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The Principle of Unanimity and Voluntary Consent in Social Choice

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The Principle of Unanimity and Voluntary Consent in Social Choice

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A discrete version of the author's incentive-compatible Auction Mechanism for public goods is applied to the problem of social choice (voting) among distinct mutually exclusive alternatives. This Auction Election is a bidding mechanism characterized by (1) unanimity, (2) provision for the voluntary compensation of voters harmed by a winning proposition, and (3) incentives for "reasonable" bidding by excluding members of a collective from maximal increase in benefit if they fail to agree on the proposition with largest surplus. Four of five experiments with six voters, bidding privacy, monetary rewards, and cyclical majority rule structure choose the best of three propositions.

Solutions to the problem of specifying incentive-compatible mechanisms for the provision of public goods have been proposed by Thompson (1965), Groves (1969, 1973), Clarke (1971), Drèze and de la Vallée Poussin (1971), Groves and Ledyard (1975), and Smith (in press *a*, in press *b*). Tideman and Tullock (1976) have applied the Clarke-Groves "demand revealing process" to the problem of social choice among discrete alternatives. Several laboratory and field experimental studies of these mechanisms, and of the so-called free-rider problem in public goods, have been conducted by Bohm (1972), Scherr and Babb (1975), the Public Broadcasting Service (reported by Ferejohn and Noll 1976), and Smith (in press *b*). These studies provide strong support for the proposition that practical decentralized mechanisms exist for the provision of public goods.

The sequel will briefly review the incentive-compatible Auction Mechanism (Smith in press *b*) for a public good whose size is variable. A

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special case of this mechanism consists of a mutually exclusive and exhaustive set of discrete alternatives. This is the familiar problem of social choice in the sense of voting among discrete alternatives to choose the "preferred" social state. The resulting voting mechanism, which we will call the Auction Election,[1] can be interpreted as an implementation of Wicksell's (1896) "principle of unanimity and voluntary consent in taxation." It is a pleasure to acknowledge Wicksell by plagiarizing the title to section 4 of his great paper.[2] In Section V the results of five voting experiments based on the Auction Election will be reported. The experimental design chosen is one for which the majority rule outcome is indeterminate, but for which there is a unanimously preferred alternative achievable with the automatic compensation features of the Auction Election.

I. The Auction Mechanism for Public Goods

Consider a collective composed of I members. Using a partial equilibrium framework,[3] let $V_i(X)$, with measurement normalized so that $V_i(0) = 0$, be the dollar value of a quantity X of the public good to member i and let q be the dollar price of the public good. Although q is assumed constant, the mechanism is easily modified for cases of increasing or decreasing returns (Smith in press *a*). Assume that collective decision must abide by the following rules or institution:

(1) Let each agent i submit a two-tuple (b_i, X_i) consisting of a bid and a proposed quantity with the understanding that his share of cost is $(q - B_i)\bar{X}$, where

$$B_i = \sum_{j \neq i} b_j, \qquad \text{and } \bar{X} = \sum_{k=1}^{I} X_k/I.$$

(2) Each agent has the unqualified right to veto or agree to the cost share $(q - B_i)\bar{X}$ allocated to him by all other agents. He sends the message "agree" by choosing $b_i = q - B_i$, and $X_i = \bar{X}$. He sends the message "veto" if he chooses $b_i \neq q - B_i$ and/or $X_i \neq \bar{X}$.

[1] Auster (1976) has proposed the use of "Compensating Elections" to resolve conflicts in social choice. The Auction Election, the Tideman-Tullock "Clarke Tax" Election, and Auster's proposal are identical in purpose although they represent distinct mechanisms.

[2] Also see Buchanan (1959) who, almost alone among modern scholars, has examined and extended Wicksell's ideas on public choice.

[3] More precisely it is assumed that there are no income effects. A general equilibrium two-good (one private, one public) version of the Auction Mechanism using Cobb-Douglas payoff (induced value) functions and a linear production possibility frontier underlies an experimental design currently in research process. This more sophisticated experiment uses the PLATO computer system to program subjects through the decision process. The results of the first several experiments suggest that introducing income effects does not reduce the ability of collectives to reach public good decisions, but the decision outcomes appear to exhibit more sampling variation (across replications with different groups of subjects) than the partial equilibrium experiments reported in Smith (in press *b*).

(3) Group equilibrium prevails if and only if agreement is signaled by every agent i. If such unanimity obtains, $\hat{X}$ units of the public good are purchased with agent i paying $b_i\hat{X} = (q - B_i)\hat{X}$.

Under these rules, i's net benefit is

$$v_i = \begin{cases} V_i(\hat{X}) - (q - B_i)\hat{X}, & \text{if } b_i = q - B_i, \quad \text{and} \\ \quad X_i = \hat{X} = \left(X_i + \sum_{j \neq i} X_j\right)\Big/ I & \text{or} \\ \quad X_i = \left(\frac{1}{I - 1}\right) \sum_{j \neq i} X_j, & \text{for all } i \\ V_i(0) = 0, & \text{otherwise.} \end{cases} \tag{1}$$

Conditions on (b_i, X_i) to maximize v_i, assuming concavity of V_i, are

$$V_i'\left[\left(X_i + \sum_{j \neq i} X_j\right)\Big/ I\right] = q - B_i, \tag{2}$$

$$b_i = q - B_i, \tag{3}$$

$$X_i = \hat{X}, \qquad \text{for all } i. \tag{4}$$

Each i will try to satisfy (2) where the marginal private benefit from his proposal, X_i, is equal to the net private price allocated to him by the "market," while if (3) and (4) are not satisfied, the rules require each i to accept the inferior outcome $V_i(0) = 0$. The rules exclude i unless he agrees to accept the unit cost $q - B_i$, and the group's proposal $\hat{X}$. This is very similar to the incentive of an economic agent to "meet the market" in a competitive auction to avoid "exclusion." The difference is that under the above rules if any i is excluded, then all are excluded. Whether this difference leads to more extensive strategic gaming and signaling that prevents equilibrium is an empirical question which so far, in the literature cited, has not been an important problem.

Equations (2)–(4) yield the Lindahl equilibrium.[4] Summing (2) over all i, and using (3),

$$\sum_{i=1}^{I} V_i'(X_i) = \sum_{i=1}^{I} V_i'(\hat{X}) = \sum_{i=1}^{I} b_i = b_i + B_i = q.$$

Hence $\hat{X}$ must be the Lindahl optimal quantity of the public good.

[4] These conditions also define one of many local Nash equilibria. As shown in Smith (in press *b*) the Auction Mechanism provides multiple local Nash equilibria among which is the Lindahl equilibrium. This is easy to see from eq. (1). If X^o is the Lindahl equilibrium, then any $X \neq X^o$ yielding $V_i(X) - (q - B_i)X > 0$ for each i is better than nothing and each i has at least some incentive to agree, i.e., to set $b_i = q - B_i$, $X_i = X$. Empirically (Smith, in press *b*) across experiments with different subjects, the final outcome bids are tightly distributed around the Lindahl prices, $V_i'(X^o)$, so that there is a clear tendency for the Lindahl optimal Nash equilibrium to prevail. But in *every* case the Lindahl (and Pareto) optimal *quantity* is chosen. Hence, empirically, the Auction Mechanism allows for a fair degree of variability in the ex post distribution of wealth while preserving Pareto efficiency.

Observe that if X is a public "bad" for any i, then V_i and V_i' are negative, his bid b_i must be negative, and in equilibrium each member harmed by X is compensated. It is in the interest of all harmed agents to agree as soon as their compensation is "adequate" (what this means theoretically is that marginal Lindahl rent is zero).

II. The Auction Election

In social choice group decision produces a common outcome. Thus a referendum legalizing marijuana either passes or fails, and all citizens experience the resulting state. This is just a discrete public good (or bad) to which the Auction Mechanism applies if X is restricted to assume only the values zero or one. Under unanimity i receives net benefit $v_i = V_i(1) - (q - B_i) = V_i(1) - b_i > V_i(0) = 0$. In the problem of pure "political" choice the proposition has a zero resource price. Thus if the proposal is to make daylight saving time official across the United States, then $q = 0$ for that common outcome. Presumably this issue involves only private valuations. Of course q could be negative, for example, legalizing marijuana saves enforcement costs.

Consider first the case of a choice between two alternatives, proposition A or $\bar{A}$ (not A), that is, if A fails to be approved the status quo continues. In the Auction Election ($q = 0$) the social choice problem is solved by allowing each i to submit a bid $b_i \gtreqless 0$ "on" or "for" the proposition. Proposition A wins if $\sum_{i=1}^{I} b_i \geq 0$, otherwise it loses. As in (1), net benefit for voter i is

$$v_i = \begin{cases} V_i(A) - b_i, & \text{if } b_i \geq -B_i, \quad \text{for all } i \\ V_i(\bar{A}), & \text{otherwise.} \end{cases} \tag{5}$$

A transparent theorem is the following: If

$$\sum_{i=1}^{I} V_i(A) > \sum_{i=1}^{I} V_i(\bar{A})$$

(A yields a larger rent to the collective than $\bar{A}$), then there exists a bid b_i^* for each i such that proposition A will win, that is,

$$\sum_{i=1}^{I} b_i^* \geq 0,$$

and no i will be made worse off, that is, $v_i^* = V_i(A) - b_i^* \geq V_i(\bar{A})$. Formally, each voter i will rationally bid no more than his personal valuation of A, $V_i(A)$, net of the *opportunity cost* of A, $V_i(\bar{A})$, that is, $b_i \leq V_i(A) - V_i(\bar{A})$. Hence, if

$$\sum_{i=1}^{I} [V_i(A) - V_i(\bar{A})] > 0,$$

TABLE 1

VOTER VALUATIONS

Voter	Alternative A	Alternative $\bar{A}$
1	30	0
2	0	60
3	40	0
Total	70	60

there exists an $\varepsilon_i \geq 0$ for each i such that if we set $b_i^* = V_i(A) - V_i(\bar{A}) - \varepsilon_i \leq V_i(A) - V_i(\bar{A})$, then

$$\sum_{i=1}^{I} b_i^* = \sum_{i=1}^{I} [V_i(A) - V_i(\bar{A}) - \varepsilon_i] \geq 0 \text{ (proposition } A \text{ wins)},$$

and $v_i^* = V_i(A) - b_i^* = V_i(A) - [V_i(A) - V_i(\bar{A}) - \varepsilon_i] = V_i(\bar{A}) + \varepsilon_i \geq V_i(\bar{A})$.[5]

An example, borrowed from Tideman and Tullock (1976), will help to illustrate the process. Table 1 exhibits the valuations of A and $\bar{A}$ for each of three voters. Proposition A might be a proposed change in a land zoning ordinance. Voter 1, now holding valueless property, would enjoy a capital gain of 30. Voter 2, owning land worth 60, would be wiped out. Voter 3, owning land worth nothing, would receive a gain of 40. In an Auction Election for A voter 1 will bid no more than 30, voter 2 no more than -60, and voter 3 no more than 40. Proposition A yields 10 units more collective rent than $\bar{A}$. Voters can submit bids for A yielding an aggregate net benefit up to 10 without causing A to lose. Thus if $\varepsilon_i = 3$ for each i, then

$$\sum_{i=1}^{3} b_i^* = 1,$$

proposition A wins, and each voter is 3 units better off. Each has a competitive incentive to bid enough to ensure passage of A to avoid

[5] Clearly there is an infinite number of imputations of the surplus

$$\sum_{i=1}^{I} [V_i(A) - V_i(\bar{A})]$$

among I voters, and each imputation represents a possible equilibrium outcome. Any particular equilibrium outcome may depend upon the strategic or "bluffing" behavior of agents, the utility of the outcome relative to the perceived subjective costs of "strategizing," and so on. The situation is analogous to the so-called indeterminacy in the classical bilateral bargaining problem. Indeterminacy simply means that we do not have as yet a sufficiently sharp behavioral theory to account for particular outcomes within the set of Pareto superior points.

"exclusion" from A and thereby being forced to accept a less desirable alternative.

Obviously, proposition A will fail to win if one or more voters is "too greedy." If voter 1 bids less than 20, thus holding out for more than a 10 unit improvement over his present position, he will block passage and get nothing. If voter 2 bids less than -70, hoping for an improvement in excess of 10, he will get no improvement. And so each voter has an incentive to yield sufficiently to ensure that proposition A wins.

III. The "Clarke Tax" Election

Using this example the Auction Election can be compared instructively with the "Clarke Tax" election proposed by Tideman and Tullock (1976). Under their scheme A would also win over $\bar{A}$. Assuming that each voter responds to the Tideman-Tullock incentive to bid his full valuation, then voter 1 pays a tax of $60 - 40 = 20$, the amount necessary to bring the bids for A up to equality with the bids for $\bar{A}$. Similarly, voter 3 pays a tax of 30, but voter 2 pays no tax because his bids do not change the outcome, that is, A would win over $\bar{A}$ if 2 did not bid at all. Hence, voter 1 ends with a benefit net of his tax, 10; voter 3 with a net benefit, 10; but voter 2, who pays no tax and gets zero from proposition A, has had his property (worth 60 under $\bar{A}$) confiscated without due process. As noted by Tideman and Tullock (1976, p. 1149), "It may seem that a person who sustains a large loss when his preference is not followed deserves compensation, but this cannot be given without motivating an excessive statement of differential value. . . . In regard to the uncompensated losses that are produced, the demand revealing process is similar to majority rule." In the Auction Mechanism, agreement requires those who would gain to compensate those who would lose. Both types of voters have motivation to not ask for an excessive share of the rent, that is, to bid sufficiently high to avoid a less favorable outcome. Any mechanism that does not exploit this competitive-like exclusion characteristic (or in some other manner maintains incentive compatibility) and does not require unanimity seems likely to be inefficient or confiscatory or both (as with majority rule). But these criticisms of the "Clarke Tax" should not detract from the innovative contribution of Clarke, Tideman, and Tullock. It should be expected that any of the several new mechanisms of public choice now in only their formative stages will be subjected to a variety of improvements.[6]

[6] The Auction, "Clarke Tax," and Auster "Compensating" elections differ primarily in terms of how each would allocate the consumer surplus from an issue among the electorate.

IV. Multiple Choice Auction Elections: An Experimental Design

The Auction Election extends readily to multiple options. Let there be N discrete alternatives, $p = 1, 2, \ldots, N$, with option p having value V_i^p normalized so that the status quo null alternative to the N options has value zero for all i. Each i submits a bid b_i^p for option p. A winning option is one for which the algebraic sum of the bids is nonnegative and no smaller than the algebraic sum of the bids for any other option. Tied options are considered equivalent and a winner selected by an equal probability random device. The expression for net benefit is then[7]

$$v_i = \begin{cases} V_i^p - b_i^p & \text{if } 0 \le b_i^p + B_i^p \ge b_i^q + B_i^q, \\ & \qquad \text{for all } i \text{ and all } q \ne p, \\ 0, & \text{otherwise,} \end{cases} \tag{6}$$

where

$$B_i^p = \sum_{j \ne i} b_j^p, \qquad B_i^q = \sum_{j \ne i} b_j^q.$$

If there is a winning option p it has the property

$$0 \le \sum_{i=1}^{I} b_i^p \ge \sum_{i=1}^{I} b_i^q$$

for all $q \ne p$. If there is no winning option, that is, $b_i^r + B_i^r < 0$ for all $r = 1, 2, \ldots, N$ the status quo is maintained.

The example in table 2 applying to six voters and three options provides the subject valuations in dollars used in the experiments to be discussed in the next section. The entries in table 2 are measured relative to the status quo, or the null proposition (not shown). Thus if proposition 3 wins, voter 1's wealth state is \$20 lower than if none of the three propositions wins. Propositions 2 and 3 are both highly attractive with aggregate rents of \$105 and \$45, respectively, but the Auction Election can be expected to choose 2. Under a majority rule decision process the outcome is intransitive. Proposition 2 beats 1 by a vote of 4 to 2, proposition 3 beats 2 by 4 to 2, and 1 beats 3 by 4 to 2. As is well known and typical of majority rule, (1) it leads to an inefficient outcome unless the "right" agenda is followed, and there is no way (to my knowledge) that an appropriate agenda can be selected on the basis of objective voting data, and (2) even if the optimal choice is selected by majority rule it produces an involuntary redistribution of wealth. The Auction Election redistributes relative wealth voluntarily.

[7] Note that an Auction Election with N options is just the Auction Mechanism with N discrete, mutually exclusive alternatives, i.e., N different public goods $X = 1, 2, \ldots, N$, one and only one of which can be chosen.

TABLE 2

VOTER VALUATIONS ($)

PROPOSITION	VOTER 1	2	3	4	5	6	TOTAL
1	5	−30	−30	25	25	0	−5
2	60	5	5	−10	−10	55	105
3	−20	45	45	0	0	−25	45

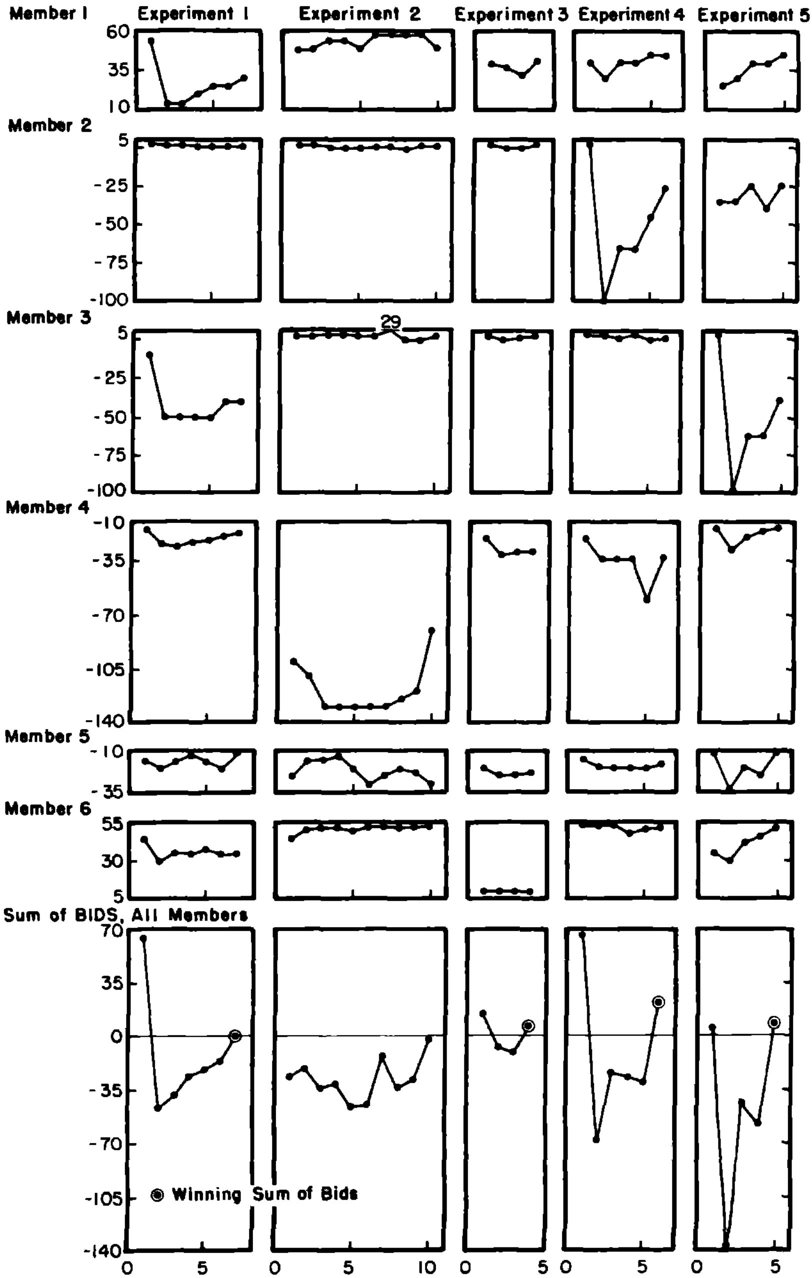
V. Experiments and Results

Thirty subjects participated in five experimental sessions, each consisting of six-member voter collectives using the induced value payoffs[8] in dollars shown in table 2. The instructions printed in the Appendix were distributed and read aloud to the six subjects in each session who had been recruited from large sections of business and economics courses at Arizona State and the University of Arizona. No subject participated in more than one session. Each subject also received a copy of a recording form, a sample of which (for voter 1 in table 2) is included in the Appendix. The three propositions, as defined by the vector of subject valuations, were reordered (i.e., renumbered 1, 2, 3) randomly for each experiment. In each experiment the subjects were assigned randomly to the six valuation conditions and seated so that the privacy of such information could be maintained. This right of privacy included a provision for separately paying each subject his cash earnings after each experiment was completed. It was then each subject's choice whether such information was to be revealed to any other person.

In each experiment a maximum number of trials was specified. The first trial was a "practice trial" that did not count in the determination of a winning proposition. Experiments 1 and 2 (see fig. 1) consisted of a maximum of 10 trials, while experiments 3, 4, and 5 allowed up to six trials. The trial maximum was reduced after the first two experiments as it became evident that a very few trials were sufficient to allow collectives to reach a decision. It seems possible that more trials may even make group agreement less likely. Only one of the five experiments (experiment 2) failed to produce a winning proposition, and it was a 10-trial session.

Figure 1 exhibits the trial sequence of individual subject bids for the superior proposal (proposition 2, table 2) in each experiment. The subject identification numbers correspond to the voter numbers, with associated

[8] Subjects were paid $V_i^p - b_i^p +$ \$2 if proposition p won, $V_i^o =$ \$2 if no proposition won, where the induced values V_i^p were as given in table 2. A total of $464 was paid to the 30 subjects under these rules.



Member 1
Experiment 1
Experiment 2
Experiment 3
Experiment 4
Experiment 5
60
35
10
Member 2
5
-25
-50
-75
-100
Member 3
29
Member 4
-10
-35
-70
-105
-140
Member 5
Member 6
55
30
Sum of BIDS, All Members
70
0
Winning Sum of Bids

FIG. 1

proposition values, shown in table 2. The panel at the bottom of figure 1 plots the bid sum for each trial.

The practice trial, besides providing familiarity with the procedure, was of considerable importance in yielding information, however imperfect, on the potential surplus available among the three proposals. In every experiment the best proposition received the largest bid sum on the first trial. This first-trial bid sum was positive in all sessions except experiment 2 and (especially in experiments 1 and 4) revealed to members of the collective that the total surplus available from the best proposition was substantial. Consequently, on the second trial the bids tended to fall sharply as subjects generally attempted to "game" for an increased share of the surplus (23 of the 30 subjects reduced their bids on trial 2). The question or hypothesis at issue, as in previous public good experiments (Smith, in press *b*) is *not* whether members will "game" for a personal advantage in the Auction Election, but whether the mechanism is sufficiently effective to guide the collective to the optimal choice. Obviously some, perhaps many, members will "game"; and obviously, in figure 1, they do "game." But the mechanism also confronts each member of the collective with the discipline of exclusion if each does not, by the final trial, at least match the "market price," $-B_i$, presented to him by the other members. Four of the five experimental collectives reached agreement on the optimal proposition. In experiment 2 the group failed by $2,

$$\sum_{i=1}^{6} b_k = -2,$$

on trial 10 to elect the best proposition. If we take these results literally, the sample evidence suggests that an Auction Election choice among three propositions (four, counting the null proposition or status quo) with parameters as defined in table 2 would select the optimal proposition in 80 percent of the elections. (And remember, under majority rule *none* of these propositions can prevail by pairwise voting.) The robustness of these results can only be established with more experiments. Experiment 2 was very close to producing agreement in spite of unusually aggressive, and ineffective, play by subject 4. This subject expressed puzzled disappointment with the outcome, suggesting that failure experiences might mitigate such aggressive bidding in subsequent elections. Experience may be an important treatment variable and deserves systematic study. However, the failure of experiment 2 may be due to the fact that subject 3's bid (29) on trial 7 exceeded his valuation (5), producing unrealistic profit expectations in the other subjects.

In previous public good experiments (Smith, in press *b*) using the Auction Mechanism it was hypothesized that equilibrium bids across

TABLE 3

Trial	$\hat{\beta}$	$t_{\beta-1}$	$\hat{\beta}_o$	$t_{\beta o}$	R^2	SE	$F(1,28)$
1	0.92	−0.678	−12.0	−3.01	.674	18.71	60.87
$t^* - 1$	1.105	−0.767	−24.18	−4.59	.630	24.72	50.38
t^*	0.998	−0.019	−16.33	−4.39	.737	17.46	82.29

individual subjects would tend to the theoretical Lindahl prices for those subjects. Formally this took the form of testing the research hypothesis $\beta_o = 0$ and $\beta = 1$ in the regression equation

$$y_{ij} = \beta_o + \beta x_{ij} + \eta_{ij}, \tag{7}$$

where y_{ij} is the observed final equilibrium bid of subject j in experiment i and x_{ij} is the (experimentally controlled) Lindahl price for subject j in experiment i. In the present Auction Election experiments there are no Lindahl prices where marginal Lindahl rents are zero because the public outcome of an election is discrete. However, the individual valuations x_{ij} of subject i in experiment j for the best proposition do represent Lindahl price upper bounds on subject equilibrium bids. In the Auction Election these valuations should explain much of the variation in the final outcome bids. In the above regression for the Auction Election the research hypothesis becomes $\beta_o < 0$, $\beta = 1$. If $\beta = 1$ the estimate $-\hat{\beta}_o$ is a measure of the equilibrium surplus ($x_{ij} - y_{ij} = -\beta_o$) obtained by the average subject. In the Auction Election the hypothesis that $\beta = 1$ follows from the expectation that the surplus obtained by a subject on a winning proposal will not depend on his valuation, that is, those able to pay z dollars more will on the average pay z dollars more.

The regression results using the data shown in figure 1 for the first, penultimate, and final (t^*) trials are shown in table 3. For each of these trials $\hat{\beta}$ is very close to unity with very low t-values, particularly on the final trial. The estimates of $\hat{\beta}_o$ indicate that the average voter's initial demand for net surplus, \$12, is below his final earnings, \$16. On the penultimate trial the extent of "bluffing" is indicated by an average demand for \$24 of surplus. The R^2 values show that subject valuations account for 63 percent or more of the variation in subject bids. However, the final trial R^2 of .74 is below the final trial R^2 in three different sets of public good experiments (Smith 1976*b*), in which the Lindahl prices accounted for 82 percent, 97 percent, and 99 percent of the variation in subject bids. A reasonable conjecture might be that the mechanically simpler Auction Election invites more strategic bluffing and signaling by members of the collective.

VI. Conjecture, Impossibility Theory, and the Evidence

In 1896, Wicksell conjectured that if the utility of a public outcome exceeded its cost then it was theoretically possible to find a distribution of costs so that all members of the collective would approve the outcome unanimously. In 1955, Samuelson first conjectured the "fatal inability" of any decentralized mechanism to determine optimal public choices, a view that was later (Samuelson 1969) reasserted even more emphatically. Neither Wicksell nor Samuelson actually specified decentralized mechanisms which could provide theoretical foundations for their respective conjectures. The Auction Election solves the Arrow (1963) problem in somewhat the same sense that a competitive private goods economy solves the problem of resource allocation: the competitive economy provides a Pareto optimal outcome for a given distribution of primary resources and has nothing to say about the optimal distribution of such resources. Actually, the mechanism does a little more than this by providing for some voluntary redistribution of wealth whenever a winning proposition is produced.

Hurwicz (1972), for pure exchange private goods economies, and Ledyard and Roberts (1974), for economies with public goods, have proved that it is impossible to find a mechanism that provides individually rational Pareto optima and which is simultaneously individually incentive compatible. Obviously, the above mechanisms do not contradict these theorems which postulate a much broader range of strategic behavior by economic agents than Nash equilibrium competitive behavior. But why do real people making real decisions for real money, in the experiments reported here and in the cited experimental public good literature, behave predominantly in accordance with the competitive postulate? Why do they not exhibit the more "sophisticated," "strategic" behavior postulated by Hurwicz and Ledyard-Roberts? I think it is because there are significant direct (and indirect opportunity) costs of thinking, calculating, and signaling which make strategizing uneconomical. In the Auction Election the opportunity cost of failing to reach agreement is the loss of the more valuable best proposition. Strategizing not only consumes costly time and thought, it increases the risk of group disagreement. Disagreement means exclusion from better wealth states on the sobering principle that nobody gets more if there is not more available to get.

Can all the hard scientific evidence from experiments to date be dismissed as irrelevant, too simplistic, or based on particular experimental parameters? I think not, for the reason that such results are consistent with a great deal of field evidence. Thousands of buildings have been purchased by religious organizations, clubs, art associations, and private societies through member voluntary contributions having the exclusionary characteristic of the Auction Mechanism and the Auction Election: if contributions do not cover the cost of the proposed project, the project dies. Numerous universities meet specific capital needs from contributions and gifts by alumni and associates. We tend to explain these phenomena, while holding on to our enshrined belief in the impossibility of decentralized public good decision, by attributing them to atypical "altruism." The theory discussed here suggests that such behavior is entirely consistent with self-interest motivation since the decision procedure is the same as that of the Auction Mechanism for public goods.

But it is not my intention to argue that either the present state of evidence or the present state of theory is satisfactory. There is no theory, only conjecture, to support the assertion above that competitive behavior may be a rational response when signaling, thinking, and calculating are costly. Nor can we be confident of the empirical results until new experiments are conducted and old experimental results replicated with different subjects and different experimenters. In future experiments I intend to explore the effect of larger collectives, experience, and balanced budget versions of the Auction Election in which aggregate overbids are rebated in proportion to individual bids.[9]

Appendix

Instructions

This is an experiment in the economics of group decision making. The instructions are simple, and if you follow them carefully and make good decisions you may earn a considerable amount of money which will be paid to you in cash at the end of the experiment. Various research foundations have provided funds for this research.

You are a member of a group that must decide which one of 3 proposals is to be selected. The group will decide by bidding which proposal will be chosen. The value to you of each alternative proposal is shown in column (1) (under each

[9] In earlier experiments (Smith, in press *b*) it was found that the stopping requirement under which each member must *exactly* match his share of cost was needlessly demanding on group agreement. A better rule is to require $b_i \geq q - B_i$ and to distribute any overbid as a rebate to each member in proportion to his bid. Letting

$$B = \sum_{k=1}^{I} b_k = b_i + B_i > q,$$

each i is assigned a new lower bid

$$b_i' = b_i - \frac{b_i(B - q)}{B}.$$

Then

$$B' = \sum_{i=1}^{I} b_i' = \sum_{i=1}^{I} \left[b_i - \frac{b_i(B - q)}{B}\right] = q.$$

The budget is balanced with the new bids (b_i'), and since $b_i' < b_i$ every agent is better off. In any case any agent can still veto the arrangement and reject the new calculated bid. This procedure makes group agreement mechanically easier, i.e., compliance cost is lower for the group stopping rule.

TRIAL 1			
PROPOSITION	(1) MY VALUE	(2) MY BID	(3) MY NET VALUE
1	5		
2	60		
3	-20		
4			
5			

TRIAL 2			
PROPOSITION	(1) MY VALUE	(2) MY BID	(3) MY NET VALUE
1	5		
2	60		
3	-20		
4			
5			

TRIAL 3			
PROPOSITION	(1) MY VALUE	(2) MY BID	(3) MY NET VALUE
1	5		
2	60		
3	-20		
4			
5			

TRIAL 4			
PROPOSITION	(1) MY VALUE	(2) MY BID	(3) MY NET VALUE
1	5		
2	60		
3	-20		
4			
5			

TRIAL 5			
PROPOSITION	(1) MY VALUE	(2) MY BID	(3) MY NET VALUE
1	5		
2	60		
3	-20		
4			
5			

TRIAL 6			
PROPOSITION	(1) MY VALUE	(2) MY BID	(3) MY NET VALUE
1	5		
2	60		
3	-20		
4			
5			

FIG. A1

trial), on your record sheet. Net value, which will be paid to you in cash on the final decision, is computed by subtracting your bid from your value for the winning proposal.

The decision process consists of a series of trial bids as follows (refer to your record sheet): On each trial each member privately selects and writes a bid in column (2), expressed in whole dollars, for each of the proposals. For example, 20, 0, − 15. A negative bid means that you are asking for compensation from the other members. *A bid should not exceed your proposal value if you want to make money.* On each trial, I will go to each member and record his bids, compute the algebraic sum of all member bids for each proposal, and post these sums on the blackboard. The proposal with the largest positive bid sum will be the winner. On each trial compute your potential net value, column (1) minus column (2), for each proposal and write it in column (3). If and when a proposal wins, draw a circle around your net value for the winning proposal. You will have a maximum of 6 trials to determine the winning proposal. The first trial will be for practice to familiarize you with the procedure and will not count in determining a winning proposition.

If a proposal wins we will stop on that trial, and you will be paid $2 plus your net value. Otherwise, you will be paid $2. The proposition values on your record sheets are not the same for all members. They represent your own private information and are not to be revealed to any other member. Feel free to earn as much cash as you can. Do not speak to any other participant.

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