Public Choice **95:** 51–62, 1998.

Whether one votes and how one votes*

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Accepted 14 November 1995

Abstract. The aim of this paper is to determine if *whether* one votes effects the vote that is cast. Using an economic model of voting and observed voting results on nuclear power referenda, the answer is a resounding yes. Overcoming registration, turnout, and “roll off’ hurdles dramatically increases the odds of voting against nuclear power. Indeed, participation swamps both economic and preference variables in the explanation of nuclear power voting outcomes. The lesson is that there is a structure to participation at the polls that should not be ignored by those interested in analyzing voting outcomes.

1. Introduction

This paper extends economic voting models in what ends up to be an extremely important way. Cox and Munger (1991) develop the idea that voting on a given issue requires individuals to leap successive hurdles to voting; voters must register, get to the booth, and vote once in the booth. This idea was further developed by Fort (1995) with a recursive treatment of voting hurdles. We pursue the idea further and discover that *whether* individuals cast a vote does influence *how* they vote.[1] For a data set of state-wide referenda, successfully navigating voting hurdles significantly increases the odds of voting against nuclear power. Further, quantitatively speaking, this participation impact swamps the usual instrumental and expressive parts of the voting explanation. Participation is between forty and seventy times more important than either instrumental or expressive impacts. Given this outcome, those interested in analyzing voting outcomes would do well to model the structure of participation.

* This investigation was supported in part by funds provided by Washington State University. The paper is better than it otherwise would have been thanks to comments by Linda Cohen, Brian Roberts, William Hallagan, Mathew McCubbins, Robert Rosenman and Tesa Stegner. Additional thanks to seminar participants at the Department of Economics, University of California (Irvine) and the Department of Political Science, University of California (San Diego), and session participants at the Western Economic Association meetings and the Public Choice meetings.

This not to say that instrumental (economic gain) and expressive (preference revelation) voting motivations do not matter. Our approach includes both of these explanations, as well as the structure of participation. Expressive voting has been found to dominate other types of nuclear voting, such as weapons freeze initiatives (Feigenbaum, Karoly, and Levy, 1988). Thus, in addition to the typical instrumental motivation (price terms, income effects, and interest group effects related to expected wealth changes), we include an index meant to hold environmental tastes and preferences constant (expressive intent). It ends up that both instrumental and expressive intentions are detected but the probability of voting against nuclear power is much more responsive to variables measuring the former.

The paper proceeds in four parts. First, the theory of individual utility maximization under referendum decision making is detailed. Second, the empirical framework is specified and the data are discussed. Third, the results are presented. Conclusions round out the paper. While instrumental intentions have a larger impact on nuclear power voting than expressive intentions, nuclear power referenda outcomes are most responsive to overcoming the hurdles to voting.

2. Theoretical approach: Individual decisions in the referendum context

The model developed here follows earlier work by Deacon and Shapiro (1975) and Fort and Christianson (1981). Under any public policy, k, individual i faces a consumption vector, q_k, at prices p_k. Some elements in the consumption vector may be provided collectively so that some elements in the price vector are tax prices rather than prices determined in private markets. The individual decision problem is to choose q_k so as to maximize utility subject to an income constraint, M_k. The subscript k makes clear that prices, income and the consumption vector can all be affected by the policy choice. Satisfaction of the individual's problem yields the indirect utility function,

$$V_k = V(p_k, M_k; y). \tag{1}$$

Since other socioeconomic characteristics will matter (the "all else constant" requirement), the vector of these characteristics, y, is included in (1).

But, rather than an individual consumption choice, the individual's role is taken to be voting on a referendum over a pair of policy choices. For example, and pertinent to our data set, let k = 0 represent closing a particular nuclear power facility and k = 1 represent letting the plant continue to operate. The highest levels of indirect utility attainable under the alternatives are:

$$V_0 = V(p_0, M_0; y) \tag{2}$$

$$V_1 \ = \ V(p_1, M_1; y). \tag{3}$$

Thus, the choice will depend upon levels and changes in prices and income as indicated in the following expression.

$$V_0 - V_1 = \Delta V = \Delta V(p_0, M_0, \blacksquare p, \blacksquare M; y). \tag{4}$$

It is worth noting that both the initial starting points and the changes in prices and income matter. It is changes in quantity demanded, not changes in demand that result from changes in price (so that the point of departure is important) while any notion of income elasticity requires the original income level.

A simple rule is vote to close the facility if $\Delta V > 0$. Herein lies the foundation of both instrumental and expressive voting behavior. For the former (all else constant), changes in prices, income, and wealth under the referendum alternatives determine voting behavior. But tastes and preferences toward nuclear power are part of the "all else constant" bundle. Attention to variables measuring environmentalist sentiment may reveal the relative strength of instrumental versus expressive voting intentions in the explanation of voting on nuclear power.[2]

But there is an added complication. Thus far, the presence of the voter at the polls has been (heroically) assumed. But a significant portion of potential voters fail to vote on a given issue. In the sample used here (on average), about 71% of potential voters actually register, 78% of these actually get to the booth (indicated by casting a vote for President), while 91% of those in the booth voted on the referenda under study. Thus, on average, only about 50% of the potential electorate casts a vote on a given referendum issue.

For now, let the hurdle-jumping, participation function depend upon a vector of determinants, C, as stated in (5). The conditioned voting decision is the amended version of (4) that appears in (6).

$$H \ = \ H(C), \tag{5}$$

$$V_0 - V_1 \ = \ \Delta V(p_0, M_0, \blacksquare p, \blacksquare M; y, H). \tag{6}$$

At the very least, conditioning on H is required to overcome the bias inherent in attributing observations about only those who voted on the referenda to a more general population. But the impact of participation on the voting decision is important in its own right. Does how people vote depend on whether or not they vote in the first place?

3. Empirical specification in the data

Use of the complete specification in (5) and (6) would be rare since a change in policy typically will affect subsets of prices and the incomes for some individuals. Further, it is extremely unlikely for the case at hand that cross-price effects are large enough to affect tax price elements in the p_k vector. Finally, empirical analysis is simplified if all individuals face the same prices for other goods.

Empirically, another limiting factor is secret ballot voting which precludes any analysis at the individual level. As a result, what follows is a "representative voter" approach where inferences about community preferences toward nuclear power is taken from the relationship between aggregate voting outcomes and county-level and state-level data. This is useful subject to the assumption that summary values of explanatory variables must be allowed in place of individual values.

In equation (6), ΔV is assumed to be a random variable from the researcher's perspective, with the parameters of the distribution of ΔV known. As a result, the *sample* proportions voting yes and no, with the inclusion of an error term, reflect the true probability of the yes-no result. Since the exponential is the most representative distribution for ΔV, logit analysis is used to estimate expression (6). With repeated sample observations for given values of the explanatory variables, the log-odds of the probability of a yes vote simply is $\log\left(\frac{\text{YES}}{\text{NO}}\right)$. Heteroskedasticity problems require weighted least squares rather than ordinary least squares.

There are three reasons to expect heteroskedasticity problems for our data. First, the dependent variable is between zero and one (Zellner and Lee, 1965). Second, using state-level data for some variables while the unit of observation is the county can produce non-constant variances. Finally, we employ a variable to measure county preferences that is based on the observed environmental voting scores of the county's member of the U.S. House of Representatives. About 5% of the counties spanned more than one member's district. In order to allow for the full variation of county preferences, multiple scores for given counties were kept and the remaining data simply duplicated for that county, a sure prescription for heteroskedasticity. Since the form of the heteroskedasticity is unknown, White's (1980) correction to the variance-covariance matrix was utilized to get consistent estimates.

The variables all are defined and descriptive statistics appear in Table 1. A yes vote is a vote against nuclear power. The empirical version of (6) was specified as follows:

$$\begin{aligned}\log\left(\frac{\text{YES}}{\text{NO}}\right) = {} & a_2 + b_1\,\text{HSPlus} + b_2\,\text{CollPlus} + b_3\,\text{MedAge} \\ & + b_4\,\text{Over65} + b_5\,\text{Urban} + b_6\,\text{Density} + b_7\,\text{Income} \\ & + b_8\,\text{Price} + b_9\,\text{EmplElec} + b_{10}\,\text{Nuke} + b_{11}\,\text{Plus} \\ & + b_{12}\,\text{Minus} + b_{13}\,\text{RefClose} + b_{14}\,\text{Constrain}\end{aligned}$$

$$+ b_{15}\ \text{Participation} + e_2. \qquad (7)$$

The fitted participation variable is taken directly from the result in Fort (1995). While the derivation is shown in the Appendix, the basic idea is that registration, turnout, and voting in the booth occur in a recursive way prior to when an individual casts their vote on a given issue. The results of the earlier work provide the variable that captures estimated participation (recursive hurdle jumping) and allows the model in (7) to condition on the effects of making it to the booth in the first place. In addition, the participation variable will identify if whether individuals vote effects how they vote; if $b_{15} > 0$, then anti-nuclear voting by county residents increases with higher levels of participation and vice versa.

The instrumental (economic) part of the explanation is captured by the income, price, employment, and nuclear generating capacity variables. Income is included to determine whether or not anti-nuclear sentiment is a normal or inferior good. Price is meant to capture expectations about the change in price, should interference in nuclear generation happen due to referendum passage. Its estimated coefficient should be positive (the lower the price of electricity, the less likely one will be to vote against the source of this low price, current nuclear generation). Also, those directly involved in electric services and industries heavily dependent upon electricity should expect their economic welfare to change in the event to altered generation techniques. Expected to be an important interest group in favor of nuclear generating capacity and cheaper electricity, the sign on this variable should be negative. In addition, whether the county is served by a utility company with nuclear generating capacity or not, that is, whether the county is directly perceived by the voters as “nuclear-powered,” is included as an additional economic consideration.[3]

Expressive intentions at the polls are measured by environmentalist attitudes. Since individual measures could not be found, we employ League of Conservation Voters (LCV) scores for the elected representative serving the county at the time of the referendum. Our measure of environmentalist extremism is the deviation of the representative’s score from the midpoint of 50. The more extreme are pro-environmental preferences (the higher the postive deviation from 50), the more likely it is that the representative voter will support anti-nuclear referenda and vice versa.[4]

Finally, two controls are included for closeness of the referendum vote and whether the issue was to constrain existing plants versus future plants only. Estimation invovles voting data on nine nuclear power referenda, seven in 1976 and two in 1980. Observations are at the county level. Details of the referenda appear in Table 2. Voting outcomes on nuclear power referenda are particularly well-suited to analysis. The incentive for voters to make

Table 1. Variable descriptions

Variable	Description	Min	Max	Mean
Dependent variable	Ratio of referendum YES to NO voting outcome	0.10	0.53	0.33
Demographics				
(County and City				
Data Book)				
HSPlus	Percent of the age 25 population with education between 12 and 16 years, inclusive	31.9	65.5	54.0
CollPlus	Percent of the age 25 population with greater than 16 years of education	4.00	46.2	13.8
MedAge	Median age (years)	20.6	46.4	31.0
Over65	Percent of the population over 65 years of age	1.6	25.4	11.8
Urban	Percent of the population in urban areas	0.00	100	44.4
Density	County population density (persons/sq. mi.)	0.30	14,767	277.5
Economics				
Income *County and City Data Book)*	Median Household Money Income ($)	11,934	53,071	29.822
Price (*Typical Electric Bills*, USEIA)	Average monthly price of electricity for 1000 kwH users ($)	– –	0.23	0.02
EmplElec *(County Business Patterns)*	Percent of the population over age 18 employed in electric services and primary non-ferrous metals production	0	19.6	0.358
Nuke *(Inventory of Power Plants in the U.S.)*	1 if the electric utility serving the county owns a nuclear generating plant, 0 else	0	1	0.009[a]
Preferences				
(Almanac of				
American Politics)				
Plus	If House member's LCV score is greater than 50, then LCV-50, 0 else	0	50	8.32
Minus	If House member's LCV score is less than 50, then ILCV-50I, 0 else	0	50	15.6
Controls				
RefClose	Raw majority margin of the referendum vote, itself[b]	55,368	2.1 mil.	804,470
Constrain	1 if the referendum is to close or constrain existing facilities, 0 else	0	1	0.790[a]
Participation	Fitted participation derived as in the Appendix	0.280	0.735	0.491

[a] Means of dichotomous variables give the sample proportions of the occurrence of the variable.
[b] Cox (1988) shows that raw majority is econometrically correct and outperforms other measures such as net and relative majority.

Table 2. Nuclear referenda, 1976 and 1980

1976	
Arizona	(14 counties): *Proposition 200*. Setting review procedures for production. The force of approval would stop Palos Verde Station (3 plants) under construction. Vote against: 70%
California	(58 counties): *Proposition 15*. The issue is setting nuclear power standards. Some existing plants would fail to meet the proposition's requirements. Vote against: 67%
Colorado	(63 counties): *Proposition 3*. The issue is setting standards for generation. Current first plant under construction was specifically exempted. Vote against: 71%
Montana	(56 counties, excluding Yellowstone National Park): *Initiative 71*. Setting review procedures. No plants in Montana. Vote against: 58%
Ohio	(88 counties): *Issue 6*. Specifically exempts first two plants under construction. Vote against: 68%
Oregon	(36 counties): *Measure 9*. Specifically exempts Portland General's Trojan plant. Vote against: 58%
Washington	(39 counties): *Measure 325*. Call for 2/3 legislative approval for future plants. Current plants and three under construction specifically exempted. Vote against: 67%
1980	
Maine	(16 counties): "*Referendum Question.*" Ban nuclear generation. Effectively, though not by name, closes Maine Yankee Plant (in Wiscassett, Lincoln county, Maine Yankee Atomic Power Co., 810 mw, existing in 1980, not jointly owned). Vote against: 60%
Missouri	(115 counties): *Proposition 11*. Review and waste siting. Stops two plants under construction (Ashley units 1 and 2, Callaway county, Union Electric Co., 1192 mw each, projected, not jointly owned). Vote against: 61%

informed decisions is greatest in referendum settings, compared to less direct democracy, since the issues are uni-dimensional. Thus, benefit-cost calculations are less complicated, reducing the incentives to remain rationally ignorant.

4. Empirical results

The results for the voting equation (7) appear in Table 3. Cutting straight to the issue of interest, it is clear that *how* individuals vote *is* determined by whether or not they vote at all. Successfully overcoming the hurdles to voting contributes significantly to anit-nuclear voting. According to the estimates reported in Table 3, increasing participation by one-percent will increase

Table 3. Voting results

Variable	Coefficient	Standard Error	Elasticity[a]
Constant	–.67547*	.22450	– –
Demographics			
HSPlus	–.00284	.00296	0
CollPlus	.01119*	.00264	.154
MedAge	–.03167*	.01047	–.981
Over65	–.00643	.00918	0
Urban	.00073	.00061	0
Density	.00006*	.00002	.016
Economics			
Income	–.00001*	.00000	–.345
Price	–.00151	.00118	0
EmplElec	–.00125	.00717	0
Nuke	–.04480	.32590	– –
Preferences			
Plus	.00636*	.00137	.053
Minus	–.00331*	.00124	–.052
Controls			
RefClose	.00000	.00000	0
Constrain	–.03432	.05992	0
Participation	2.7405*	.50430	1.34
R^2		.249	
Adj. R^2		.228	
Observations		562	
DF[b]		506	

[a] Elasticities are calculated at the mean of the independent variable.
[b] Each regression in the recusrive structure (see Appendix) leads to accumulated losses of degrees of freedom. 522 are left after the recursive technique in the appendix.
* Significant at the 99% level.
** Significant at the 95% level.

the probability of voting against nuclear power on the referendum by about 1.3 percent. Further, participation is the only variable engendering an elastic response.

There also are instrumental and expressive portions of the explanation of voting on this sample of referenda. The only variable shedding any light on the instrumental portion of the explanation is income; all else constant, richer counties favor nuclear power. Turning to expressive considerations, counties with more extreme pro-environment representatives are more likely to vote against nuclear power, while the opposite is true of counties with representatives at the other extreme. Quantitatively (the elasticity column in Table 3), the income elasticity of voting in favor of nuclear power is seven times the size of elasticities with respect to extremist representation. While expressive variables matter in voting decision on nuclear power, instrumental reasons matter more.

There are some other observable differences across counties. Counties with large shares of high school graduates vote no differently than other counties but voting against nuclear power does increase with the share that graduated from college. Counties with higher median ages favor nuclear power (that is, they are less likely to vote against it) but counties with larger elderly populations vote no differently than other counties. Controlling on the share of urban dwellers, increased population density is another factor contributing to anti-nuclear sentiment revealed through voting. The other controls reveal that issues designed to constrain existing, rather than future, plants engendered to voting difference and the closeness of the vote did not matter.

The central result is the importance of participation relative to instrumental and expressive effects. For the former, the probability of voting against nuclear power is forty times more responsive to participation than it is to variables measuring instrumental intention. For the latter, the probability of voting against nuclear power is seventy times more responsive to participation than it is to environmental extremism.[5]

5. Conclusions

Our analysis finds that whether individuals vote is a significant contributor to the explanation of how they vote. Voting against nuclear power was more responsive to successful navigation of the hurdles to voting than to any other variable in the analysis. While both instrumental and expressive factors matter in the explanation of anti-nuclear voting, participation swamps them both. The concluding observation is straight forward. Efforts aimed at explaining voting outcomes should incorporate the underlying structure of participation.

Notes

1. In a related area, Cohen and Noll (1991) analyzed the impact of abstention in Congressional floor voting. For a reasonably complete review of economic models of demand for public services revealed through referendum voting see Fort (1988).
2. Other important considerations of the "all else constant" variety would include advertising spending to influence individual votes as well as media impacts on individual considerations. These effects are not included in the analysis.

3. This variable is only a coarse filter for such perceptions since electricity is traded over networks in a broad way. For example, large portions of the electricity generated in the Pacific Northwest end up for sale by Consolidated Edison of California. The electricity is obtained through long-term contracting over the inter-tie network of the Bonneville Power Administration.
4. Linda Cohen suggested this idea to us and pointed out that in other literature this is referred to as issue saliency.
5. We address the policy implications elsewhere (Fort and Bunn, 1995). Basically, parties interested in formulating efforts aimed at effecting referendum outcomes would do well to target participation, relative to feeding the fire of the "ideological" battle. This especially is true since it appears that the inherent preference differences just offset each other.

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Appendix: The hurdles to voting

This Appendix is a brief overview of the approach in Fort (1995) which produced the participation variable used in the present paper. The proportion of the eligible voting population that actually votes can be decomposed into the product of three factors (Cox and Munger, 1991):

$$\frac{V_i}{P} = \left(\frac{R}{P}\right)\left(\frac{B}{R}\right)\left(\frac{V_i}{B}\right). \tag{A1}$$

V_i is the actual number voting on the issue at hand, P is the potentially eligible voting population, R is the number actually registering to vote, and B is the number of registered voters that actually make it to the booth. Thus, the share of the potential voting population that actually votes on the issue at hand must leap three hurdles: registration, $\frac{R}{P}$, turnout, $\frac{B}{R}$, and voting once in the booth, $\frac{V_i}{B}$.

The complete structure of participation is observable all along the way to the final vote. Expression (A1) suggests a recursive framework. First comes registration, determined by a set of variables, X_1:

$$\log\left(\frac{R}{P}\right) = a_1 + b_1X_1 + e_1. \tag{A2}$$

The next step takes the fitted part from the right-hand-side of (A2) and includes it in the determination of turnout (captured by variables X_2), where the "hat" notation signifies fitted values:

$$\log\left(\frac{B}{R}\right) = a_2 + b_2X_2 + b_2[-\hat{a}_1 - \hat{b}_1X_1] + e_2. \tag{A3}$$

With $b_2 = 1$ dictated by (A1), the regression becomes:

$$\log\left(\frac{B}{R}\right) + \hat{a}_1 + \hat{b}_1X_1 = a_2 + b_xX_2 + e_2. \tag{A4}$$

In like fashion, the cumulative registration and turnout impacts are included in the determination of voting in the booth as follows:

$$\log\left(\frac{V_i}{B}\right) = a_3 + b_3X_3 + b_3[-\hat{a}_2 - \hat{b}_2X_2] + e_3. \tag{A5}$$

The X_3 variables determine voting in the booth. Again, $b_3 = 1$ is dictated by (A1), and using (A4), the regression becomes:

$$\log\left(\frac{V_i}{B}\right) + \hat{a}_2 + \hat{b}_2X_2 = a_3 + b_3X_3 + e_3. \tag{A6}$$

Once estimated, the last equation yields the final result:

$$\hat{\log}\left(\frac{V_i}{P}\right) = \hat{\log}\left(\frac{R}{P}\right) + \hat{\log}\left(\frac{B}{R}\right) + \hat{\log}\left(\frac{V_i}{B}\right) = \hat{a}_3 + \hat{b}_3 X_3. \qquad \text{(A7)}$$

This recursive system, along with the linear restrictions $b_2 = 1$ and $b_3 = 1$ consistent with the satisfaction of expression (A1), provides a comprehensive accounting of the cumulative impacts of jumping the hurdles to voting. Put another way, the design in (A2)–(A7) yields an estimate of the left-hand-side of (A1) that controls for all of the important aspects of overcoming the hurdles to voting. It is this fitted value, produced in earlier work for another purpose on the same sample, that is used in the current work under the name "participation."