate of return gives politicians incentives to campaign for super-majorities today to ease re-election in the future.

Table 3 reports a series of statistical tests designed to give evidence on the correct level of data pooling and best functional form. First, comparing the sum of squared errors (SSE) of the 1978–84 regression to the sum of the SSE's in the two subperiod regressions gives an F-test on the stability of the slope coefficients in each model. As tests 1 and 2 show, the null hypothesis of coeffi-

Table 3. Some hypothesis tests

1. H_0: Linear model slope coefficients are equal in 78–80 and 82–84.
   $F_{4,91}$ = 0.55 (cannot be rejected, even at 0.10 level)

2. H_0: Quadratic model slope coefficients are equal in 78–80 and 82–84.
   $F_{6,87}$ = 0.95 (cannot be rejected, even at 0.10 level)

3. H_0: Squared terms equal zero, 78–84 (full model).
   $F_{2,91}$ = 12.87 (can reject at 0.001 level)

4. H_0: Squared terms equal zero, 78–80.
   $F_{2,31}$ = 11.69 (can reject at 0.001 level)

5. H_0: Squared terms equal zero, 82–84.
   $F_{2,50}$ = 17.15 (can reject at 0.001 level)

cient stability cannot be rejected even at a modest (0.10) significance level for either the linear or quadratic models.[7] This implies that the full sample estimates are appropriate.

Second, comparing the SSE of equations with and without the squared expenditure variables tests the null hypothesis that the linear model is correct. These F-tests are numbered 3, 4, and 5 in Table 3, and clearly indicate that the squared spending terms ($CHAL\$^2$ and $INC\$^2$) add significant explanatory power to the regressions. This result holds in all three samples used (even though $INC\$^2$ has an insignificant coefficient in 1982–84), and implies that the data consistently prefer the quadratic model.

In Table 4, I test the statistical significance of the differences in the shapes of the incumbent and challenger expenditure functions in both the quadratic and linear models. If the two functions are mirror images of each other, then only net spending by the incumbent matters. That is, the effect on %VOTE would be the same whether net spending changed by decreased challenger expenditure or increased incumbent spending. The equations in Table 4 force the functions to be mirror images by restricting spending to enter the models as the difference between incumbent and challenger expenditure. The reported F-statistics compare the fit of these restricted equations to the freely estimated ones above. Clearly, equal incumbent and challenger spending have different relative effects. The null hypothesis of equal sized, but opposite signed effects (mirror image functions) is rejected, even at the 0.001 level.

Based on these results, the individual quadratic expenditure functions embodied in equation 2 of Table 2 are singled out for further analysis.

Table 4. Does challenger and incumbent spending have equal-sized, but opposite-signed effects on incumbents' %VOTE?

EQ.	INT	D8284	$\%VOTE_{-1}$	SCANDAL	INC$-CHAL$	(INC$-CHAL$)^2	$\bar{R}^2$
1.	38.29	3.95	0.292	−12.84	0.0086	–	.22
	(7.11)	(2.11)	(3.32)	(2.74)	(2.39)		
				$F_{1,95} = 38.00$			
2.	36.96	2.85	0.300	−12.97	0.0335	−0.000032	.32
	(7.35)	(1.62)	(3.67)	(2.97)	(4.67)	(3.93)	
				$F_{2,93} = 25.05$			

T-statistics are in parentheses. The F-statistics test the null hypothesis that the challenger and incumbent expenditure functions are mirror images (i.e., coefficient on CHAL$ = −1* (coefficient on INC$). In both cases, the null can be decisively rejected at the 0.001 level.

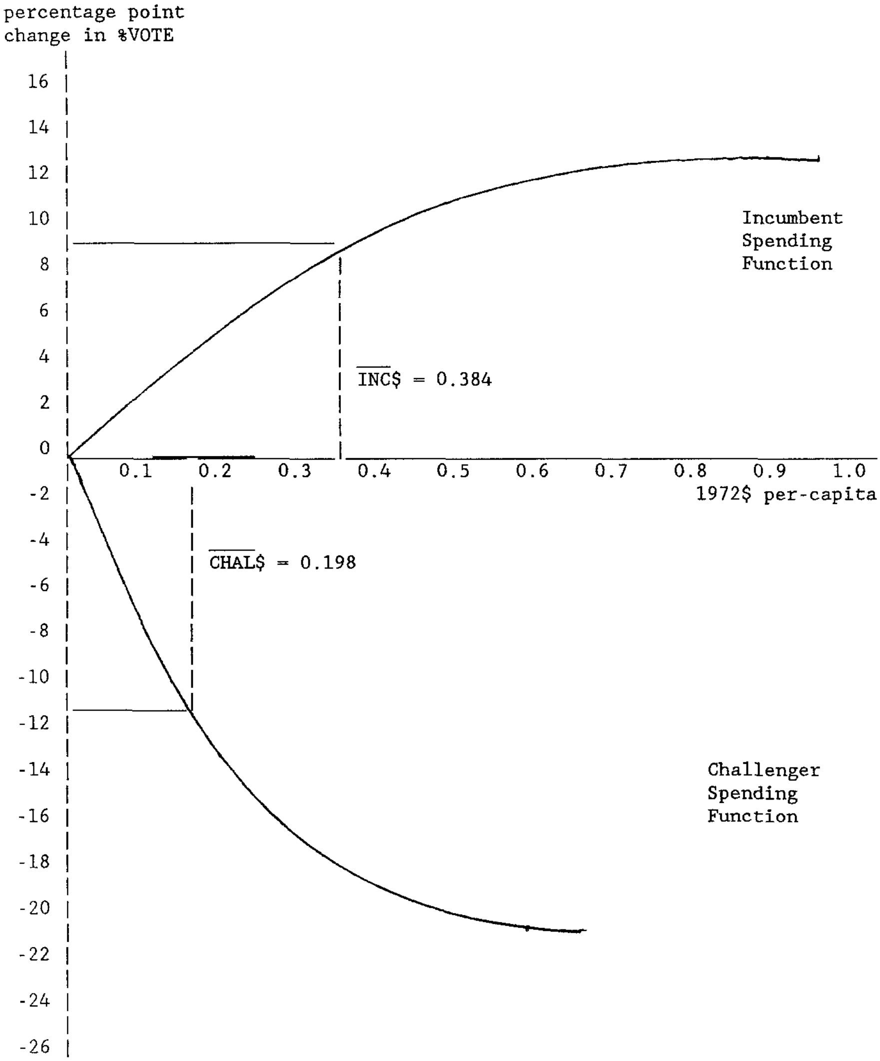

Figure 1. The relation between incumbents' percent of the vote and spending by challengers and incumbents. (From equation 2 of Table 1)

5. The effects of spending on votes

The estimated expenditure functions described above are graphed in Figure 1. The notable feature is that at lower spending levels, challenger spending is more effective than equal amounts of incumbent spending, while incumbent spending is productive longer than is challenger spending. That is, the challenger function is steeper, but peaks sooner than the incumbent spending function.

Numerically, challenger spending has a maximum negative effect at about $0.60 per person. This level of spending reduces the incumbent's vote percent, ceteris paribus, by about 21 percentage points. The sample mean of CHAL$ is $0.198 per person, which implies an 11.6 point reduction in incumbents' vote percentage.[8]

The incumbent expenditure function is maximized at $0.90 per person, implying a 13 point increase in incumbents' percent of the vote, other factors held constant. The sample mean of INC$ is $0.384, which translates to a 8.67 point increase in incumbent vote percent. On average then, incumbents spend $0.186 per person more than challengers (almost twice as much) to achieve a net loss of 2.96 percentage points, other factors held constant.

Quadratic functions assume declining marginal products. Here challengers start with higher marginal productivity that declines faster than incumbents'. At the average challenger expenditure of $0.198 per-capita, an additional penny per person spent by the challenger lowers the incumbents vote percent by 0.52 points while a penny increase in incumbent spending raises his vote percent by 0.24 points. Challenger spending is twice as productive at this point. At the average of incumbent spending ($0.384) an additional penny per-capita of challenger (incumbent) spending lowers (raises) the incumbent vote by 0.29 (0.16) percentage points. At spending levels of about $0.55, marginal products are equalized. Here an extra penny per capita spent by the challenger (incumbent) lowers (raises) the incumbent vote percent by about 0.105 points.

These results can explain why expenditure limits or public financing have not been enacted by incumbents.[9] The average 2.96 net percentage point vote loss suffered under the current system is better for incumbents than the likely outcome under expenditure regulation. Suppose an expenditure limitation was enacted at $0.20 (in 1972 dollars) per person, roughly the mean of challenger spending in my sample. Then, incumbent net loss due to differential expenditure productivity would be 6.58 percentage points, more than twice the estimated actual average loss. Given the functions in Figure 1, the worst case scenario for incumbents would be publically financed campaigns at a level of about $0.55 per capita. This level of spending by both challenger and incumbent creates a net vote loss of 12.86 percentage points for incumbents. As long as incumbents have an advantage in raising money, they will on average prefer laissez-faire campaign financing. The next best alternative would be extremely low expenditure limitations. For example, the current average incumbent vote loss of about 3 percentage point could be duplicated with an expenditure limit of just under $0.07 (in 1972 dollars) per capita. Any limit greater than this, up to around $0.55, increases challengers' prospects above their estimated actual average position.

One obvious reason that challenger spending has a relatively larger effect at low expenditure levels when compared to incumbent spending is that in order to be elected, a candidate must be recognizable to the voters. While incumbents are typically well known before buying any campaign ads, initial challenger spending typically must buy recognition. Jacobson (1978) has shown a strong positive correlation between challenger spending and challenger name recognition in voter surveys.

Additionally, incumbents have their positions recorded in their voting history, so that it is generally easier to direct negative advertising at incumbents than at challengers. That is, it may be easier to get voters to turn against a politician the more positions the politician is forced to take. Perhaps incumbents are unwilling to stoop to effective, but negative, advertisements until they are in a serious contest (i.e., the challenger has spent a significant amount of money).

6. Big spenders

Besides the perverse effects of incumbent spending, Jacobson was also displeased by the estimated rate at which negative returns to additional spending occurred in his quadratic models. This, rather than the type of statistical test undertaken above, was the reason he rejected the quadratic model.[10] In the equations estimated here, negative returns do not occur too quickly for either challenger or incumbent spending. The maximum points of the functions are 3 and 2.4 times larger than the means of challenger and incumbent spending.

The three instances of greatest total per-capita spending in an election were cases where both incumbent and challenger overshot their estimated maximum effective spending points. In 1980, Abnor beat incumbent McGovern 61% to 39% having spent $1.46 to McGovern's all time record $2.63 per South Dakotan.[11] In the 1980 Idaho race where challenger Symms beat incumbent Church by 51% to 49%, Church spent about $1.15 and Symms $1.06 per person. Finally in 1984 in North Carolina, incumbent Helms defeated Hunt 52% to 48%, and both men barely overshot the empirical maximum effect point with Helms spending $1.23 and Hunt $0.69 per person.[12]

Since these few outliers seem concentrated in small states, it is natural to wonder whether the regression equations are influenced by population. I test for heteroskedasticity in the regression error term via the Goldfeld-Quandt (1965) test. The F-statistics for the linear and quadratic equations are 1.02 and 1.04. The null hypothesis of a constant variance of the regression error term cannot be rejected, even at the 0.10 level.

Even given this result of no heteroskedasticity, it is possible that small states should not be given equal weight with large states in the regressions. I investigate this by estimating a population weighted version of the quadratic model. The signs and significance levels of all the coefficients are unchanged, and the only substantive change from equation 2 in Table 2 is that the intercept becomes smaller and the coefficient on $\%VOTE_{-1}$ becomes larger.

7. Why are these results different?

This paper reports results that help explain Jacobson's paradox that incumbents have not enacted expenditure limits though (he finds) any campaign spending hurts them. Here, incumbent spending is effective, but not as effective as challenger spending until a fairly high level of expenditure. As long as incumbents can raise substantially more money than challengers, they will prefer a system that lets them outspend their opponent.

One remaining question is why my results differ so greatly from Jacobson's results on the Senate in his 1978 and 1984 papers. Three possible answers to this question are (1) different equation specification, (2) different functional forms, and (3) different samples.

In Jacobson's work on the Senate, he presents only semi-log regressions on individual cross-sections of a model that in my notation would be:

$$(100\text{-VOTE\%}) = B_0 + B_1{*}\text{Ln(CHAL\$)} + B_2{*}\text{Ln(INC\$)} + B_3{*}\text{CHALPARTY} \quad (1)$$

Where CHALPARTY = 1 if the Challenger is a Democrat and zero otherwise. He consistently reports insignificant coefficients for Ln(INC$). Compared to my model, Jacobson excludes variables to control for the general level of incumbent support ($\text{VOTE\%}_{-1}$) and vote reducing scandals (SCANDAL), and includes a party dummy variable. None of these factors make any difference in my results. Adding party gives an equation where party is insignificant and the other variables basically unchanged, while dropping SCANDAL gives only a slightly adverse effect on the significance of $\text{\%VOTE}_{-1}$ without effecting the size or significance of the expenditure variables.

Jacobson's sample selection technique varies slightly from mine. In the 3 election cross-sections we both study (1978, 1980, 1982) I have 20, 24, and 29 observations, while Jacobson has 21, 24, and 30. I believe that this is because in both 1978 and 1982, there was an appointed incumbent running for re-election that I exclude because $\text{VOTE\%}_{-1}$ is missing.

The biggest difference though is the functional form. While Jacobson (1978: 478) reports on linear and quadratic equations in House election regressions, he only shows semi-log equations for the Senate, noting that "The regression model that clearly fits the data best is the semi-log form." The effect this choice of functional form has on the results reported here depends crucially on what is done with the 5 observations where either incumbent or challenger spending is equal to zero.[13]

Since the natural log of zero is undefined, the observations must be dropped or altered in some ways. Changing the zeros to $1.00, and including the observations as Jacobson does produces the result of an insignificant incumbent

Table 5. Explaining Jacobson's Senate regression results

EQ.	INT	D8284	%VOTE$_{-1}$	SCANDAL	Ln(CHAL$)	Ln(INC$)	$\bar{R}^2$
1978–1984: expenditures of zero set to $1.00 (N = 101)							
1.	50.78	4.287	0.212	−10.967	−2.095	0.393	.51
	(9.59)	(2.93)	(2.99)	(2.95)	(8.15)	(0.89)	
1978–1984: expenditures of zero dropped from sample (N = 96)							
2.	43.79	4.112	0.229	−10.050	−4.705	3.631	.54
	(6.89)	(3.01)	(3.53)	(3.01)	(8.29)	(3.53)	

Numbers in parentheses are T-statistics.

spending coefficient in the full sample. This is displayed in equation 1 of Table 5.

However, dropping the 5 observations where one candidate spent no money reinforces my result that incumbent spending is significant, but less productive over a given range of experience. This is shown in equation 2 of Table 5, where the log of incumbent spending per thousand of population is positive and significant at the 0.001 level, but about 25% smaller than the size of the challenger spending coefficient.

One likely reason that setting zero spending equal to $1.00 makes such a big difference is that before the regressions are estimated, spending is divided by population (and in my data by a price deflator). 1/population is a very small fraction which makes the log of 1/population a very, very large negative number. This data manipulation exacerbates the degree that the zero spending observations are outliers, putting an unwarranted greater weight on these observations in determining the values of the regression coefficients. In any case, the semi-log equation does not dominate the quadratic equations under the crude metric of adjusted R^2, and the quadratic functions do not require artificial data manipulations before estimating them on the full sample.[14]

8. Simultaneity bias?

Contrary to previously reported results, the equations estimated here find a significant positive relationship between incumbent expenditures and incumbent vote percentage that is intuitively plausible. However, Jacobson and others have argued that OLS results like these suffer from simultaneity problems that cause the spending variables to be correlated with the error term in the %VOTE equation. This implies that OLS coefficients are biased and inconsistent.

Jacobson in particular argues that while spending should affect votes, the viability of the candidate will affect money raising, and thus spending. By equating the *actual* vote with the *expected* vote, he arrives at the conclusion described above, that OLS estimates are biased.

> The OLS equations show that challengers win votes by spending money; but it is also clear that the amount they spend depends on their anticipated ability to win votes. When two variables are reciprocally related, their OLS coefficients are subject to bias and inconsistency because *endogenous variables, treated as explanatory variables, are correlated with the error term* (Jacobson, 1984: 31) (Emphasis added).[15]

I believe this argument is wrong. To see why, consider the classic illustration of simultaneous equation bias, a simple supply and demand model.

$$q^d = a_1 - b_1(p) + e_1 \quad (2)$$

$$q^s = a_2 + b_2(p) + e_2 \quad (3)$$

$$q^d = q^s \quad (4)$$

Here q is quantity and p is price, the superscripts d and s denote demand and supply, and e_i is the OLS error term in the ith equation. A positive demand shock ($e_1 > 0$) will shift out the demand curve. With supply held constant, this raises both price and quantity. Clearly, then, the independent variable p is positively correlated with e_1, and the OLS estimates of a_1 and b_1 will be biased and inconsistent. The reason this occurs is that the two endogenous variables, price and quantity, are determined at the same point in time. Now consider a simple version of Jacobson's Vote/Expenditure model:

$$\%\text{VOTE} = a_1 + b_1(\text{EXPENDITURE}) + c_i(X_i) + e_1 \quad (5)$$

$$\text{EXPENDITURE} = a_2 + b_2(\text{EXPECTED }\%\text{VOTE}) + f_i(Z_i) + e_2 \quad (6)$$

$$\text{EXPECTED }\%\text{VOTE} = E\,[\%\text{VOTE}] \quad (7)$$

Where E[] denotes the expected value operator and the X's and Z's are other exogenous explanatory variables. Here I have replaced the assumption of literally accurate expectations with best linear unbiased expectations. By definition, the regression error term e_1 has an expected value of zero, so when contributors form expectations on the right hand side variables of equation 4 to find how well they expect the incumbent to do and therefore what they will contribute, the one thing they do not know anything about is the unpredictable component of the election, e_1. Expected vote and therefore contributions are independent of the random error in the %VOTE equation and there is no bias produced from the fact that expenditure is an endogenous variable used as an explanatory variable in the equation.

This argument stands, even though the expectations-contributions-expenditure sequence is repeated many times at different points in the campaign. As long as there is any random error in the %VOTE equation, expectations and contributions made before the actual election are independent of that error and no coefficient bias develops.

Jacobson's simultaneity argument depends crucially on the assumption that expectations are exactly accurate, which is an untenable position. If, as he assumes, contributions are based strictly on expected outcomes, and expectations are accurate then the losing candidates are known from the beginning and should not attract any campaign funds. Simple observation indicates that the history of American politics is crowded with well financed losing candidates. As long as elections have some resemblance to a horse race Jacobson's argument does not hold.[16]

In addition to this logical argument, there is a statistical test for the existence of correlation between an endogenous regressor and the regression error term, generally referred to as the Hausman-Wu specification test (See Hausman, 1978; Wu, 1973). The test is applicable whenever instrumental variables techniques are possible. It exploits the fact that, under the null hypothesis of no correlation, the predicted values of the endogenous explanatory variables from the first stage regression as well as the residuals from the regression will have the same coefficient value in the original regression. This means that these residuals from the first stage should have a zero coefficient when added to the original equation that contains the actual endogenous variable.[17]

I operationalize this test by regressing incumbent spending on all the other explanatory variables in the %VOTE equation along with population, tenure, a dummy for party, and a dummy for holding a party leadership position.[18] When the residuals from this regression are added to the original linear %VOTE equation, the coefficient is −0.0095 with a T-statistic of 1.26, which is insignificant, even at the 0.20 level. The inability to reject that the coefficient is zero implies a corresponding inability to reject the hypothesis that incumbent expenditure is uncorrelated with error term in the %VOTE equation. This means there is no statistical evidence to convict the OLS results presented above on charges of coefficient bias and there is reason to be skeptical about claims of potent simultaneity in the contributions – voting outcome relationship.

Another reason often given for the inability to measure positive effects of incumbent spending is that incumbent spending is reactive. Incumbents only spend a lot when a challenger is spending a lot, and the collinearity between the spending variables is such that the computer cannot precisely separate the ceteris paribus effect of incumbent spending. It is indisputable that challenger and incumbent spending is correlated. In my full sample the linear correlation between INC$ and CHAL$ is 0.72. However this is not obviously a distressingly high degree of correlation. If social scientists were restricted to regressions where all pair-wise correlations between independent variables was less than 0.70, there would be a lot more journal space for theory. Generally, the existence of linear correlation between explanatory variables is neither a necessary or sufficient condition for the inference that undesired results are caused by a collinearity problem.

Belsey, Kuh and Welsch (BKW, 1980) have suggested a sophisticated approach to the detection of harmfull collinearity. Here the ratios of the largest to all the other characteristic roots (eigenvalues) of the data matrix are computed. A large ratio, called the condition number, implies a small eigenvalue relative to the largest of the matrix, creating a suspicion of collinearity problems.[19] BKW and Kmenta use 30 as the critical value of the condition number. In all the regressions run for this paper, no condition number ever exceeded 20. The linear correlation between challenger and incumbent spending does not seem to cause a problem, at least in this data set.

9. Conclusions

This paper uses a sample of recent Senate election results and estimates vote equations that show challenger spending hurts, and incumbent spending helps, incumbent re-election. While both types of spending have diminishing returns, the effects are asymmetrical. Challenger spending is more productive at lower levels of spending, but incumbents can spend greater amounts more profitably than can challengers. These results can explain why Senate incumbents spend money, why they typically outspend their challenger, and why incumbents who can outspend their challenger would tend to be against spending limits or public financing.

However, the results do not explain why incumbent spending does not "work" in House election equations. Jacobson and others have run countless linear and quadratic specifications that persistently show perverse effects for incumbent spending. These results are not affected by the procedural problem of logging observations that have a value of zero, and pose a genuine puzzle. There are other empirical results suggesting the idea that there are basic differences in the nature of elections between the House and Senate. For example, Grier and Carlson (1988) find that state-level economic conditions have a strong effect on individual Senate elections, while Owens and Olson (1980) find that district-level economic conditions have no effect on House elections. Since I show that there are a significant number of elections where incumbent spending does matter, and that simultaneity bias may not be a tenable explanation for results where incumbent expenditures do not matter, it may be time to take a new look at the House data or to develop a testable theory that can explain persistant empirical differences in the determinants of elections in the House and Senate.

Notes

1. The log-linear function implies diminishing returns to spending that asymptotically approach zero, while the quadratic function allows negative returns to occur.
2. However, Jacobson also chooses his preferred functional forms on nonstatistical grounds, and does not make a serious attempt to exploit the consistency property of least squares by pooling his data, or even testing the appropriateness of pooling the data. This can be important in Senate elections where the individual cross-sections are small.
3. "The 2SLS (two-stage least squares) slopes are steeper than the OLS slopes, which is surprising, since simulteneity is supposed to create an upward bias in OLS estimates" (Jacobson, 1984: 33).
4. I also included a dummy variable for party (= 1.0 if Democrat) and a continuous variable for tenure (= number of years of service in the Senate). None of these variables is significant in any of the sample periods and models used in the text. The dummy variable D8284 is included to allow the pooling tests reported in Table 3 to concern only the slope coefficients in the regression.
5. For very election, the CQ Almanac surveys the Senate races, pointing out incumbents injured most by scandalous behavior. From 78–84 the scandal-plagued candidates are Brooke, MA (personal finances), Talmadge GA (censured by Senate), Cannon NV (Teamster bribe case), and Jepson IA ("health spa"/bordello). Feldman and Jondrow (1984) and Ragsdale and Cook (1987) also use a very similar variable. Dropping this variable has no material effect on the reported results.
6. Ragsdale and Cook show (1987) that incumbent actions like district trips and staff size do not have a measurable influence on challengers' fund-raising ability, but they do not investigate the effect of $\%VOTE_{-1}$ on challengers. Instead of $\%VOTE_{-1}$, Lott (1987) directly uses past campaign spending to measure brand-name influence on current elections.
7. This result is unchanged when the pooling test is conducted by estimating four cross-sectional equations and then comparing the sum of the four individual SSE's to the SSE of the regression over the full sample with 3 intercept shifts.
8. The spending data are measured as $ per thousands of people in the tables to reduce the number of zeros in the regression coefficients, while the text and Figure 1 are scaled in $ per-person.
9. Strictly binding limits on campaign spending have been ruled unconstitutional by the Supreme Court. Current proposals call for public financing in return for "voluntarily" adhering to the limits along with public money to match spending by an opponent who spends over the limit.
10. "I rejected the quadratic form because it not only allowed for diminishing returns but also showed them becoming negative at implausibly low levels of spending" (Jacobson, 1984: 15).
11. McGovern's profligacy is such an outlier that taking it out of the sample reduces the mean of incumbent spending from 383.9 to 361.4 and the standard deviation from 371.4 to 296.7. However, omitting this observation from the dataset has basically no effect on the results.
12. In the 1984 data, there are 2 cases of lavish incumbent spending in elections that turned out to be easy victories. Stevens spent $1.19 per person in Alaska getting 71% of the vote and Biden $1.18 in Delaware getting 60%.
13. One of these zero spending observations in incumbent William Proxmire running for re-

election in 1982. The other four are challengers. John Stokes vs. Sam Nunn in 1978, Clarence Brown vs. Spark Matsunaga in 1982, Mike Hicks vs. Sam Nunn in 1984 and Victor Ryan vs. Alan Simpson in 1984.

14. I confirmed Jacobson's technique via private communication. Additionally, estimating the quadratic spending equations on a sample that excludes the observations where one candidate spent no money does not alter the results presented above.
15. As I show below, the phrase in italics is not literally true.
16. Ragsdale and Cook make a similar observation: "it is logically inconsistent to use the strength of the challenger as it actually emerges as a surrogate for the expected strength of the challenger before the election occurs. To the extent that incumbents have abilities to preempt challengers and win votes, the actual election results are not good estimates of expected election results."

    There is another, more subtle, avenue for simulteneity problems to appear. If the error term in the contribution equation is correlated with the error term in the voting equation, then a "seemingly unrelated" technique that estimates both equations and the error covariance at the same time is the best technique.
17. Suppose the model can be described as:

$$y_i = a_0 + a_i x_i + e_i \quad (1)$$

where we suspect that x is correlated with e. If there is an exogenous variable z such that,

$$x_i = b_0 + b_1 z_i + v_i \text{ we can obtain} \quad (2)$$

$$\hat{x}_i = \hat{b}_0 + \hat{b}_1 z_i \text{ and } \hat{v}_i = x_i - \hat{x}_i \quad (3)$$

Intuitively, if there is no bias in equation 1, then when we replace x with $\hat{x}$ and $\hat{v}$, the two parts of x should have equal coefficients. If there is bias, it should show up in a different coefficient on the residuals. That is, under H_o:

$$y_i = a_0 + a_i\hat{x}_i + a_2\hat{v}_i + e_i, a_1 = a_2. \quad (4)$$

This can be simplified as follows:

$$y_i = a_0 + a_1(x_i - \hat{v}_i) + a_2\hat{v}_i + e_i, \text{ or} \quad (5)$$

$$y_i = a_0 + a_1 x_i + (a_2 - a_1)\hat{v}_i + e_i, \quad (6)$$

so that the null hypothesis is simply that the coefficient on the residuals equals zero. See Kmenta (1986: 365–366) for a further exposition and Palda and Palda (1985) for an example of this test applied to Canadian voting data. The fact that this test finds no evidence of bias in the OLS equation is important because this implies that simultaneity problems from other sources than what Jacobson discusses (e.g., cross-equation correlation of error terms) are not important in this data.

18. This first stage equation has a good fit ($R^2 = .67$) and the exogenous variables that are used here and excluded in the Vote% equation are significant as a group in the spending equation and insignificant in the Vote% equation.
19. Perfect collinearity (a non-invertable data matrix) implies that at least one eigenvalue is zero. A small eigenvalue cannot be well-defined in absolute terms because it is possible that a data matrix A with a set of characteristics roots all less than those of another matrix B has less of a collinearity problem than does B. Hence the relative definition of smallness embodied in the condition number.

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