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Social preferences and voting: An exploration using a novel preference revealing mechanism

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ABSTRACT

Public referenda are frequently used to determine the provision of public goods. As public programs have distributional consequences, a compelling question is what impact, if any, do social preferences have on voting behavior. This paper explores this issue using laboratory experiments wherein voting outcomes lead to a known distribution of net benefits across participants. Preferences are elicited using a novel Random Price Voting Mechanism (RPVM), which is more efficient in eliciting preferences than a dichotomous choice referendum but gives consistent results. Results suggest that social preferences, in particular a social efficiency motive, lead to economically meaningful deviations from selfish voting choices and increase the likelihood that welfare-enhancing programs are implemented.

1. Introduction

Majority-voting rules are used extensively by representative legislative bodies in ballot initiatives and referenda, and by clubs to determine the provision of public goods. It is safe to say that nearly all public programs impose varying levels of costs and benefits on individuals. If voters are motivated in part by social preferences, we should expect their decisions to be influenced by their perception of the potential impacts of the outcome of the vote on others. As a simple illustration, consider a proposal for a school bond. Some elderly citizens may choose to vote "yes" in a referendum on such a proposal, at a personal cost to them and without any anticipated benefits to their own children or grandchildren. On the other hand, an advocate of school programs may be worried that voting "yes" on the associated tax could impose unwanted costs on those without children and vote "no."

A number of empirical economic studies have investigated the role of social preferences in voting (e.g., Deacon and Shapiro, 1975; Holmes, 1990; Shabman and Stephenson, 1992, 1994; Kotchen and Powers, 2006). Given the overwhelming evidence of pro-social behavior in bargaining, trust, reciprocity, public goods, and other games, it is not surprising that these studies have demonstrated deviations from pure self-interest in actual referenda: following terminology recently used by Bergstrom (2006), voters appear to be partly motivated by "sympathetic gains" obtained from others' enjoyment of public goods as well as "sympathetic losses" that each bears for the share of costs paid by others. However, the aggregated and anonymous data used in these studies preclude measuring the extent of the deviation from self-interest (Mueller, 1989), identifying the precise form that such social preferences take, or assessing the impact of those preferences on the desirability of using referenda as a public goods allocation mechanism.

In an effort to better explain field and laboratory deviations from rational, self-interested behavior, economists have sought to develop utility-theoretic frameworks that account for both personal gains as well as social preferences. Fehr and Schmidt (1999; hereafter FS) and Bolton and Ockenfels (2000; hereafter ERC) propose theoretical models to explain other-regarding behavior that are based on the notion that individuals are averse to inequality among players. Alternatively, Charness and Rabin (2002; hereafter CR) propose a quasi-maximin social preference model in which individuals are motivated by both social efficiency and maximin preferences (i.e.,

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preferences for maximizing the welfare of the worst-off individual). They support this approach with evidence from two- and three-person dictator games and response games that suggests this specification better explains experimental game behavior than inequality aversion.

A handful of recent laboratory studies have used simple distribution experiments, similar in spirit to CR, to examine social motives (e.g., Engelmann and Strobel, 2004; Bolton and Ockenfels, 2006; Fehr, Naef and Schmidt, 2006). A review of this class of games leads Engelmann and Strobel (2007) to conclude that models that capture both efficiency and maximin preferences appear to be the most successful. However, they find that preferences appear to be quite heterogeneous across games and differ within and between subject pools. Of particular relevance to our study is the work of Bolton and Ockenfels (2006), who conduct a distribution experiment in a majority-voting context. In their experiment, individuals in three-person groups vote between an allocation that yields equal payoffs to all voters and one with an inequitable but more efficient allocation. While Bolton and Ockenfels conclude that preferences for equity dominate those for efficiency in their experimental voting setting, Engelmann and Strobel (2006) point out that this particular result may be attributed to an experimental design that systematically favored equity.

Given the importance of voting as a social choice mechanism, the limited amount of research on measuring and identifying expressions of other-regarding preferences through voting is surprising Further, pro-social preferences are likely to manifest themselves differently in a voting context relative to other experimental games. For instance, unlike with voluntary contribution mechanisms, many public referenda are coercive. In comparison to dictator-type games, group voting adds the layer of a shared outcome that affects an individual's final payout.

The primary objective of our study is to provide empirical evidence to help distinguish among competing theories of social preferences in a voting setting. This research also makes a practical methodological contribution to the study of voting by introducing a new laboratory mechanism. The Random Price Voting Mechanism (RPVM) is a public goods extension of the Becker-DeGroot-Marschak (BDM) (1964) mechanism. It is shown to be incentive compatible and capable of accurately measuring point estimates of the willingness-to-pay (WTP) and willingness-to-accept (WTA) compensation of individuals for public programs in an environment that emulates voting decisions.

Although dichotomous choice, yes/no, voting directly parallels real world referenda and is demand revealing both theoretically (Gibbard, 1973; Satterthwaite, 1975) and empirically (Taylor et al., 2001), the limited information about an individual's value obtained from a simple yes or no vote implies that very large samples of voters facing different net benefits are required to obtain a detailed map of social preferences. The RPVM provides a means for revealing preferences more efficiently in a referendum-voting situation.

In the RPVM, each individual in a group places a bid for a public program. This bid acts like a vote: the referendum is passed and the program is implemented only if the majority of individuals places a bid higher than or equal to a randomly selected price. In this case, all individuals must pay the randomly drawn price, a coercive tax that closely parallels the format of many referenda. Similar to the BDM, the RPVM elicits a point estimate of value and is incentive compatible under the expected utility framework.[1]

Experimental subjects are organized into groups of three, and social preferences are studied by evaluating the distribution of bids obtained through a RPVM for the implementation of a program that would result in net gains or losses for members in the group. Voting patterns for homogeneous and heterogeneous payoff vectors are studied for all four Hicksian welfare settings. Participant decisions in homogeneous payoff settings suggest that the RPVM is empirically demand revealing, which is consistent with laboratory evidence for the BDM (Irwin et al., 1998; Plott and Zeiler, 2005) and the dichotomous choice voting mechanism (Taylor et al., 2001). The existence and nature of social preferences are explored using a simple structural estimation approach of behavior in the heterogeneous payoff setting. Specifically, experimental data are used to estimate the unknown parameters of optimal RPVM bid functions coincident with the FS, ERC, and CR behavioral theories. This analysis, along with simple comparisons across treatments, leads us to conclude that voters in our experiments were motivated by the appeal of their own potential gains as well as by a concern for the overall social efficiency of proposed programs. Such evidence is consistent with both directions of altruism as described by Bergstrom (2006). However, it is inconsistent with the inequality aversion theories of ERC and FS. While generally consistent with CR's theory and the empirical work of Engelmann and Strobel (2007), our results further refine our understanding of social preferences by showing that only pure altruism, and not maximin preferences, is consistent with the experimental data.

2. The random price voting mechanism and theoretical predictions

In this section, we further detail the RPVM and develop theoretical predictions of bidding behavior within this mechanism. As Karni and Safra (1987) and Horowitz (2006) demonstrate, the simpler, private BDM is not always incentive compatible outside of the expected utility framework. For this reason, we limit our analysis to expected utility. For ease of exposition, the presentation focuses on the case where the game is played in the WTP for gains domain and where individuals have social efficiency motives. Once the results for the social welfare function have been established in this context, they are readily extended to the other three Hicksian measures (WTP for losses, WTA for gains, and WTA for losses) and for the other forms of preferences considered in this paper: the ERC and FS forms of inequality aversion, maximin preferences, and a combination of social efficiency and maximin preferences (CR).

The RPVM works as follows: N individuals are asked to each submit a bid, B_i, representing the maximum amount of money they would be prepared to pay for a program defined by a known payoff vector $\prod = (\pi_1, \pi_2, ..., \pi_N)$. In the WTP for gains domain, π_i represents the gross monetary benefits to individual i if the program is implemented. The public program submitted to a "vote" has two components: 1) the induced values $\prod$ and 2) a transfer payment (C) from individuals to the implementing authority. This payment, which is analogous to a uniform tax, is randomly drawn from a distribution with probability density $p(C)$ over the interval $[0, C_{\max}]$ *after* individuals have submitted their bids. The program is implemented if the majority of individuals (>50%) have submitted bids greater than or equal to the per-person cost C.[2] In this case, individual i receives a monetary payoff $\pi_i - C$ (the sum of which could be negative) to be added to an initial endowment Y. Absent any form of social preferences, the utility of player i defined over money is then given by $U_i = u_i(Y + \pi_i - C)$. If the majority of the bids are below C, the program is not implemented and subjects retain their initial endowment for a utility $U_i = u_i(Y)$. We assume that U is increasing in income.

[1] The RPVM is less complex than other incentive compatible public goods funding mechanisms, such as the Smith (1979) auction and the Groves-Ledyard (1977) mechanism. Unlike those mechanisms, the RPVM does not seek to efficiently provide the collective good. Rather, it elicits an individual's value for a good in a voting context.

[2] To simplify exposition, we restrict the presentation to the situations where N is an odd number. Minor modifications are required to prove the results presented below when N is even but the same conclusion is reached.

2.1. Bidding behavior of players without social preferences

A key characteristic of the RPVM is that a purely self-interested individual has a weakly dominant strategy to bid her value. The basic intuition is that, when a voter is pivotal, bidding below (above) her value decreases (increases) the probability that a program that yields a positive (negative) monetary payoff will be implemented, thus decreasing the individual's expected payoff. However, when players have complete information about the distribution of potential payoffs (this is the way the game is implemented in this research), bidding one's true value is only a weakly dominant strategy because each player can ascertain who, in fact, the median voter will be. Hence, nonpivotal voters can depart from bidding true value without affecting the outcome. Thus, while truthful revelation by all players is a Bayesian Nash Equilibrium of the RPVM game, it is not the only equilibrium when payoffs are known.[3]

2.2. Bidding behavior of players with social preferences

2.2.1. Social efficiency

Given these foundations, the theoretical predictions emanating from more explicit models of individuals with other-regarding preferences can be more closely examined. Our objective here is to develop equilibrium bidding strategies in the RPVM for the four competing specifications of other-regarding preferences most debated in the recent behavioral economics literature. We present with some detail the solution for individuals with social efficiency preferences (Charness and Rabin, 2002) who are asked to bid their WTP for a program conferring gains. We then summarize the predictions for the alternative models and for the remaining three welfare settings.

An individual i with social efficiency preferences is postulated to have increasing utility in the gains of others such that $U_i = u\left(Y + \pi_i - C + \sum_{j\neq i}(\alpha_i \cdot (\pi_j - C))\right)$. Here $\alpha_i \geq 0$ parameterizes the intensity of individual i's altruism (for pure selfishness, $\alpha_i = 0$). This is a purely altruistic individual who weighs equally the gains and losses to others.

To compute the Bayesian Nash Equilibrium we rely on the critical values B_m and B_k, the interval defining the range over which the bid of voter i makes this individual the median voter.[4] Thus, i's expected utility can be expressed as

$$\begin{aligned} EU_i(B_i, B_{-i}) = & \int_0^{B_m} p(C)U\left(Y + \pi_i - C + \alpha_i \sum_{j\neq i}(\pi_j - C)\right)dC \\ & + \int_{B_m}^{B_i} p(C)U\left(Y + \pi_i - C + \alpha_i \sum_{j\neq i}(\pi_j - C)\right)dC. \\ & + \int_{B_i}^{B_k} p(C)U\ (Y)\ dC + \int_{B_k}^{C_{\max}} p(C)U\ (Y)\ dC. \end{aligned} \tag{1}$$

The first term is the expected utility conditional on the randomly drawn cost being below B_m. Here, i's bid is irrelevant since a majority of voters is already willing to pay more than the cost of implementing the program for this range of costs. The second and third terms cover the interval over which the bid of individual i will have a marginal effect on the probability that the program is implemented. In this range, B_i is the median bid. The last term is the interval over which i has no effect on the outcome since no matter how large B_i is, too few individuals have bids high enough to implement the program. Maximizing with respect to B_i yields the first order condition:

$$p(B_i)U\left(Y + \pi_i - B_i + \sum_{j\neq i}\alpha_i \cdot (\pi_j - B_i)\right) = p(B_i)U(Y). \tag{2}$$

This equation has a degenerate solution at $p(B_i) = 0$ that can safely be ignored. The interior solution equates expected utility under the two states of the world (the program is funded or not). Solving for B_i, the optimal bid is then given by:

$$B_i^*(\prod) = \frac{\pi_i + \alpha_i \sum_{j\neq i}\pi_j}{1 + \alpha_i(N-1)}. \tag{3}$$

Note that an individual's optimal bid is independent of the α_j of other individuals. As such, Eq. (3) is a symmetric Nash equilibrium if all players have this preference structure conditional on α (but allowing a different parameter α across individuals). Note also that the BDM is nestled in the RPVM: setting $N = 1$ yields the familiar BDM result that $B_i^* = \pi_i$, as we should expect.

As noted above, in the case of selfish individuals the median voter component of the referenda once again allows for other equilibria. From any strategy profile, it is always possible for one player to choose a strategy different than Eq. (3) without having any effect on the expected outcome of the game. It is therefore not possible to rule out other equilibria involving weakly dominated strategies. Multiple equilibria necessarily impose limits on the generality of the conclusions we reach in the empirical section of the paper. The intent here is limited to identifying which of the alternative behavioral models best capture the empirical data from laboratory referenda.[5]

A number of behavioral predictions emerge from the solution.

(1) If $\pi_j = \pi_i \forall j$, $B_i^* = \pi_i$. Bidding one's private value is optimal when all players have equal payoffs. Therefore, even in the presence of other-regarding preferences, equal payoffs results in behavior no different from the selfish bidding strategy. Deviating from one's own value only increases the probability that the program will be funded in the range where costs exceed everyone's private benefits or not funded in the range of costs where everyone would benefit.

(2) The optimal bid is increasing in one's induced value:

$$\frac{\partial B_i^*(\prod)}{\partial \pi_i} = \frac{1}{1 + \alpha_i(N-1)} > 0. \tag{4}$$

(3) A ceteris paribus increase (decrease) in the sum of gains of others increases (decreases) i's optimal bid:

$$\frac{\partial B_i^*(\prod)}{\partial \pi_j} = \frac{\alpha_i}{1 + \alpha_i(N-1)} > 0. \tag{5}$$

(4) Individual i will increase (decrease) his bid when some of the payoffs of others, are increased (decreased) and none is decreased (increased). This is a direct result from Eq. (5).

2.2.2. Extensions to WTA gains, WTP losses, and WTA losses

The theory can be reinterpreted to describe the optimal bidding strategy of individuals faced with the other Hicksian measures of

[3] See the Appendix for a proposition that shows that, for a purely self-interested, expected-utility-maximizing agent, bidding $B_i^* = \pi_i$ is a weakly dominant strategy for the RPVM.

[4] For an odd number of voters, B_m is defined as the $[(N+1)/2]$th largest bid in B_{-i} and B_k is the $[(N-1)/2]$th largest. For instance, if $N = 3$, $B_m$is the smallest and B_k is the largest of the two bids in B_{-i}. B_m and B_k bound the range of value in which player i's bid would be pivotal (i.e., the range in which i is the median voter).

[5] Multiple equilibria can be eliminated by introducing beliefs about the likelihood that one's bid will be pivotal. This could be accomplished by formally introducing uncertainty about the values of π_j or α_j or allowing bidding errors by other players. Strictly positive probability beliefs that one can be the median voter would make all weakly dominated strategies become strictly dominated and eliminate them from equilibrium solutions.

welfare change. In the case of a group asked to express their individual minimum WTA compensation to forego gains, C represents the randomly determined compensation to be paid in exchange for not receiving a payoff defined by $\prod$. B_i then denotes the smallest amount that individual i would accept. If the majority of bids are less than or equal to C, compensation C is paid but the gains $\prod$ are not, for a utility level $U\left(Y + C + \alpha_i \sum_{j \neq i} C\right)$. Otherwise, $\prod$ is paid and utility is $U\left(Y + \pi_i + \alpha_i \sum_{j \neq i} \pi_j\right)$.

Deriving the optimal bidding strategy for social efficiency preferences yields exactly Eq. (3) and the same theoretical predictions, although the vector $\prod$ now represents individual opportunity costs of implementing the compensation program. An increase in the opportunity cost to any player implies a decrease in the social value of the compensation program and therefore increases the minimum acceptable level of compensation required by voters.

The optimal strategies for the WTA compensation for a program that imposes a loss and for the WTP for a program that eliminates a loss also replicate Eq. (3) and can be interpreted with similar adjustments to the language. Tables 1 and 2 summarize the theoretical predictions for all forms of social preferences and welfare settings considered.

2.2.3. Other forms of social preferences

Using a similar approach, we characterize bidding behavior separately for the ERC and FS forms of inequality aversion and for maximin preferences. We also develop Nash-bidding predictions for individuals who combine both social efficiency and maximin preferences (i.e., CR quasi-maximin preferences) since we will consider this possibility in the empirical analysis of our data.

Under ERC equity preferences, it is hypothesized that individuals like their own net benefits to be as close as possible to the group average. To capture this, the social component of utility is assumed to be (in a WTP gains context) $-\alpha_i\left|(\pi_i - C) - \frac{1}{N}\sum_{j=1}^{N}(\pi_j - C)\right|$.

Under FS equity preferences, individuals incur disutility when their own payoffs differ from the payoff of another player. The social component of utility is given by $-\frac{\alpha_i}{N-1}\sum_{j \neq i} Max\left[(\pi_j - C) - (\pi_i - C), 0\right] - \frac{\beta_i}{N-1}\sum_{j \neq i} Max\left[(\pi_i - C) - (\pi_j - C), 0\right]$, which corresponds directly with FS's specification of the utility function. FS postulate that individuals are less affected by differences in their favor than by situations where they are the poor party in the comparison. That is $\alpha_i \geq \beta_i$.

The social component of the utility function for maximin preferences is $+\beta_i\ (\pi_w - C)$, where π_w identifies the payoff of the worst-off player in the group in either state of the world (the program is implemented or it is not). Combining both social efficiency and maximin preferences yields the social component of utility $+\alpha_i \sum_{j \neq i}(\pi_j - C) + \beta_i\ (\pi_w - C)$. The symmetric Bayesian Nash Equilibrium bid functions for all forms of social preferences considered are presented in Table 1. For ERC and FS preferences, two bid functions are presented as they differ slightly between gain (WTP and WTA) and loss (WTP and WTA) welfare settings.

Table 2 presents behavioral predictions under the weakly dominant bidding equilibrium strategies for each type of social preference and permutations of welfare settings and configurations of induced values. For example, predictions for social efficiency preferences are given in the first row. In heterogeneous value settings, the optimal strategy calls for someone with an induced value equal to the group average to bid her value. An individual with a value below the mean would bid above value and an individual with a value above the mean would bid below value. These predictions hold regardless of welfare setting.

While the ERC Equity and the FS Equity bid functions follow directly from the discussion above, the maximin preferences and combined efficiency–maximin require a bit more explanation. In both cases, the worst-off person differs depending on whether the program is over gains or losses. In gains, the worst-off person is the player with the smallest payoff whereas in losses it is the person with the highest (absolute) induced value. In all circumstances, it is predicted that the worst-off person will bid her value. For others, however, maximin preferences will modify the bid. In gains, those with higher values for the program lower their bids so as to reduce the likelihood that there will be a strictly worst-off player (WTP for gains) or to avoid the status quo in which there is a strictly worst-off player (WTA to forego unequal gains). The reverse holds true for losses, leading to the prediction that all but the individual with the highest absolute loss will bid above personal values either when contemplating a program where they pay to avoid a loss or get compensated for taking it.

In the combined model, these maximin preferences interact with efficiency considerations to yield slightly different predictions. First, the worst-off player who cares about efficiency will no longer bid his own value. In gains, the low value individual will now bid above. In losses, the high loss person will lower her bid. In addition, now only a fraction of other players' bids can be predicted. In gains, it can be predicted that those with induced values equal or above the mean will bid lower than their own payoffs while in losses, those with (absolute) losses below the mean will increase their bids.

Overall, the different predictions contained in Tables 1 and 2 will allow us to identify which theory best explains our experimental data as we can evaluate how subjects balance their selfish preferences with potential social preferences such as efficiency, inequity aversion, and concerns about the worst-off player.

Table 1
Optimal bid (offer) functions for alternative social preferences.

	GAINS (WTP and WTA)	LOSSES (WTP and WTA)
Social efficiency (pure altruism)	$\frac{\pi_i + \sum_{j \neq i}\alpha_i \pi_j}{1 + (N-1)\alpha_i}$	Same
ERC equity	$\pi_i - \alpha_i\left\|\pi_i - \sum_{j=1}^{N}\frac{\pi_j}{N}\right\|$	$\pi_i + \alpha_i\left\|\pi_i - \sum_{j=1}^{N}\frac{\pi_j}{N}\right\|$
FS equity	$\pi_i - \frac{\alpha_i}{N-1}\sum_{j \neq i} Max[(\pi_j - \pi_i, 0]$	$\pi_i + \frac{\alpha_i}{N-1}\sum_{j \neq i} Max[\pi_i - \pi_j, 0]$
	$-\frac{\beta_i}{N-1}\sum_{j \neq i} Max[(\pi_i - \pi_j, 0]$	$+\frac{\beta_i}{N-1}\sum_{j \neq i} Max[\pi_j - \pi_i, 0]$
Maximin	$\frac{\pi_i + \alpha_i \pi_w}{1 + \alpha_i}$	Same
Efficiency and maximin	$\frac{\pi_i + \alpha_i \sum_{j \neq i}\pi_j + \beta_i \pi_W}{1 + (N-1)\alpha_i + \beta_i}$	Same

Note: Both induced values (π) and optimal bids (B_i) are always represented by their absolute values. This is important when considering losses since a larger absolute value implies a greater loss.

3. Experimental design

Subjects ($n = 276$) were recruited from a variety of undergraduate business and economics courses at Cornell University. Experimental sessions were conducted in the Laboratory for Experimental Economics and Decision Research in cohorts ranging in size from 12 to 24. A session lasted approximately 90 minutes and average earnings were $35. Each session consisted of either two nine-decision WTP sequences (WTP-Gains and WTP-Losses) ($n = 138$) or two WTA sequences (WTA-Gains and WTA-Losses) ($n = 138$). Subjects received written instructions and were permitted to ask questions prior to each sequence.

Each session implemented permutations of one of three possible sets of induced values: one that allowed for symmetric distributions of heterogeneous values ($2, $5, $8) and two that allowed for asymmetric distributions of heterogeneous values ($1, $5, $6; $4, $5, $9). As implied by Table 2, using both symmetric and asymmetric value distributions is important for discriminating between the social preference theories. For example, the ERC and FS equity theories

Table 2
Behavioral Predictions for Alternative Social Preferences.

	Private ($N=1$) or homogeneous distribution	Heterogeneous distribution		
Social efficiency (Pure altruism)	$B_i^*=\pi_i$	For $\pi_i=\overline{\pi}$ $B_i^*=\overline{\pi}$	$\pi_i<\overline{\pi}$ $B_i^*>\pi_i$	$\pi_i>\overline{\pi}$ $B_i^*<\pi_i$
ERC equity	$B_i^*=\pi_i$	$\pi_i=\overline{\pi}$ $B_i^*=\overline{\pi}$	Gains; $\pi_i\neq\overline{\pi}$ $B_i^*<\pi_i$	Losses; $\pi_i\neq\overline{\pi}$ $B_i^*>\pi_i$
FS equity	$B_i^*=\pi_i$		Gains; all π_i $B_i^*<\pi_i$	Losses; all π_i $B_i^*>\pi_i$
Maximin	$B_i^*=\pi_i$	$\pi_i=\pi_w$ $B_i^*=\pi_w$	Gains; $\pi_i>\pi_w$ $B_i^*<\pi_i$	Losses; $\pi_i<\pi_w$ $B_i^*>\pi_i$
Efficiency and maximin	$B_i^*=\pi_i$	Gains: $\pi_i=\pi_w$ $B_i^*>\pi_i$ Losses: $\pi_i=\pi_w$ $B_i^*<\pi_i$	Gains: $\pi_w<\overline{\pi}\leq\pi_i$ $B_i^*<\pi_i$ Losses :$\pi_i\leq\overline{\pi}<\pi_w$ $B_i^*>\pi_i$	

Note: Both induced values (π) and optimal bids (B_i^*) are always represented by their absolute values. This is important when considering losses since a larger absolute value implies a greater loss.

generate the same directional hypotheses except in the case where a bidder has an induced value equal to the mean of the distribution.

Costs in the WTP setting (compensation in the WTA setting) were randomly determined from a uniform distribution on the interval [$0.00, $9.99] in one-cent increments. Participants received a $10 endowment in each WTP sequence. To avoid potential income effects, the endowment was $5 in each WTA sequence in order to equate expected earnings with the WTP setting. In each sequence, participants made nine distinct bid (offer) decisions.

Within each sequence, three decision tasks involved a group size of one (recall that the RPVM reduces to the BDM in a private good setting), each corresponding to one of the three induced values used in the session. Three decisions involved a group size of three where all group members had the same value. For example, in a session with the set of values ($2, $5, $8), the three decisions would have homogeneous distributions: ($2, $2, $2), ($5, $5, $5), and ($8, $8, $8). The final three decisions involved a group size of three where each player had a different private value dictated by the set of induced values. For the set ($2, $5, $8), for example, a participant made one decision as the $2 individual (the other two group members were assigned $5 and $8), one as the $5 individual (the others were assigned $2 and $8), and one as the $8 individual (the others were assigned $2 and $5). For all decision tasks, the distribution of induced values across all group members was common knowledge; however, subjects did not know which other participant was assigned to each of the values from the distribution.

This research sought to put the referenda into a social environment as suggested by Bohnet and Frey (1999) among many others. Seating and groups were assigned at random and all members were seated at desks equipped with a privacy screen that were aligned in rows facing forward. Members of the same group were separated by a minimum of one seat and no verbal communication was allowed. Therefore, upon the announcement of the group, communication between subjects was limited to brief eye contact with other members of the group.[6] While members in the group knew the distribution of payoffs within the group, they did not know which member of the group had which induced gain/loss. The order of the decision tasks within a sequence and the order of the welfare settings were varied across sessions to avoid possible order effects. At the end of the session, one decision from each sequence was selected randomly to determine earnings by having a volunteer draw from a bag of marked poker chips. The cost (compensation) associated with each selected decision was then determined by a participant dropping a pen on a table of random numbers. At the end of the session, the payment of participants was staggered so that participants did not leave the laboratory at the same time.[7]

Similar to studies using the BDM mechanism (Boyce et al., 1992; Irwin et al., 1998), prior to each sequence, subjects participated in ten low-incentive practice rounds with the private goods BDM where payoff feedback was provided after every round. Corresponding to the welfare setting, participants faced the three session-specific induced values with the same cost (compensation) range that they would face in the high-incentive RPVM decisions. Decisions in the practice rounds had a higher exchange rate (average earnings per round of $0.50). The goal of these practice rounds was to give subjects an opportunity to gain experience with the mechanism before facing the complexity of a public goods setting. The welfare framing as either WTP or WTA for the practice rounds was the same as in the subsequent sequence.

For both individual and group decision settings, the instructions used language parallel to that found in public referenda. The WTP instructions directed each subject to *vote* whether to *fund* a *program* by submitting a *bid* that represented the “highest amount that you would pay” and still vote in favor of the program. In the WTP-Gains setting, if the majority of group members placed a bid *greater than or equal to* the randomly selected cost, the program was “funded” and everyone received her induced value and paid the cost. Otherwise,

[6] As noted by an anonymous reviewer, while permitting the opportunity for visual eye contact makes the social context of the voting setting more real, it could also have influenced behavior by reducing the social distance between group members and engendering cooperation. This design feature was important because it potentially could delineate effects between a club-like vote and purely anonymous voting without group identification. Moreover, it is unclear how strong (if any) the visual eye contact effects were within this mechanism. While some research has shown that nonverbal communication and social cues can exert an influence on cooperation (Gächter and Fehr, 1999; Boone et al., 2008), results specific to “mutual eye gaze” in experimental settings have been found to be “somewhat inconsistent” (Kurzban, 2001, p. 245). Recognizing that there is no single standard for a voting situation, the results reported here should be interpreted within our specific design.

[7] Even though the experiments were conducted at a large university, where introductory economics and business courses can exceed 500 students, we cannot preclude the possibility of group member interaction after the experiment. As pointed out by an anonymous reviewer, the possibility of post-experiment interaction could have engendered an environment that favored efficiency preferences over concerns for equality. However, at best, only partial information regarding these confidential bids (offers) could have been inferred from the actual voting outcomes as the price (compensation) was determined randomly, and only the outcome (i.e. the proposal passes or not) is announced as opposed to the individual bids (offers). Given this uncertainty, it seems likely that participants with social preferences would have acted upon them directly within the context of the experiment and those with preferences for equitable outcomes would have exhibited that behavior directly, as in each of the four welfare treatments one of the two possible voting outcomes ensured equitable earnings for all group members.

the program was "not funded" and no one received the induced value nor paid the cost. In the WTP-Losses setting, if the majority of bids were *greater than or equal to* the determined cost, the program was "funded" and all group members paid the determined cost but did not have the personal loss amount (induced value) deducted. Otherwise, the program was "not funded" and the determined cost was not paid but all group members had to pay their induced loss amounts.

In the WTA-Gains setting, subjects were directed "to indicate the lowest amount of money you would accept as compensation" in order to forego an anticipated payment (their induced values). If the majority of bids were *greater than* the random compensation, group members received their induced gains, not the compensation amount. If the majority of bids were lower than or equal to the randomly drawn compensation, all group members gave up their induced gains and received the compensation amount. In the WTA-Losses setting, subjects were asked to indicate "the lowest amount of compensation you would accept to vote in favor of the program." If the majority of offers were less than or equal to the random compensation, all group members received the compensation amount but they had to pay their induced losses. If the majority of offers were greater than the random compensation, the program was not implemented and all group members neither received compensation nor paid their induced losses.

Table 3
Random price voting mechanism experiment results, induced gains.

Private[a]			Homogeneous[b]			Heterogeneous[c]		
Value	WTP	WTA	Others	WTP	WTA	Others	WTP	WTA
$1			$1, $1	$1.25	$1.28	$5, $6	$1.40†	$1.91†*
$2	$2.10	$1.96	$2, $2	$2.06	$2.06	$5, $8	$2.64†*	$2.47†*
$4			$4, $4	$4.06	$3.90	$5, $9	$4.26	$4.77†*
						$1, $6	$4.95	$4.74
$5	$5.09	$5.12	$5, $5	$5.10	$5.03	$2, $8	$5.19	$5.06
						$4, $9	$5.31	$5.35
$6			$6, $6	$6.08	$6.14	$1, $5	$5.90	$5.64
$8	$8.11	$8.15	$8, $8	$8.14	$8.18	$2, $5	$7.78*	$7.75†*
$9			$9, $9	$8.75	$8.84	$4, $5	$8.24†*	$8.41†

Notes:
† indicates a mean that is statistically different than induced value at the 5% confidence level.
* indicates a mean in the heterogeneous value treatment that is statistically different from the corresponding mean bid in the homogeneous value treatment at the 5% confidence level.
[a] For both WTP and WTA, $n=93$.
[b] For both WTP and WTA, $n=183$ for the homogeneous distribution of values of $5; $n=93$ for the homogeneous distribution of values of $2 and $8; and $n=45$ for the homogeneous distribution of values of $1, $4, $6, and $9.
[c] For both WTP and WTA, $n=93$ for the heterogeneous distribution of values of $2, $5, and $8 and $n=45$ for the heterogeneous distribution of values of $1, $5, and $6 and $4, $5, and $9.

4. Analysis of experiment data

4.1. RPVM bids (offers) in relation to induced values

The experiments yield 76 unique treatments where a treatment is defined by a specific welfare setting (e.g., WTP-Gains), the subject's induced value, and the other players' values (if any). To facilitate comparisons between bidding behavior and induced values, as well as to identify statistical differences across treatments, we pool the data from all treatments and regress individual bids on 76 indicator variables to produce estimates of the average bid in each treatment. As each individual produces multiple observations, we estimate robust standard errors adjusted for clustering at the individual level. Given that all decisions from the individual are made without feedback until the end of the session, there are neither controls for learning behavior nor a need for clustering at a session level in the estimation.

Tables 3 and 4 present the treatment-specific mean bids for the gain and loss settings, respectively, for both WTP and WTA. Estimates that are statistically different than induced value at the 5% level are denoted by "†". Further, matching heterogeneous and homogeneous estimates that are statistically different at the 5% level are denoted by "*". Inspection of these results suggests that behavior does not appear to exhibit WTP/WTA discrepancies. While such a finding would seem to run contrary to the vast literature demonstrating a WTP/WTA gap across a number of experimental and real world settings, our results are consistent with Plott and Zeiler's (2005) recent findings that, under controlled economic experimental settings using a BDM mechanism with paid practice rounds, training, and anonymity, a disparity between WTP and WTA is not evident. Our data suggest that this result extends to settings without training and anonymity and to the public good extension of the BDM used here.

Mean bids are statistically equal to value in 39 of the 40 treatments involving either a private good or a public good with homogeneous values, the sole exception being "WTA-Losses" for private $5. This provides evidence that the RPVM is approximately demand revealing and extends similar demand revelation findings for the BDM with training rounds (Irwin et al., 1998; Plott and Zeiler, 2005). Bidding behavior for the heterogeneous value treatments suggests that social preferences do play a role as there are many instances in heterogeneous treatments where mean bids are statistically different than induced value. In particular, mean bids are statistically different than induced value in 18 of 36 cases.

Fig. 1 conveys information on the effect of heterogeneity on bids by presenting empirical cumulative distribution functions for WTP-Gains in the ($2, $5, $8) treatments.[8] The figure suggests that low-value subjects have a tendency to bid above induced value whereas high-value subjects are more likely to bid below value.

Tables 3 and 4 present the statistics for all of the treatments and confirm those observations. Of the twelve distinct heterogeneous value treatments with low-value voters, mean bids are higher than induced value in all twelve treatments. In eight of those, the difference is statistically significant at the 5% level. Likewise, mean bids by high-value participants in the heterogeneous treatments are always lower than induced value with the difference being statistically significant in eight of the twelve instances. Furthermore, the high- and low-value bidders in the heterogeneous treatments tend to bid differently than those in comparable homogeneous value treatments, generating statistical differences in 13 of the 24 possible cases. For example, as shown in Table 3 individuals with the low value of $2.00 submitted a WTP and WTA of $2.06 when the values were distributed homogeneously. In contrast, in a heterogeneous value setting, on average individuals submitted significantly higher WTP bids ($2.64) and WTA offers ($2.47).

The behavior of middle-value voters is not as strongly impacted by variations in the payoff vector. In treatments with symmetric distributions of induced value, mean bids are roughly equal to value, although in one of four welfare settings (WTP-Losses) a statistical difference can be detected. In treatments with asymmetric distributions, there is a weak tendency for middle-value subjects to bid below value when the value is above average (i.e., the $1, $5, $6 vector) and a weak tendency to bid above value when the value is below average (i.e., the $4, $5, $9 vector). For example, with gains (Table 3) subjects with the $5 induced value bid in the asymmetric treatment ($1, $5, $6) expressed a mean WTP of $4.95 and a mean WTA of $4.74. In contrast, they submitted, on average, a WTP of $5.31 and a WTA of

[8] Similar patterns exist for the other three welfare settings and value vectors.

Table 4
Random price voting mechanism experiment results, induced losses.

Private[d]			Homogeneous[e]			Heterogeneous[f]		
Value	WTP	WTA	Others	WTP	WTA	Others	WTP	WTA
$1			$1, $1	$1.04	$1.07	$5, $6	$1.24	$1.77†*
$2	$2.23	$2.06	$2, $2	$2.14	$2.11	$5, $8	$2.67†*	$2.54†*
$4			$4, $4	$3.93	$3.98	$5, $9	$4.18	$4.47
						$1, $6	$4.74	$4.36†
$5	$5.19	$4.68†	$5, $5	$4.98	$4.92	$2, $8	$5.38†*	$4.82
						$4, $9	$5.05	$5.67*
$6			$6, $6	$6.01	$6.26	$1, $5	$5.73	$5.42†*
$8	$7.99	$7.91	$8, $8	$7.80	$7.94	$2, $5	$7.68†	$7.29†*
$9			$9, $9	$8.91	$8.87	$4, $5	$8.30†*	$8.35†

Notes:
† indicates a mean that is statistically different than induced value at the 5% confidence level.
* indicates a mean in the heterogeneous value treatment that is statistically different from the corresponding mean bid in the homogeneous value treatment at the 5% confidence level.
[d] For both WTP and WTA, $n=93$.
[e] For both WTP and WTA, $n=183$ for the homogeneous distribution of values of $5; $n=93$ for the homogeneous distribution of values of $2 and $8; and $n=45$ for the homogeneous distribution of values of $1, $4, $6, and $9.
[f] For both WTP and WTA, $n=93$ for the heterogeneous distribution of values of $2, $5, and $8 and $n=45$ for the heterogeneous distribution of values of $1, $5, and $6 and $4, $5, and $9.

$5.35 in the ($4, $5, $9) treatment. We note, however, that the mean bid of middle-value subjects in heterogeneous treatments is statistically different from induced value (lower) only in the WTA-Losses treatment with values ($1, $5, $6).[9]

4.2. Estimated bid (offer) functions and the nature of social preferences

The unknown parameters α and β of the optimal bid functions[10] can be estimated econometrically for the alternative theories of social preferences discussed in Section II and presented in Table 1 using bidding data from the heterogeneous public good treatments. Estimated parameters that are statistically different than zero with the correct sign provide support that a particular theory has some ability to organize the data. Furthermore, the magnitudes of estimated parameters shed light on the relative importance of social versus selfish preferences and their influence on bidding behavior.

The restricted least squares estimator is used to estimate unknown structural parameters. To allow for heteroscedasticity and the correlation of individual-level responses, robust standard errors adjusted for clustering at the subject level are estimated. The parameters of the bid functions for the two equity models can be directly estimated (imposing the constraint that the coefficient on π_i equals one). The bid functions for the social efficiency, maximin, and combined efficiency-maximin theories are nonlinear in the unknown

[9] Direct comparisons can be made between the results from the RPVM WTP-Gains experiment that use the ($2, $5, $8) value distribution and separate experiments that use dichotomous choice voting (yes/no) with the same values. As shown in Table 5 and described in the Appendix, there is a close correspondence between dichotomous choice referenda voting and RPVM bidding, both in levels and in terms of homogeneous versus heterogeneous treatment differences. Based on this evidence, we cannot reject the hypothesis that the RPVM predicts voting patterns in dichotomous choice voting. Overall, the pattern of bidding in the RPVM and voting in binary choice experiments suggests that players are motivated in part by distributional considerations or the welfare of others.

[10] In addition to the structural models presented here, we estimated an integrated model that considered all forms of social preferences simultaneously and include this in the Appendix. Theoretically, a bidder with all forms of social preferences would be internally inconsistent and, as such, the integrated model is reduced-form. Nevertheless, the integrated model supports the conclusions drawn from the structural estimation.

Table 5
Selected comparisons between dichotomous choice and RPVM in a WTP-gains setting and symmetric value distributions[a].

Mechanism	Value	Cost	Distribution of values	Percent "Yes"	t-statistics	p-value
DC voting	$2	$2.50	Heterogeneous	18.6%	0.825	0.4102
RPVM	$2	$2.50	Heterogeneous	23.7%		
DC voting	$2	$2.50	Homogeneous	5.7%	1.469	0.1436
RPVM	$2	$2.50	Homogeneous	11.8%		
DC voting	$8	$7.50	Heterogeneous	73.3%	1.350	0.1787
RPVM	$8	$7.50	Heterogeneous	81.7%		
DC voting	$8	$7.50	Homogeneous	86.4%	1.330	0.1854
RPVM	$8	$7.50	Homogeneous	92.5%		

[a] Sample size is 93 for RPVM, 88 for Homogeneous DC Voting, and 86 for Heterogeneous DC Voting.

parameter(s). However, this does not preclude linear regression since the bid functions can be rewritten as linear in unknown parameters and our structural estimates of interest recovered from these in a straightforward fashion. For example, we can express the maximin bid function as:

$$B_i = \delta_1 \pi_i + \delta_2 \pi_w \tag{6}$$

where $\delta_1 = (1+\beta_i)^{-1}$ and $\delta_2 = \beta_i/(1+\beta_i)$. The parameter β_i is overidentified but it can be shown easily that $\delta_2 = 1-\delta_1$. Imposing this restriction directly into the model resolves the identification issue. The restricted model is then:

$$B_i - \pi_w = \delta_1(\pi_i - \pi_w). \tag{7}$$

With an estimate of δ_1 in hand, an estimate of β_i and its standard error can be obtained using the delta method. In a similar vein, exactly identified specifications that correspond to the efficiency and the combined efficiency-maximin bid functions can be constructed.

Individual participants did not make a sufficient number of decisions in our experiments to allow for the estimation of participant-specific coefficients. We therefore constrain the unknown parameters to be equal across individuals. The resulting estimates can then be best thought of as bid functions for the representative individual. For estimation purposes, we also include an error term and an overall model constant. Although the theoretical bid functions do not imply a constant, whether or not one should be included is essentially an empirical question. If the mean of the error term is not zero, for instance, omitting the constant term would serve to distort coefficient estimates.

Table 6 presents bid functions estimated by pooling the entire sample.[11] Pooling data for all welfare settings is justified by statistical tests. The first important observation is that the two equity-based specifications are not supported by the data. The parameter of the ERC model is not statistically different than zero and has the incorrect sign. The two parameters of the FS model are statistically different than zero but here again the result that $\alpha<0$ is inconsistent with the theory. In particular, it suggests that individuals bid to *increase,* rather than to decrease, inequality. We note, however, that $\alpha<0$ is consistent with efficiency preferences.

[11] As noted by an anonymous reviewer, there is a potential concern that deviations from induced values are "cheap talk" if there is a range of cost amounts for which the player perceives her deviation to have no consequence, i.e., she would not be the pivotal voter. This motivated an additional analysis where the sample was restricted to middle-value voters. That analysis, the results of which are available upon request, supports the conclusions reported here with the larger sample.

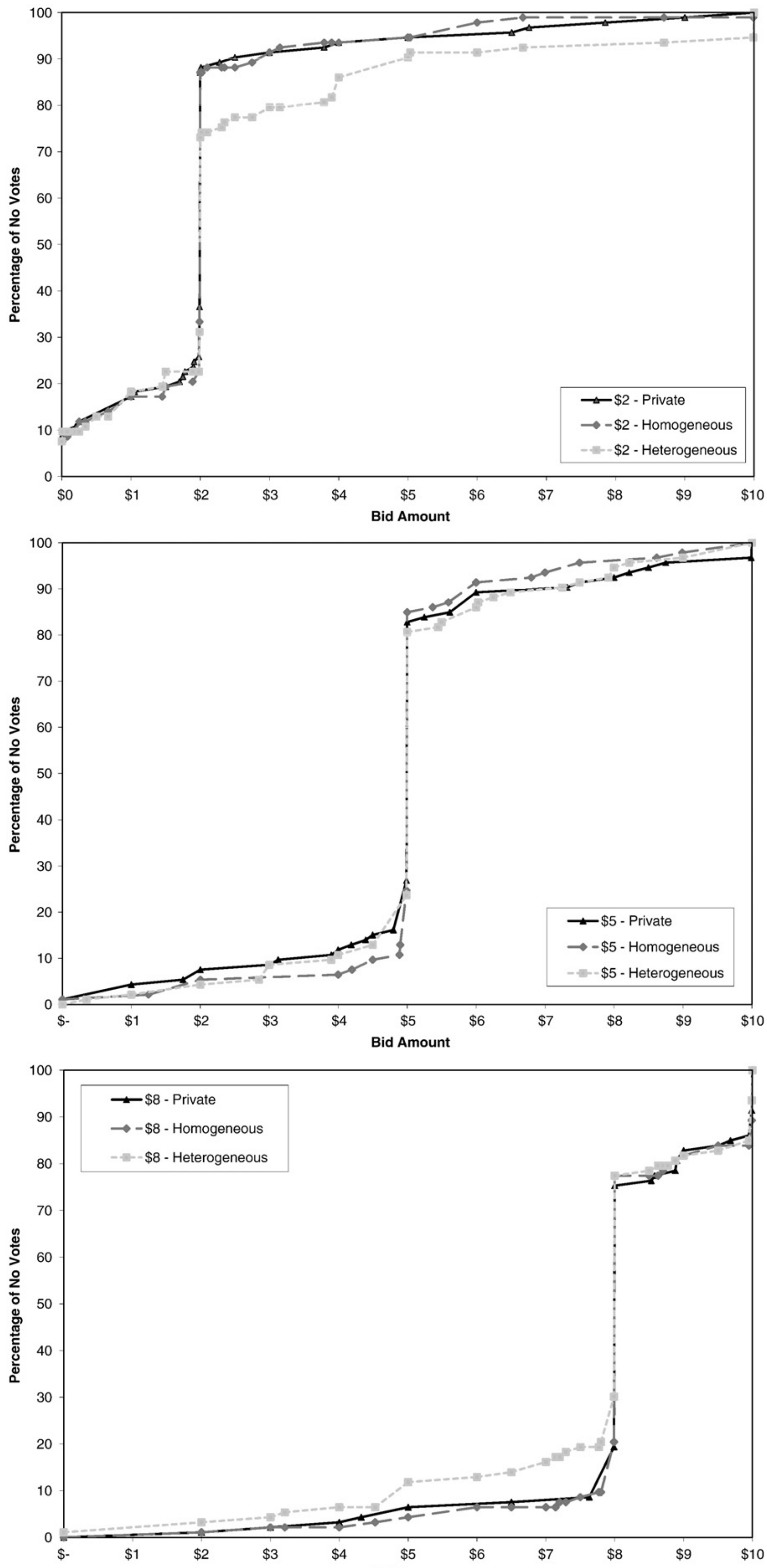

Fig. 1. Cumulative distributions of WTP-gains experiment, ($2, $5, $8) value vector.

The estimated parameters for the social efficiency and maximin model are both consistent with theoretical predictions, positive and different from zero at the 1% level. For the efficiency model, the estimate of $\alpha = 0.070$ implies that the marginal weights that an individual puts on self-interest and the welfare of others are, respectively, $\partial B_i^* / \partial \pi_i = {}^1/_{(1+2\alpha)} = 0.88$ and $\partial B_i^* \Big/ \partial\left(\sum_{j\neq i} \pi_j\right) = {}^{\alpha}/_{(1+2\alpha)} = 0.06$. This suggests that if own payoff from a program increases by \$1, ceteris paribus, the average individual increases her bid by \$0.88. On the other hand, an individual is willing to give up \$0.06 in order to give \$1 to another group member.

That an individual who cares about social efficiency will not increase his bid by a full dollar following a \$1 increase in his own potential benefits may not be immediately intuitive. With $\alpha > 0$, an increase in one's bid clearly has the positive effect of increasing the bidder's expected dollar payoff. At the same time, increasing one's bid also has the negative consequence of reducing the expected net benefits of the program to others. With the induced values of other participants unchanged, the socially conscious voter who increases her bid realizes that in doing so she is increasing the expected value of the random cost that others will have to pay. This is a real (expected) social cost of the new program, one that an individual concerned with social efficiency appropriately considers. Viewed differently, the value of α – the extent to which the bidder cares about the net benefits to others – defines the degree to which a voter internalizes the externality that she imposes on others when she increases her bid and thereby increases the probability of higher costs being imposed on others. In the case of the maximin model, similar concerns are at play with the estimate of β implying that an individual increases his bid by \$0.93 for a \$1 increase in own payoff and by \$0.07 for a \$1 increase in the payoff to the worst-off group member.

The empirical support of the social efficiency and maximin theories separately considered motivates an examination of the overidentifying restrictions present in both models, as well as an examination of a model that accounts for both motives (i.e., quasi-maximin preferences). For the maximin model, the overidentifying restriction is rejected at the 1% level, raising serious doubts about its validity. For the efficiency model, we fail to reject the overidentifying restriction.

The last column of Table 6 presents estimates from the combined efficiency-maximin model. These results raise doubts about the validity of this model and further erode the support for the maximin model itself. The estimate for β (from the maximin component of preferences) has the wrong sign and is statistically insignificant. In many ways, these results confirm our initial observation that both low-value and high-value individuals systematically modify their bids. If individuals held maximin preferences, worst-off individuals would bid their values. The findings that worst-off players increase (decrease) their bids in games for gains (losses) are ultimately inconsistent with the maximin models, a result that clearly comes out in the combined model where both the maximin and efficiency parameters compete to capture the explanatory power of each theory. Overall, we conclude from the empirical results that a theory of social efficiency preferences best explains the empirical data.

5. Social preferences and efficiency of referenda

With strong empirical evidence of social efficiency preferences, a compelling question is whether such behavior increases the likelihood that efficient programs will be implemented when subjected to a referendum. To address this issue, we examine all possible voting outcomes that could have occurred based on subject decisions in treatments with asymmetric value vectors. With 1000 possible costs for WTP settings and 1000 possible compensation amounts for WTA, there are 1000 possible outcomes associated with a particular voting group for a particular treatment. As a measure of the welfare properties of

Table 6
Estimated bid functions.

	Efficiency	Maximin	ERC	FS	Efficiency and Maximin
α	0.070**	–	−0.018	−0.136$^{\Delta\Delta}$	0.077**
	(0.011)		(0.014)	(0.019)	(0.009)
β	–	0.070**	–	0.111**	−0.020
		(0.014)		(0.018)	(0.016)

Notes: WTP and WTA Data, n=2196; *, ** denote estimates that are statistically different than zero and the correct sign at 5% and 1% levels, respectively. 'Δ' and '$\Delta\Delta$' indicate that the estimated coefficients are statistically different than zero at the 5% and 1% level but do not have the expected sign. Cluster-robust standard errors are in parentheses.

referenda when individuals have social preferences, we compute the percentage of inefficient outcomes (either the proposition is passed when the average benefit is lower than the per-person cost or it is not passed when benefits exceed costs) that are eliminated relative to purely selfish voting:[12]

$$\frac{\#\text{efficient outcomes (actual bids)} - \#\text{efficient outcomes (bid} = \text{value)}}{\#\text{total outcomes} - \#\text{efficient outcomes (bid} = \text{value)}} \times 100\%. \tag{8}$$

This measure equals 0% if all bids equal induced values and equals 100% if bidding leads to the efficient outcome under every possible cost (compensation) amount. Averaging across all treatments, the measure is 32%, which suggests that the relatively small degree of concern for others' payoffs observed in the data results in a fairly important increase in the frequency of referenda that lead to efficient outcomes.

6. Conclusion

This paper proposes a new elicitation mechanism, the Random Price Voting Mechanism (RPVM) and uses it to investigate the role of social preferences in referendum voting. The RPVM, which is best thought of as a public goods extension of the private goods BDM, is more efficient than the simple yes/no referendum voting mechanism in eliciting individual and group values. Using induced-value experiments where the distribution of group values is common knowledge, we find that individuals with relatively high induced valuations bid below induced value whereas those with relatively low valuations bid above value. These deviations from own payoff are both statistically significant and economically meaningful. Subject behavior is most succinctly explained by a preference for efficiency, or, similarly, pure altruism. Inequality aversion and maximin preferences are largely inconsistent with the data.

Our results further Engelmann and Strobel's (2007) assessment of the distribution game literature with respect to efficiency and equity preferences but not with the evidence they provide for maximin preferences. Two characteristics of our experiments are worth noting in relation to those in the distribution game literature. Unlike previous distribution games, the RPVM elicits a point estimate of the value individuals place on a particular distribution of payoffs. This contribution is important because distribution games typically have individuals choose between a small number (usually two or three) of discrete group-payoff allocations. As a result, preferences are only coarsely measured and the set of choices can be constructed in ways that unduly favor identification of a particular motive (see, for example, the

[12] This measure is undefined with a symmetric value vector (\$2, \$5, \$8) as purely selfish voting (as well as voting consistent with social efficiency preferences) leads to the efficient outcome for all possible cost (compensation) amounts. For these treatments we calculated the percentage of efficient outcomes that would arise from bidding. On average, actual decisions in symmetric value treatments would lead to the efficient outcome 98% of the time.

discussion in Engelmann and Strobel (2006)). In contrast, participants in our experiment have the possibility of achieving a perfectly equitable outcome as well as outcomes that involve any balance between self-interest and any type of other-regarding motives.

In the same vein as the BDM, we propose the RPVM as a practical mechanism for eliciting demand for public goods in the laboratory. It has potential advantages over other public good mechanisms, such as the Groves-Ledyard mechanism or the related ‘pivot’ version of the mechanism, that have been shown to not be demand revealing in single-shot laboratory settings (Davis and Holt, 1993; Attiyeh et al., 2000). The RPVM's ability to elicit point estimates also is an advantage over dichotomous choice voting. Given the rapid expansion of behavioral economics and the search for greater understanding of apparent deviations from the model of self-interested individuals, a reliable mechanism for estimating the demand for public goods should be quite useful. The RPVM could also be used to validate various elicitation formats in stated preference surveys.

One could also imagine using the RPVM to elicit values in either field experiments or for the actual provision of public goods by government agencies and other organizations. One challenge, however, to using it in an actual provision context is that once the agency knows the bids and the true costs, implementation of the efficient solution would not likely involve the use of the RPVM. Under the belief that the RPVM would not be applied ex-post, participants may have an incentive to misrepresent their values. Thus, it would be necessary to maintain credible uncertainty about the cost of a program. For example, the RPVM could be used to elicit individual bids when a cost assessment is still under way. Participants would submit bids and the program could eventually be implemented if a majority submitted a bid in excess of the per capita cost. Thus, an accurate assessment of benefits might be developed for applying the program in other jurisdictions or on a broader scale.

These experiments represent a first step from which a number of issues related to voting, public goods, and social preferences can be further examined. Possible extensions include a number of unresolved questions related to the effects of group size, variations in the interactions between group members before and after voting, the distributions and probabilities of group payoffs, the degree of information provided about payoff distributions, the effect of keeping the subject's relative payoff-position constant, different degrees of anonymity in voting behavior, the effect of imposing varying degrees of inequity, multiple rounds of voting with feedback, and introduction of nonmonetary public goods, as well as field applications of the RPVM. These extensions should help reveal whether social efficiency preferences in voting extend more generally or if they are a limited response to the specific design elements presented here.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.jpubeco.2009.12.004.

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