BUREAUCRATS VERSUS VOTERS: ON THE POLITICAL ECONOMY OF RESOURCE ALLOCATION BY DIRECT DEMOCRACY*

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Building on the models developed by Downs [1957], Black [1958], and their predecessors in economics,[1] a body of recent work on public expenditures has claimed that the level of expenditures will correspond closely to that preferred by the "median" voter in the political unit.[2] This model is "competitive" in spirit, for it assumes that any government that spends far from the median will soon be driven from office by an opposition that proposes an expenditure "closer" to the median. Under majority rule voting, if the expenditure is greater than the median, for example, an enterprising politician can bring expenditures into line by forming a coalition of the median voter and all those who favor expenditures lower than the median.

The competitive model may be of limited validity as a positive theory of public expenditure. The institutional structure of political resource allocation may work against "median voter" outcomes. Noncompetitive institutions may arise due to such factors as costs of organization and differential information. As an alternative to the competitive model, Niskanen [1971, 1975] suggested that the bureaucrats who spend the money not only prefer to maximize expenditures but also achieve considerable "monopoly" power over the alternative expenditures available to the political decision-makers, legislators, or voters.

The purpose of this paper is to develop the monopoly model

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1. See Hotelling [1929], Smithies [1941], and Bowen [1943].
2. See Barr and Davis [1966], Davis and Haines [1966], Borcherding and Deacon [1972], Bergstrom and Goodman [1973], Denzau and Mackay [1976], Edelson [1976].

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within the explicit framework of "direct democracy" referendum voting on public expenditures. In the United States these referenda represent political institutions of considerable economic importance. Budgets for primary and secondary education, the largest nondefense category of direct public expenditure, reflect referendum outcomes in twenty-two states, including such populous ones as California, Illinois, Michigan, and New York.[3] Expenditures on such items as fire protection, flood control, and water resources are also subject to referenda in many localities.

Exploring the monopoly model in the context of expenditure referenda has advantages for both model building and empirical analysis.

As to model construction, the monopoly model assumes that bureaus are expenditure maximizers. Furthermore, voters allow the bureaucracy to control the agenda, and in essence respond as price takers to the bureau's supply offer. On a given ballot, voters have only a choice between some institutionally defined *reversion expenditure* and the proposal offered by the bureau or proposal *setter*. Voters then do not form coalitions to overturn or control the setter's monopoly power over the agenda. While it would certainly be desirable to advance these assumptions to the status of endogenous consequences of a more general and basic model, such a task is beyond the scope of this paper. Our concern lies solely with investigating the implications of the monopoly model and with asking whether the monopoly model offers an explanation of observations. In this respect, direct democracy situations would appear more consistent with the monopoly assumptions than would the Congressional legislative context to which Niskanen [1971] first applied his model.[4]

Implications of the monopoly model are explored in the first three parts of the paper. Using standard economic assumptions on consumer-citizen preferences, Part I characterizes the level of expenditure when an agenda-setting bureau has complete information about preferences and turnout. Our central finding is that the level of expenditure depends critically on the reversion point; that is, on what happens if the voters turn down the proposed budget. Actual expenditures are always at least the level preferred by the median voter. In other words, expenditures are generally greater, and never less, than the expenditure level for the competitive model. When the

3. Tron [1977] has a survey of school expenditure institutions.
4. In Congress it is clear that the voters (legislators) are not always passive and have some capacity to modify the agenda.

reversion point is below the preferred level for the median voter, the *lower* the reversion point, the *higher* the actual expenditure.

Uncertainty is introduced in Part II by allowing electoral turnout to be random. For high reversion points, a risk-neutral agenda setter (bureau) will obtain an expected budget greater than the certainty budget, but for low reversion points, uncertainty works against the setter except under unusual conditions. In Part III, the uncertainty framework is extended beyond the single election context. In some U. S. states, if the setter's proposal fails, a small number of additional elections may be held. Within limits on the total number of elections, the sequence can continue until passage is obtained. The reversion point occurs only if the last election fails or if the setter elects not to hold further elections. We show that a sequence of decreasing proposals is optimal for the setter. The gain from being able to conduct a sequence of elections can outweigh the loss that results from random turnout.

With regard to empirical work, Part IV of this paper indicates how some referenda and expenditure data permit a test of the monopoly model against the competitive model. That part also contains stylized facts for Oregon school expenditures that are consistent with the monopoly model and highly implausible as median voter outcomes.

I. The Setter's Problem Under Certainty and the Importance of the Reversion Point

1. *The Individual Voter*

We assume that voting behavior is individualistic, with each voter making decisions independently of others. Each voter i has a strictly quasi-concave preference function $U^i(C^i,G^i)$, defined over all non-negative pairs of goods (C,G) and nondecreasing in (C,G). C^i represents i's consumption of a bundle of private goods and G^i his consumption of a collectively provided good. This good may be a pure public good, a private good, or some mixed good. Its essential characteristic is that it is financed collectively and allocated politically. The relationship between collective expenditures (measured in units of private consumption good) and i's consumption G^i is given by

$$G^i = f^i(E). \tag{1}$$

We take $f^i(E)$ to be increasing and (weakly) concave. It follows that $U^i(C^i,f^i(E))$ is strictly quasi-concave and nondecreasing in (C^i,E).

Supply of the collective good is financed directly by a tax on individual income or wealth. For simplicity, we assume a proportional tax, though other tax structures could be discussed within the same framework. The level of expenditures is given by

$$E = \tau Y, \tag{2}$$

where Y is the local tax base (i.e., total taxable income or wealth) and τ is the rate of tax.[5]

The ith individual has total income Y_0^i of which Y^i is subject to the local tax. His demand for the publicly provided good can be derived from individual maximization, which involves choosing (C^i,E) to maximize $U^i(C^i,f^i(E))$, subject to the budget constraint,

$$C^i \leq Y_0^i - \tau Y^i. \tag{3}$$

Substitution in (3) for τ from (2) gives

$$C^i \leq Y_0^i - EY^i/Y.$$

Define the *indirect utility function* for voter i:

$$V^i(E) \equiv U^i[Y_0^i - EY^i/Y, f^i(E)].$$

From strict quasi concavity of U^i and the convexity of the individual's constraint set, we have the following: For each voter i, $V^i(E)$ is single-peaked in E. Specifically, $V^i(E)$ is strictly increasing in E for $E < \overline{E}^i$ and strictly decreasing in E for $E > \overline{E}^i$, for all i, where $\overline{E}^i$ is voter i's "most-preferred" or *ideal expenditure,* given the tax structure.

If the voter were free to choose the level of expenditure, he would choose his *ideal expenditure* $\overline{E}^i$. (See Figure I.) An essential feature of the political allocation mechanism, of course, is that the individual is not free to choose the value of E. Rather, the decision must be made in a referendum in which the voter faces a choice between an expenditure level proposed by the setter and some predetermined expenditure that we shall call the *reversion point.* This reversion point may correspond to the current level of expenditure, or it may be defined by a legally prescribed "reversion rule" that specifies the level of expenditure that occurs if the *alternative* proposed by the setter is voted down.

For a given tax structure, the reversion point and the possible alternatives to it imply (C^i,E) pairs that lie on each individual's

5. For wealth-based taxes, Y should be interpreted as the income flow whose capitalized value is the value of the asset being taxed. Note, too, that we are assuming that voters correctly perceive the tax cost of collective expenditures. For a discussion involving a more general formulation of tax structure, see Romer and Rosenthal [1978].

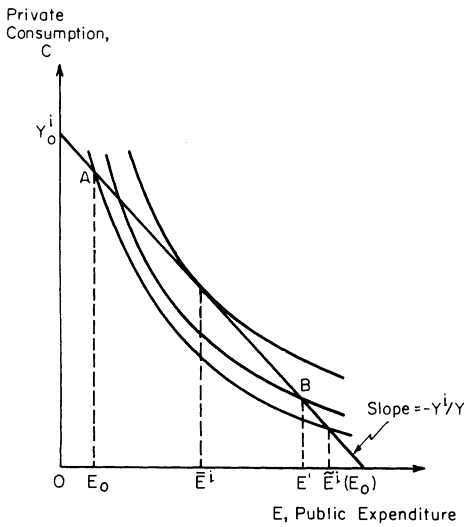

FIGURE I

budget constraint. For example, in Figure I reversion expenditure E_0 allows the individual to consume the bundle represented by A. Changes in public expenditure (and the corresponding changes in tax levies under the proportional tax structure given by (2)) involve movements along the individual's budget constraint. Alternative expenditure E' would allow the voter to consume at B.

We now assume that all voters behave as if the current election were truly an all-or-none choice between the setter's alternative and the reversion expenditure. Although we later discuss the possibility of more sophisticated behavior by voters, our assumption appears quite reasonable for jurisdictions like Arkansas, where the law permits holding elections only annually. Even when elections may be held more often, as with school budget referenda in Ohio or Oregon, failure to approve an operating budget may lead to a reversion outcome, as witnessed by school closings in those states.

Our assumption has an immediate implication for voter behavior. In deciding between a proposed alternative expenditure and the reversion point, the voter will choose the level of spending that yields the higher utility. With reversion expenditure E_0 and alternative E', the individual votes *for* the setter's proposal if and only if $V^i(E') \geq V^i(E_0)$. We arbitrarily—and unimportantly—assume a "Yea" vote in the case of indifference between the proposed alternative and the reversion point.

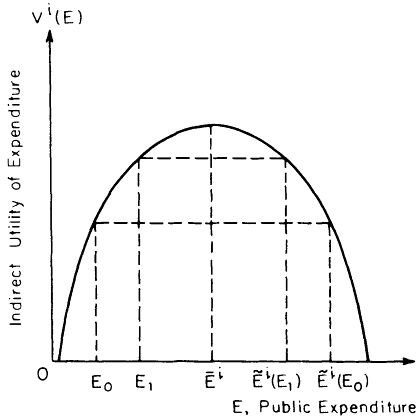

FIGURE II
$\tilde{E}^i(E_0)$ and $\tilde{E}^i(E_1)$ are the largest expenditures receiving a Yea vote against reversion expenditures E_0 and E_1, respectively.

For a given reversion expenditure E_q define an expenditure $\tilde{E}^i(E_q)$ as follows:

$$\tilde{E}^i(E_q) = \sup\{E : V^i(E) \geqq V^i(E_q)\}.$$

$\tilde{E}^i(E_q)$ is thus the largest expenditure on which the ith individual will vote "Yea" when the reversion point is E_q. The way $\tilde{E}^i(E_q)$ depends on E_q is critical to further analysis. From single-peakedness of $V^i(E)$, it follows that
(a) for $E_q \geq \overline{E}^i, \tilde{E}^i(E_q) = E_q$ and hence $\tilde{E}^i(E_q)$ is *increasing* in E_q;
(b) for $E_q < \overline{E}^i, \tilde{E}^i(E_q) > \overline{E}^i$ and $\tilde{E}^i(E_q)$ is *decreasing* in E_q.
(See Figures II and III.)

2. *The Setter's Behavior*

We consider first the setter's problem in a situation of certainty: the setter knows voter preferences, and everyone votes.

The setter faces an electorate of m voters. For a given expenditure proposal E, define $b_i(E) = 1$ if voter i votes "Yea" and $b_i(E) = 0$ if "Nay." Then the setter's objective is to

$$\max E \quad \text{subject to} \quad \sum_i b_i(E) > \frac{m}{2}. \tag{4}$$

In the previous section we observed that an individual voter's

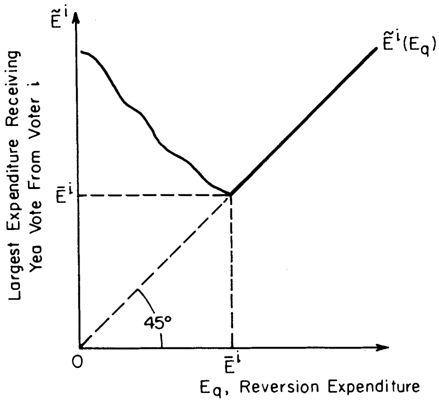

FIGURE III
Individual voting as a function of the reversion point. *Note:* $\overline{E}^i$ is voter i's ideal expenditure.

decision depends on the reversion point. Consequently, we would expect the reversion point to have an effect on the solution to (4). In particular, we are concerned with how the solution changes with increases in the reversion expenditure. The analysis depends critically on how the reversion expenditure is located relative to the ideal expenditure of the median voter.

3. *Effect of Reversion Point on Election Outcome*

We define the *median* of a distribution as follows: If $\mathcal{F}(\chi)$ is the distribution function of a variable χ (so that $\mathcal{F}(\chi_0)$ denotes the proportion of the population with $\chi < \chi_0$), then

$$\text{median } \chi \equiv \sup \{\chi : \mathcal{F}(\chi) < 0.5\}.$$

Thus, the *median ideal expenditure* $\overline{E}^\mu$ is the largest possible expenditure such that $\mathcal{F}(E) < 0.5$, where $\mathcal{F}(E)$ denotes the proportion of voters who, for the given tax structure, have ideal expenditures $\overline{E}^i$ less than E.

A. Reversion Point Greater Than or Equal to Median Ideal Expenditure

If the level of expenditure associated with the reversion rule is not less than $\overline{E}^\mu$, then the reversion point is the best that the setter can do. No expenditure *greater* than the reversion point would be preferred to the reversion point by a simple majority of the voters, so the reversion point solves (4).

B. Reversion Point Less Than Median Ideal Expenditure

The more interesting condition involves reversion expenditure levels less than the median of ideal expenditures. For this condition we show that there is a *negative* relationship between the level of expenditures that solves the setter's problem—which we call the *approved level*—and the reversion level. This result is formalized in the following proposition.

PROPOSITION. Let $E^*(E_0)$ be the approved level of expenditures when the reversion expenditure is E_0 and let $E^*(E_1)$ be the approved level of expenditure when the reversion point is E_1. With single-peakedness of $V^i(E)$ for all i, if $E_1 < E_0 < \overline{E}^\mu$, then $E^*(E_1) > E^*(E_0)$.

Proof. Note first that the expenditure level $E^*(E_q)$ that solves (4) for reversion expenditure E_q is given by

$$E^*(E_q) = \text{median } \tilde{E}^i(E_q), \tag{5a}$$

so that

$$E^*(E_0) = \text{median } \tilde{E}^i(E_0).$$

From single-peakedness of $V^i(E)$,

$$\tilde{E}^i(E_0) < \tilde{E}^i(E_1) \tag{5b}$$

for all i such that $E_0 < \overline{E}^i$. Since $E_0 < \overline{E}^\mu$, (5b) must hold for at least half the voters. Consequently, median $\tilde{E}^i(E_1) >$ median $\tilde{E}^i(E_0)$; that is,

$$E^*(E_1) > E^*(E_0).$$

This result can be compared with the corresponding result for the "competitive" model. In "competitive" voting where all pairs of alternatives are (potentially) voted on, the majority voting outcome with single-peaked preferences is the median ideal expenditure $\overline{E}^\mu$. In contrast, the controlled agenda or "monopoly" structure with a budget-maximizing setter leads to expenditure *in excess of* $\overline{E}^\mu$, unless the reversion expenditure just happens to be $\overline{E}^\mu$. To see this, note that if $E_q \geq \overline{E}^\mu$, then $E^*(E_q) = E_q$. If $E_q < \overline{E}^\mu$, then $\tilde{E}^i(E_q) > \overline{E}^\mu$ for all i such that $\overline{E}^i \geq \overline{E}^\mu$, so that median $\tilde{E}^i(E_q) > \overline{E}^\mu$. (Note, incidentally, that the voter with median $\tilde{E}^i(E_q)$ for one value of E_q is not necessarily the voter with median $\tilde{E}^i(E_q)$ for different E_q.) Figure IV illustrates the overall relationship between actual expenditures (the solution to the setter's maximization problem (4)) and reversion expenditures.

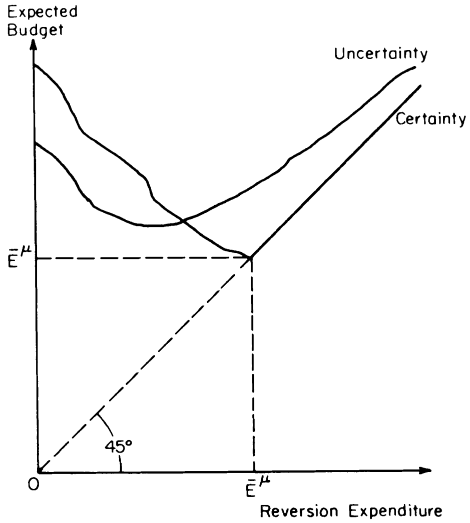

FIGURE IV
Expected budget as function of reversion expenditure. *Note:* $\bar{E}^{\mu}$ is median ideal expenditure.

II. BUDGET-MAXIMIZING WITH UNCERTAIN TURNOUT

With knowledge of voters' preferences and full turnout (or perfect information about turnout) the setter is assured of a certain outcome. Lack of information about preferences or voter turnout introduces uncertainty, so that a risk-neutral setter's problem becomes one of maximizing the expected size of the budget, given the information available to him.

There are a variety of ways that the setter's uncertainty may be characterized. In this part we discuss the solution to the setter's problem when turnout is random, although the setter continues to have complete information about the distribution of preferences for the entire electorate. Effectively, for a given voter the setter knows the voter's preferences, but does not know whether the voter will actually go to the polls. We are particularly interested in how this form of uncertainty affects the setter's monopoly power.

The assumption that the setter knows the distribution of voter preferences is not unreasonable, especially for those jurisdictions where the annual budget process has been repeated for many years. Our turnout assumption, that each voter abstains with fixed probability r, appears to be more limited. It would be desirable to model turnout as being systematically affected by the setter's behavior. In particular, the abstention probability might be a decreasing monotonic function of the voter's utility difference between the setter's proposal and the reversion. Turnout would then reflect the intensity of relative preference for the two alternatives. This type of turnout model is the abstention from indifference model reviewed in Riker and Ordeshook [1973] and applied to the empirical analysis of school budget elections by Barkume [1976].

There are two reasons why we prefer to pursue a purely random turnout model rather than an indifference model. First, implementing the indifference model would add considerably to the analytical baggage without, we conjecture, really altering our central conclusion. With the random model, we conclude that, for sufficiently low reversion expenditures, uncertainty gives a risk-neutral setter an expected budget that is less than the certainty budget. Now, for a given proposal by the setter, the systematic turnout effect from indifference basically changes the original distribution of voters to some distribution conditional on the proposal. For the uncertainty budget to exceed the certainty budget, an appropriate conditional distribution would still have to satisfy the strong conditions imposed below on the unconditional distribution. Thus, our basic conclusions are unlikely to be modified by a systematic turnout model.

A second consideration is that many turnout decisions are indeed independent of the setter's proposals. Looking at individual voting records at the precinct level in France, Lancelot [1968] concluded that 5 to 10 percent of the electorate is affected by such "random" considerations as illness, vacation, etc. How much of the remaining electorate's participation is affected by the setter's proposal can only be a subject of speculation. It is probably true, however, that many voters nearly never vote. Thus, while the effect of the setter's proposal on turnout may be substantial, the effect may well not dominate those turnout variations that can be represented as purely random turnout. Note further that if each voter had an abstention probability r_i which was independent of the setter's proposal, we would obtain results similar to those for uniform r.

1. *Normalization Relative to Reversion Point*

We now turn to analysis of the model with random turnout.

A budget-maximizing setter will never propose an alternative less than the reversion point. With this in mind, it is convenient to structure the analysis to focus on *increases* in expenditure relative to the reversion point. We make the following normalizations for a

given reversion expenditure E_q:
Define

$$(6) \qquad \begin{aligned} x &= E - E_q \\ \tilde{x}^i &= \tilde{E}^i(E_q) - E_q \\ \tilde{x}^c &= E^*(E_q) - E_q \end{aligned}$$

and

$$w^i(x) = V^i(E).$$

$w^i(x)$ assigns to a given *change* from the reversion point the utility level associated with the absolute *level* of expenditure corresponding to that change from the reversion point. It follows from the single-peakedness of $V^i(E)$ that $w^i(x)$ will be single-peaked in x. Thus, a proposed *increase* $x^+ > 0$ in the expenditure level will be opposed by all individuals for whom $x^+ > \tilde{x}^i$.

The fraction of the population with $\tilde{x}$ less than x is given by $F(x)$, which can be thought of as the probability distribution function of $\tilde{x}$. We assume that F is differentiable, with $F'(x) \geq 0$.[6]

2. Voting with Partial Turnout

Consider a proposed expenditure *increase* $x > 0$. Individuals for whom $\tilde{x}^i > x$ would vote "Yea" on this proposal if they turned out to vote, while those for whom $\tilde{x}^i < x$ would oppose the proposal. Recall that m is the size of the *electorate* (the total number of eligible voters). Let $q(x)$ be the fraction of the electorate with $\tilde{x}^i \geq x$;

$$q(x) = 1 - F(x)$$

and

$$q'(x) = -F'(x) \leq 0,$$

with strict inequality for

$$F'(x) > 0.$$

For a given proposal the electorate may be divided into two distinct groups. One group, of size qm, either abstains or votes "Yea." The other group, of size $(1 - q)m$, either abstains or votes "Nay." Within each group the probability of abstention is r, and the probability of casting a vote is $1 - r$. For the first group define the indicator variables Y_i $(i = 1, \ldots, qm)$ such that

6. Although we have assumed a finite number of voters, we consider the number of voters sufficiently large and their preferences suffcently diverse so that the distribution of $\tilde{x}$ may be represented by a differentiable function F. Working with a discrete distribution of $\tilde{x}$ would not alter the nature of our results.

$$Y_i = \begin{cases} 1 & \text{if the } i\text{th voter in this group votes "Yea"} \\ 0 & \text{if the voter abstains.} \end{cases}$$

For the second group define the variables N_j $(j = 1, \ldots, (1-q)m)$ such that

$$N_j = \begin{cases} -1 & \text{if the } j\text{th voter in this group votes "Nay"} \\ 0 & \text{if the voter abstains.} \end{cases}$$

Each Y_i has mean $(1 - r)$ and variance $r(1 - r)$, while each N_j has mean $-(1 - r)$ and variance $r(1 - r)$. The m random variables are independent.

Let Z be the *difference* between the total "Yea" and "Nay" votes cast; that is, $Z = \Sigma Y_i + \Sigma N_j$. By Liapounoff's version of the Central Limit Theorem,[7] the standardized sum,

$$S = \frac{Z - m(1-r)(2q-1)}{\sqrt{mr(1-r)}},$$

has asymptotically *normal* distribution with mean 0 and variance 1.

Now we are interested in the probability $p(x;m,r)$ that a proposed expenditure increase x will be ratified by a simple majority of those voting. But $p(x;m,r) = \text{prob}\,\{Z > 0\}$. For sufficiently large electorates, the probability of success may be approximated by[8]

$$\begin{aligned} p(x;m,r) &= \text{prob}\{Z > 0\} \\ &= \text{prob}\left\{S > \sqrt{\frac{m(1-r)}{r}}\,[1 - 2q(x)]\right\} \qquad (7) \\ &= 1 - \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{t(x;m,r)} \exp\left(\frac{-s^2}{2}\right) ds, \end{aligned}$$

where

$$t(x;m,r) = \sqrt{m(1-r)/r}\,[1 - 2q(x)].$$

Note that

$$\frac{\partial p}{\partial x} = \frac{2}{\sqrt{2\pi}} \sqrt{\frac{m(1-r)}{r}}\, q'(x) \exp\left[-\frac{1}{2}\,(t(x;m,r))^2\right] \leq 0,$$

7. See Cramér [1946, pp. 215–17] for details.

8. Empirically, r is usually between 0.4 and 0.9. For values of $q(x)$ not near 0 or 1, applying rules of thumb similar to those used with the normal approximation to the binomial leads us to conclude that the normal approximation to the distribution of Z should be "accurate" for m of 50 or greater.

with strict inequality for $F'(x) > 0$ (i.e., $q'(x) < 0$). The probability of passage is nonincreasing in the proposed increment to the budget.

3. *The Expected Budget Under Uncertainty: Single Election*

With uncertain turnout a risk-neutral setter chooses a proposed alternative to the reversion point so as to maximize the expected size of the budget. In our formulation this involves choosing x to

$$\text{maximize } B(x) = xp(x). \tag{8}$$

The remainder of this part is concerned with analyzing the properties of the setter's solution to this problem, especially in comparison to the certainty budget that was characterized in the previous part of the paper.

Let x^* be the solution to (8) and $B(x^*) = x^*p(x^*)$ the expected increase over reversion expenditure corresponding to it.[9] Under full voter turnout, $\tilde{x}^c$ (defined in (6)) solves the setter's problem, since full turnout is equivalent to certainty, given that the setter knows the distribution of $\tilde{x}$. When the median ideal point is greater than the reversion point, $\tilde{x}^c$ is the median value of $\tilde{x}$, and when the median ideal point is less than or equal to the reversion point, $\tilde{x}^c = 0$. We consider first the relationship of the expected budget under uncertainty with the budget under full turnout (certainty). We then go on to ask how variations in turnout affect the expected budget.

A. *Relationship of $B(x^*)$ and $\tilde{x}^c$*

i. Low Reversion Point. Suppose that the reversion expenditure is less than the lowest ideal expenditure; that is, $F(0) = 0$. In this case no voter would prefer a *reduction* from the reversion point. (This is not as extreme a case as it may seem; for example, it is not unusual for the reversion point to be zero in expenditure referenda. For some types of spending, everyone may prefer positive expenditure.) We now proceed to show that, for $F(0) = 0$, $B(x^*) < \tilde{x}^c$, except when F satisfies strong conditions that we conjecture are empirically rare.

Let $\tilde{x}^u$ be the upper bound of values of $\tilde{x}$ in the population:

$$\tilde{x}^u = \sup\{x\!:\!F(x) < 1\}. \tag{9}$$

Suppose that for some x,

$$B(x) = xp(x) > \tilde{x}^c \tag{10}$$

9. Again, we ignore costs of holding an election. If the setter has to bear an election cost $c > B(x^*)$, he would prefer not to hold an election.

i.e.,

(11) $$p(x) > \tilde{x}^c/x.$$

For (11) to hold, we must have that $x > \tilde{x}^c$, since $0 \le p(x) \le 1$. But $p(x) \le 1/2$ for $x > \tilde{x}^c$, so that (11) cannot hold for $x \le 2\tilde{x}^c$.[10] Thus, a *necessary condition* for the expected budget under uncertainty to exceed $\tilde{x}^c$ is that $x^* > 2\tilde{x}^c$. Clearly, this possibility is *ruled out* for any F such that $\tilde{x}^u < 2\tilde{x}^c$. This result means, for example, that $B(x^*)$ must be less than $\tilde{x}^c$ for any bounded, symmetric distribution.[11]

Even when $\tilde{x}^u > 2\tilde{x}^c$, the distribution of $\tilde{x}$ must have a lot of weight in the upper tail (that is, in the range $x > 2\tilde{x}^c$) in order for the expected budget increase under uncertainty to exceed the certainty budget increase $\tilde{x}^c$. A condition on the tail of the distribution that is necessary and sufficient for $B(x^*) > \tilde{x}^c$ is given in the Appendix.

For low reversion expenditure, the expected budget under uncertainty (incomplete turnout) will be less than the full-turnout budget $\tilde{x}^c$, provided that the distribution of $\tilde{x}$ is sufficiently concentrated below $2\tilde{x}^c$.

ii. High Reversion Point. Consider a reversion expenditure greater than the ideal expenditure of the median voter. In the certainty case the reversion point is the *best* the setter can do. With uncertainty the reversion point is the *worst* the setter can do. So long as the reversion point is not greater than the highest ideal expenditure, $B(x^*)$ is positive, since the setter can make proposals in excess of the reversion point, and the probability of some proposal winning is positive. It follows that the expected expenditure level with uncertain turnout will *exceed* the corresponding expenditure with full turnout. With reversion expenditure in excess of the median ideal expenditure, uncertainty increases the setter's monopoly power relative to the certainty case. This result, which holds for a risk-averse as well as a risk-neutral setter, is independent of the distribution of preferences.[12]

10. Note that for abstention probabilities such that (7) is valid, we have $q(\tilde{x}^c) = 0.5 \Rightarrow t(\tilde{x}^c) = 0 \Rightarrow p(\tilde{x}^c) = 0.5$.

11. F is bounded and symmetric, with $F(0) = 0$, if $\tilde{x}^u$ is finite and

$$F(x) = \begin{cases} 0 & x \le 0 \\ 1 - F(\tilde{x}^u - x) & 0 < x \le \tilde{x}^u. \\ 1 & x > \tilde{x}^u \end{cases}$$

12. Suppose that the reversion rule is set as the previous year's expenditure and that the reversion point already exceeds the median ideal expenditure. In the absence of shifts in voter composition, the controlled-agenda budget under certainty would remain constant over time. The same reversion rule under uncertainty would lead to an increasing trend in expenditures once one year's expenditure exceeded the median ideal expenditure. Under such a reversion rule, however, sequential elements may become important, as setter and voters take into account the effect of today's outcome on future reversion points.

iii. Summary. We thus have the following:

1. For low reversion point and sufficiently concentrated F, $B(x^*)$ is less than the corresponding $\tilde{x}^c$.

2. For sufficiently high reversion points, for any F, $B(x^*)$ is greater than the corresponding $\tilde{x}^c$.

For low reversion points, uncertainty hurts the setter (relative to the full-turnout equivalent), while for high reversion expenditures the setter benefits from less than full turnout. As in the certainty case, the reversion point critically influences the outcome. (See Figure IV.)

B. Effect of Changes in r on $B(x^*)$

A change in turnout probability will affect the expected budget. At a solution to (8) we must have, for given m,

$$p(x^*,r) + x^* \frac{\partial p(x^*,r)}{\partial x} = 0. \tag{12}$$

Equation (12) defines x^* as an implicit function of r, so we write

$$x^* = h(r)$$

and

$$B^*(r) \equiv x^* p(x^*,r) = h(r)p[h(r),r] \tag{13}$$

$$\frac{dB^*(r)}{dr} = h'(r)\left[p(x^*,r) + x^* \frac{\partial p(x^*,r)}{\partial x}\right] + h(r)\frac{\partial p(x^*,r)}{\partial r}.$$

The term in square brackets is zero from (12), so

$$\frac{dB^*(r)}{dr} = x^* \frac{\partial p(x^*,r)}{\partial r} = \left.\frac{\partial[xp(x,r)]}{\partial r}\right|_{x=x^*}$$

$$\operatorname{sign}\frac{dB^*(r)}{dr} = \operatorname{sign}\left.\frac{\partial p}{\partial r}\right|_{x=x^*}$$

$$\frac{\partial p}{\partial r} = \frac{1}{2\sqrt{2\pi}} e^{-t^2/2}[m^{1/2}(1-r)^{-1/2}r^{-3/2}(1-2q(x))].$$

Therefore,

$$\frac{dB^*(r)}{dr}\begin{cases} > 0 & \text{for } q(x^*) < 1/2, \text{ i.e., for } x^* > \tilde{x}^c \\ = 0 & \text{for } q(x^*) = 1/2, \text{ i.e., for } x^* = \tilde{x}^c \\ < 0 & \text{for } q(x^*) > 1/2, \text{ i.e., for } x^* < \tilde{x}^c. \end{cases}$$

The budgetary effect of a small uniform change in the probability of abstention will depend on whether the setter's optimal *proposal* exceeds the certainty budget increase $\tilde{x}^c$. If x^* is less than $\tilde{x}^c$, the setter benefits from *higher* turnout (lower r). If x^* is above $\tilde{x}^c$ (as would be the case if, for example, the reversion point were above the median ideal expenditure), then a fall in voter turnout (increase in r) leads to a higher expected budget.

In some situations the setter may attempt to influence turnout. Presumably, an expenditure-maximizing setter would aim to increase turnout at the upper end of the $\tilde{x}$ distribution. Such selective turnout manipulation may be quite difficult. Our results suggest that even when turnout effects are uniform over the population, increasing turnout may work in the setter's favor.

An intriguing way to summarize our results concerning uncertainty is to note the formal correspondence of our model to a budget selection process in which each voter is polled with probability r. The polled voters then indicate their preference between the reversion point and some proposed expenditure level. As r approaches zero, our model approximates compulsory voting. Our results suggest that, combined with appropriate reversion rules, requiring such a poll, rather than holding an election, might just provide a way of counteracting the monopoly power of a budget-maximizing setter. In particular, the poll could lead to lower expenditure than compulsory voting.

Note that we would require a purely random poll of variable size, in contrast to the stratified polls of fixed size used in public opinion research. Switching to polls of fixed size should not change our qualitative results. For fixed r, however, stratification reduces the uncertainty confronting the setter. One can, nonetheless, combine stratification with a higher value of r.

Our sense of the debate over polls versus elections is that the emphasis has concerned a tradeoff between the cost of elections and the variability of polls. Our results concerning expenditure elections add a new dimension in that the parameter r directly affects the setter's proposal. We emphasize that the proposal is lowered by a poll only in the case of a sufficiently low reversion point. For high reversion points it is the setter who benefits from a poll. It is thus important that the reversion rule be an integral part of any plan for institutional change. Parallel with the prior results on the expenditure process under certainty, the reversion rule is critical to the determination of the setter's behavior and the resulting expenditure level.

III. Exploiting a Sequence of Elections

In some cases the setter may be allowed the opportunity of holding more than one referendum, if necessary, in order to pass a budget. There will generally be a limit to the number of times citizens may be asked to vote on the budget for a given period. This limitation often takes the form of a legal or constitutional restriction on the number of ballots.[13] The setter may try at most T times, where T is the legal limit. He is, however, free to choose the number of attempts (subject to the limitation) and the proposal put before the voters on each attempt.

Concerning voter behavior, we make the important assumption that in each ballot of a series of ballots to determine a given period's budget, individuals who turn out vote *sincerely* ("myopically" or "naively" are probably more accurate characterizations). They view each election as if it were the last one of the series and do not base their voting decisions on expectations about the future, particularly about the likelihood of there being more referenda on this period's budget. Again, this assumption is primarily a convenience. Nonetheless, it should be pointed out that there is little empirical evidence one way or the other that indicates whether voters can handle the multi-stage information processing problem necessary for sophisticated voting. We make this assumption here as a starting point from which we may begin further work on models with more sophisticated behavior. As we point out at the end of this section, however, even quite sophisticated voter behavior may leave the setter with substantial monopoly power.

We shall suppose, as in Part II, that the setter knows the distribution F, and makes proposals based on sincere voting with random turnout. The expenditure level for a given reversion point is then determined as follows:

—If a proposal *passes,* that proposal becomes the budget, and no more elections are held.

—If a proposal *fails,* the setter may call another election (with the same or a different proposal), with the proviso that no more than T elections may be called in all.

—If all elections fail, the budget is the reversion point—that is, E_q (or $x = 0$).

Given the behavior of voters and the restrictions on number of

13. For example, in Oregon there can be no more than six school budget elections per year, while in Ohio the limit is three.

attempts, what sequence of proposals maximizes the expected budget?

We consider here only the setter's problem when the setter does not bear the cost of holding elections. The case when the setter incurs a fixed cost for each election is a fairly simple extension that does not change the qualitative properties of the solution in an important way. We also abstract from discounting over the period from the first to the last possible election date.

Denote by $x_1, x_2, \ldots, x_T$ the setter's proposed increases over the reversion point in the 1st, 2nd, . . . , Tth election, respectively. Then the setter's problem is to

$$\text{(14)} \qquad \text{maximize } B(x_1, \ldots, x_T) = \sum_{t=1}^{T} p(x_t)x_t \prod_{k=0}^{t-1} (1 - p(x_k)),$$

where

$$p(x_0) = 0.$$

Provided that the usual (second-order) regularity conditions hold, it can be shown that the solution requires that

$$x_1 > x_2 > \cdots > x_T$$

and

$$x_T = x^*.$$

The setter's optimal sequence of proposals involves choosing a relatively high value of x on the first try. Given failure on the first election, a reduction is made, and if the second election fails, the proposal is cut further, down to the last possible election. On the last permissible attempt, the setter offers x^*, the proposed increase over the reversion point that would be offered if there were only one election.

Since x^* is the lowest proposal the setter would make over the sequence of elections, it is clear that the expected expenditure resulting from a multiple-election process exceeds the expected expenditure from a single election (with the same probability of turnout). The setter can exploit the sequence and thereby gain monopoly power. If the sequence is sufficiently long, the budget-reducing effects of uncertainty at low reversion points, which we observed in the single-election case, may be entirely mitigated—and the expected expenditure from the sequence will become greater than the corresponding outcome under certainty.

Sophisticated behavior by voters may work to reduce the ability of the setter to exploit the sequence. By (correctly) anticipating the setter's proposals, voters may be able to "hold out" until a preferred alternative is proposed. In modeling sophisticated voting behavior, the ability of voters to forecast proposals and the behavior of other voters become important factors. As an extreme case, the voters' information could be identical to that of the setter, so that voters correctly anticipate the setter's sequence. This would tend to reduce the expected budget—some voters may hold out until a lower term in the sequence appears. Nevertheless, the setter could not be made worse off than he would be in the single-election case. In the last election (if it were *known* to be the last election), there would be no gain from voting other than sincerely, so the setter is guaranteed at least the single-election outcome $B(x^*)$.

IV. Implications for Empirical Research

Our analysis of the monopoly power of the setter has implications for the empirical analysis of local public finance. A substantial body of the work on estimation of demand functions for publicly supplied goods and services assumes the competitive model.[14] Therefore, the observed quantity is viewed as the quantity preferred by the voter with median ideal point. A proxy for this voter is found on the basis of additional assumptions that relate the median voter to tax shares and the median of the income or wealth distributions. Aggregate demographics are used to remove contaminating factors arising from cross-sectional differences in preferences.

When the goods are "produced" by a setter with monopoly power, estimation based on the competitive model is misspecified in two related ways: (1) the quantity produced is not the quantity corresponding to the median ideal point but rather to the median of the $\tilde{x}$ distribution; (2) the pivotal voter, assuming certainty, is not the voter at the median of the ideal point distribution but rather the voter at the median of the $\tilde{x}$ distribution. Since this median is a function of the reversion point, the pivotal voter will, in general, change with changes in the reversion point.

Nonetheless, if ideal point distributions map conveniently onto $\tilde{x}$ distributions and if all observations have similar reversion points, regressions based on the competitive model will show a good fit to the

14. For example, see Barr and Davis [1966], Borcherding and Deacon [1972], Bergstrom and Goodman [1973]. Many other studies make little or no reference to any underlying social choice mechanism and simply regress public expenditures on a number of economic and demographic variables. Romer and Rosenthal [1979] present a critical survey of the literature dealing with the competitive model.

data, even in monopoly environments. To see this, assume that the data contain little or no variation in reversion points. Assume further that median ideal points can be reasonably proxied by an estimated function of median income and other variables. Finally, assume that the units of analysis are sufficiently similar so that median $\tilde{x}$ are highly correlated with median ideal points. In this case, expenditures will show a reasonable "fit" to the median ideal point proxies even though the actual expenditures exceed the median ideal point and are, in fact, equal to the reversion point E_q plus the median $\tilde{x}$.

Finding a set of observations with substantial variation in reversion points is one requirement for getting a reasonably clean situation that would discriminate between the competitive and monopoly models. Fortunately, local school expenditures in the state of Oregon appear to represent an appropriate cross-section. Local school boards are free to levy, without voter approval, taxes that produce revenues up to the following amount:

$$E_q = (BASE)(1.06)^{t-1916} \quad \text{(sic)},$$

where $BASE$ is roughly equal to total school taxes levied in 1916 and t is the current calendar year. Expenditures in excess of E_q must be approved by the voters.

For most districts $BASE = 0$. This implies that the schools will close unless the referendum succeeds. (The conditions and amounts of federal and state aid do not permit schools to operate without local funding.) In other districts E_q is sufficiently large for the schools to operate without exceeding E_q. Some districts are in an intermediate situation. After appropriate controls, we would expect variations in $BASE$ to explain variations in expenditures that are not explained by the competitive model.

A systematic, econometric analysis of the Oregon school referendum data is beyond the scope of this paper, and is the subject of our ongoing research. A number of simple "stylized facts" do present some interesting elementary observations that relate to our theoretical findings.

In Oregon the local budget committee, which consists of elected school board members and members appointed by the board, is formally responsible for the proposals. However, the committee members are unpaid and largely dependent on an interested bureaucrat, the superintendent of schools, for their proposals. This situation gives some credence to the budget-maximizing assumption, even with an elected board.

Districts where E_q is very high (in relative terms) permit a direct

TABLE I

TOTAL LOCAL SCHOOL LEVIES IN OREGON DISTRICTS NOT HOLDING ELECTION
(millions of dollars)

	Portland		Other districts			Total	
Year	E_q (1)	Amount levied (2)	E_q (3)	Amount levied (4)	Number of districts (5)	E_q (1) + (3)	Amount levied (2) + (4)
1970–71	48.66	48.66	3.17	3.14	8	51.83	51.80
1971–72	51.58*	51.58*	4.44	4.43	10	56.02	56.01
1972–73	54.67	54.67	4.84	4.84	11	59.51	59.51
1973–74	57.95	57.95	4.17	4.06	8	62.12	62.01
1974–75	61.43	61.43	5.48	5.37	8	66.91	66.80
1975–76	65.11	65.11	2.85	2.85	6	67.96	67.96
1976–77	69.02	69.02	4.79	4.79	6	73.81	73.81

* E_q enacted after 3 election failures in 1971:

Election date	Additional levy proposed	"Yes" votes	"No" votes
May 3, 1971	6.96	22,677	40,404
June 10, 1971	6.96	23,660	35,251
Sept. 28, 1971	5.74	26,290	45,072

and simple confrontation of the monopoly and competitive models. Both models predict that, under certainty, no election will be held once E_q is greater than the median ideal point. (If sufficiently high costs of elections are borne by the board, then even under uncertainty there would be no election in either case.) The monopoly model further predicts that the actual expenditure will in fact be E_q—the setter will extract the highest possible budget. The competitive model, in contrast, predicts that actual expenditures will be below E_q, except in the improbable case where the median ideal point and E_q coincide.

In Table I we present data for seven recent years. For each year, the table gives E_q and total school tax levied for educational districts that held no elections that year. We list Portland, the state's largest district, which held no elections (except for 1971–1972—see below), separately. The other districts not holding elections are aggregated.

Over these years, Portland assessed its entire E_q in every year—a total of $408.4 million over the 1970–1977 period. Other districts not holding elections, taken together, never assessed less than 97 percent of aggregate E_q in a given year. Over the period of Table I, districts

TABLE II

CHANGE IN BUDGET PROPOSAL RELATIVE TO PRECEDING PROPOSAL IN DISTRICTS WITH TWO OR MORE BALLOTS

	1970–71	1971–72	1972–73	1973–74	1974–75	1975–76	1976–77
Number of increases over previous proposal	2	6	2	2	4	5	4
Number with no change	52	50	42	28	36	48	52
Number of decreases from previous proposal	115	77	54	62	54	95	112

Source (Tables I and II). State of Oregon Department of Education.

not holding elections (including Portland) assessed in school taxes a total of $437.9 million out of the $438.2 million to which they were statutorily entitled without having to go to the voters. The budget-maximizing model appears to be quite well supported for those districts. While the distribution of median ideal points is unknown, a reasonable prior expectation based on the competitive model would certainly have called for considerably greater deviation between E_q and the actual levy—and for considerably lower expenditures.

If an initial proposal is defeated, additional elections may be held. The Portland district, which had not held an election for many years, relying wholly on its reversion expenditure (together with outside aid), went to the voters in 1971 to obtain an additional $7 million. After two failures at the polls, the additional request was trimmed to $5.7 million. This too met defeat, by an increased margin with larger turnout. The school board then retreated to using the full reversion amount. This interesting episode can be interpreted in terms of our framework. Having not had any elections for some time, the board did not have up-to-date information about voter preferences. Calling elections may be viewed, in part, as an attempt to discover whether E_q was above the median ideal point. The resounding defeats of attempted increases gave an affirmative answer. In the following five years, Portland held no school budget referenda.

Each year, a sizable number of districts go to two or more elections before gaining approval of the year's budget. As shown in Table II, the pattern over a sequence is for budget proposals to be either maintained or cut on later ballots. There are very few increases. This is largely in accord with our theoretical model. Although our model does call for a strict cut after every defeat, the percentage cut from the previous request should be smaller for earlier ballots in the sequence than for later ballots. A more detailed examination of the data shows that the proportion of cuts is greater between the third and fourth ballots, when they occur. Thus, the failure to cut the budget could be partly a matter of simply not "fine tuning" when very small changes are called for—although the setter's interest in not signaling information to voters may well be an even more important factor. Our model also implies that the probability of passage, $p(x)$, increases as the sequence advances. Again, the data appear to be in accord: the greater the ballot number within a sequence, the greater the proportion of proposals that pass.

Our model has a number of other implications—about the magnitudes of cuts in proposals, the relationship of reversion points and proposals, the effects of turnout—that are amenable to econometric study. Here we have attempted to give only some simple but suggestive evidence that the framework of this paper has potentially interesting empirical implications.

APPENDIX

Rewriting (11) gives

$$\Phi[\theta(1 - 2q(x))] < 1 - \tilde{x}^c/x, \tag{A1}$$

where $\Phi(\cdot)$ is the standard normal cumulative distribution function and $\theta = \sqrt{m(1 - r)/r}$. In order for (11) to hold for a particular electorate, there must be at least one value of $q(x)$ such that (A1) is satisfied, with $\tilde{x}^u \geq 2\tilde{x}^c$, for given θ.

Let α be defined by

$$\Phi[\theta(1 - 2\alpha)] = 1 - 1/k, \tag{A2}$$

where $k > 1$, i.e.,

$$\alpha(k;\theta) = \frac{1}{2} - \frac{\Phi^{-1}(1 - 1/k)}{2\theta}. \tag{A3}$$

Then $B(x) > \tilde{x}^c$ if and only if, for given θ, there is a value of $k > 2$ such that

$$q(k\tilde{x}^c) > \alpha(k;\theta). \tag{A4}$$

Values of α are plotted against k for several values of θ in Figure V. Note that α declines very slowly as k increases. Thus, in order for (A4) to hold and, consequently, for $B(x^*)$ to exceed $\tilde{x}^c$, there must be a significant concentration of individuals with $\tilde{x}$ greater than twice the

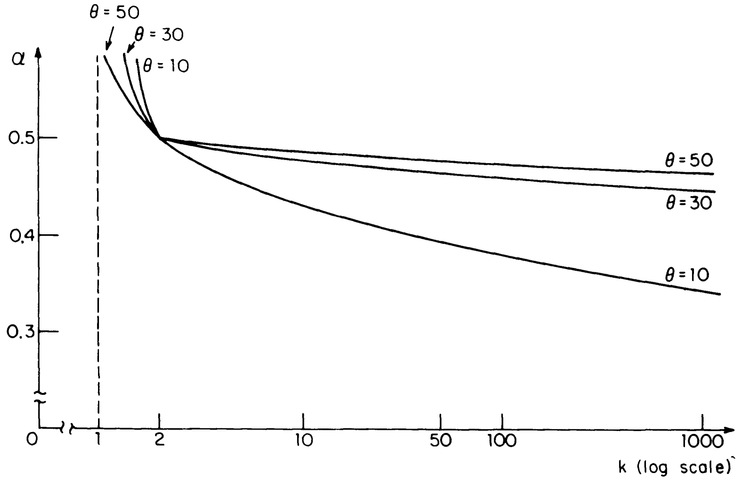

FIGURE V

median $\tilde{x}$. (For example, even with θ as low as 10, which would correspond, say, to $m = 100, r = 0.5$ or $m = 400, r = 0.8, \alpha > 0.35$ for $k <$ 1,000. As θ increases, so does $\alpha(k)$; with $\theta = 30$, e.g., if $m = 1800, r =$ 2/3, $\alpha > 0.45$ for $k <$ 1,000.) Although it is quite simple to construct functions for which (A4) holds, we would conjecture that such distributions would be rare in the context of our problem. (If the distribution of $\tilde{x}$ were close to bimodal, with slightly more than half the population favoring a small increase over the reversion point and nearly half favoring a much larger increase, than (A4) would hold.)

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