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Procedurally Fair Collective Provision: Its Requirements and Experimental Functionality

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Abstract

This paper derives and justifies a procedurally fair bidding mechanism and reviews experiments that apply the mechanism to public projects provision. In the experiments, not all parties benefit from provision, and the projects' costs can be negative. The experimental results indicate that the mechanism is conducive to efficiency, despite the multiplicity of equilibria and underbidding incentives. The only condition is that the cost of the most efficient project must be positive.

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1 Introduction and overview

If an upstream factory produces some poisonous liquid, dumps it into a river, and thereby kills the fish of a downstream fishery, we classify this as an externality. If the eruption of an upstream volcano has the same causal effect we will treat it as an "exogenous shock" rather than an externality. This aptly shows that economists, who – like the authors of this paper – do treat human beings as a part of nature, nevertheless tend to conceive of them differently when institutions and human choice making are concerned.

To put this somewhat more philosophically, we all can approach fellow humans with an "objective attitude" treating them as parts of nature like the volcano or, say, birds on which we use a scarecrow. But we also can adopt the "participant's attitude" to the interaction with other individuals. We can treat them as persons whose "free choices" we respect or resent (see Strawson 1962). In our example of water pollution, it does not make sense to reward or punish the upstream volcano, but it can make sense to sanction an upstream factory, to bribe those running the plant, or to enter negotiations with its owner(s).

When we evaluate, justify, or plan mechanisms of interaction, we typically do so from a participant's point of view. Only if we ascribe faculties of "free" (teleological or purposeful) choice making, autonomy, and responsibility to the (human) decision-makers we envision, do value-laden concepts – like externality – and ideals – like justice and inter-individual respect in interpersonal dealings – make sense.

This applies in particular to the specification of mechanisms or procedures governing inter-action of choice makers. Here economists implicitly tend to assume or demand that mechanisms of interaction express respect for the choice making of individuals. This requires that decision-mechanisms bestow private decision rights and/or participatory voting rights on decision makers. This holds good for private and collective decision-making.

The market order is a typical example of a mechanism based on private decision rights. After an initial definition of private spheres – a definition that rules out certain actions as illegitimate – individuals are entitled to make choices regardless of whether or not others like them. Under a meaningful explication of that concept it does not rule out externalities. It rather amounts to stating that, within their spheres, decision-makers are entitled to make choices regardless of externalities on others. Individuals can deal with externalities privately by mutual agreements and, in particular, offer compensation payments to those whose legitimate use of rights they resent or desire.

In the preceding private law case, institutions of collective action are "clubs" with a membership endogenous to private contract and legitimized by it.[1] In the second case, all individuals are treated as members of an exogenously fixed community in which initially nobody is entitled to act individually. All authority to initiate legitimate action is vested in the community. All acts of individuals are forbidden initially unless authorized by the unanimous consent of all members of the community. What is to be treated as private – for which the consent of others is not required ("anymore") – must be unanimously agreed on in an initial collective decision.

In sum, there are two basic ways to conceive of mechanisms that respect the autonomy of individuals. In the first case, initially all is private and any decision to collectivize (forming "clubs" including the state) is based on agreement or consent. In the second case, all legitimate decision-making is collective initially. An initial collective decision to privatize certain decisions and to vest individuals with the authority to make them legitimately is required.

This line of argument characterizes the two polar extremes of dealing with externalities in the notional spectrum between purely private and purely collective decision-making. None of these extremes has ever been realized in its pure form. However, as a long history of "public discourse" demonstrates, the evaluation and acceptance of results as a matter of fact depends on such contrary to fact speculations.

In this paper, we are not interested in conceptual issues and ideals per se (as interesting as they may be), but rather in real world institutional realizations and issues. We are interested, first, in mechanisms or systems of rules that might approximately represent the underlying ideals of mutual respect as real world institutions. and, second, in how real individuals (in the lab) relate to such mechanisms given their (typically egalitarian) "sense of justice". Taking for granted that free contracting on markets represents the purely private ideal starting point rather well, we shall focus mainly on the polar extreme of a (communitarian) fully collective starting point in which mutual respect is implemented by individual veto power.

We believe that there are at least two strong reasons for this focus. First, even though they express the same values of interpersonal respect, collective interactions under a unanimity constraint (veto) have not been explored to the same extent as market mechanisms. Second, it is rather obvious that markets do not naturally appeal to the sense of justice of most people who mostly seem to approach normative ethical issues from a communitarian rather than

[1] Actually in a new experiment, not covered in the review presented here, we allow for endogenous group formation, and hence for the possibility that group members inflict positive or negative externalities on outsiders.

individualist contractarian point of view.

In the first step we elaborate a bit further on some of the fundamental philosophical and theoretical issues involved (Section 2). We then introduce our formal model of procedurally fair egalitarian bidding (Section 3). It expresses fundamental intuitions of equal respect for i) individual autonomy in determining results (all have a veto), and ii) equal consideration of interests as affected by results of the procedure (all group members profit equally from it).[2] After that we turn to an overview over the results so far reached in the laboratory (Sections 4–6), and finally evaluate them (Section 7).

2 Economic philosophy background

2.1 Externalities at Charlottesville

It is an insufficiently known but most significant bit of intellectual history that Ronald Coase and James M. Buchanan, when developing their path-breaking insights on social costs and gains in the late 50s of the last century, were both at the University of Virginia, UVA, Charlottesville.[3] They were dealing with the same problems of social interdependence, but approaching them from slightly different perspectives. Ronald Coase started from the premise that individuals, within the limits of their private capacities, were entitled to internalize externalities in mutually agreeable contracts in any way that seemed fit to them. Buchanan (most of the times jointly with Gordon Tullock) maintained that agreement under a collective decision rule of unanimous decision-making was the more fundamental and therefore correct conceptual starting point.

Coase evidently had to presuppose that the contractual process would start from some initial legal or normative status quo. Whatever that status quo was, as long as it happened to be well-defined and no so-called transaction costs applied, the outcome predicted under rational behavior was an efficient allocation of resources. Though rights had to be assigned initially by some non-contractual process or other, relative to this assignment private contracting could run its course and bring about efficiency.[4]

[2]The first is more in line with preference; the second with classical utilitarianism.

[3]And so was Rutledge Vining who like Buchanan, following their academic teacher Frank Knight, thought that economics should be done with a participant's attitude.

[4]All agreements were treated as permissible as long as they were keeping within the protected sphere of what David Hume – hijacking an ancient concept – had called fundamental laws of nature: "that of the stability of possession, of its transference by consent, and of the performance of promises" (see Hume 1896, book III, part ii, Sect. VI). The resulting resource allocation would be efficient because inefficient allocations would trigger new negotiations aiming at better allocation results.

Buchanan and Tullock were considering problems of externalities in the polar opposite setting. They started from a situation in which every individual action was forbidden unless unanimously allowed. Other than in Coase's exercise, before the collective decision to authorize individuals to make their own decisions was made, all authority was vested in the collectivity. Before defining in an initial decision what should be private and what public there was no private sphere. To put it again very simply, if anybody wanted to sleep on his belly rather on his back that had to be agreed on collectively beforehand.

In both the Coasean and the Buchanan-Tullock approach, compensation payments were crucial. The difference, of course, is that with the Coasean starting point individuals were entitled to take certain actions (and thereby to legitimately exert externalities without asking for the consent of those not party to their agreements), whereas in the Buchanan-Tullock setting always the whole community of potentially affected individuals had to be treated as participating in the decision-making.[5]

At the risk of beating this to death, imagine 10 individuals in an original situation of natural law (and no politics). In the Coasean setting individuals have well-defined spheres of decision-making. As long as they do not transgress the limits of their authority they are free to reach any agreement. Any subset of the ten can agree on something and go ahead. If, for instance, any three individuals agreed to form a club providing some good for them, then the other individuals would not have a veto. The seven outsiders could, however, offer payments to induce the three to behave differently. They could, for example, offer compensation payments for not forming the club. Likewise in the Buchanan-Tullock setting, any single individual could block any action of others unless compensations were paid for his agreement. In the absence of transaction costs, the omission of counter-offers indicates agreement in the first case while in the second case the omission of a veto signifies the same.

2.2 Ability to bid and compensation power

In case of the Coasean agreement, the parties concerned implicitly were assumed to have sufficient credit to induce others to enter certain agreements. The omission of counter offers of other contracts would signify implicit agreement and efficiency only if those omitting to make such offers could in fact have made them. This leads to the standard objection to free markets that individuals

[5]Strangely enough, some people seem to assume that in a private law society action is legitimate only if it does not impose externalities on others. But things are quite the opposite the whole point of making something a private decision is that the externalities from it as perceived by others do not matter.

would have to command sufficient resources to make counter offers.[6] In the Buchanan-Tullock case, a response to this objection is built into the mechanism itself. The seven remaining individuals need not make a counter offer since any of them can veto, unless adequately compensated.

The default option in the Cosean conceptual exercise is different from that of Buchanan and Tullock, but otherwise the differences are minor. In the Buchanan-Tullock framework, all legitimate individual action is subject to collective decision-making. In the presence of individual veto-power, complicated redistribution schemes of side-payments may be necessary to induce all to omit the use of their veto, i.e. to agree.

That Buchanan's and Tullock's treatment of externalities is the mirror image of the Coasean is notoriously overlooked in the literature. Implementing a stronger variant of fair bidding that grants veto power to all individuals can bring collective goods' provision somewhat closer to the Coasean efficiency case while taking into account distributional concerns.[7] The mechanism expresses the two fundamental egalitarian values of equal respect for the autonomy of individuals in decision-making, and equal respect for their interests concerning the outcomes of their decision-making.

As indicated in the introductory overview, we next characterize axiomatically what we understand by "procedurally fair egalitarian bidding". Obviously this precise understanding will not be explicitly represented in the perceptions of real subjects who are exposed to procedurally fair egalitarian bidding mechanisms. Nevertheless, whether or not some mechanism fulfills the axioms may matter for whether or not real world individuals are won over by it. Our sketch of some preliminary experimental results seems to indicate rather positive responses. Still, as we point out in the final section, whether or not real-world decision-makers do appreciate the egalitarian normative properties of equal "voice" and equal "gains" needs to be explored in more detail.

3 The procedurally fair egalitarian bidding

Let $\Omega = \{P_1, P_2, \ldots, P_m\}$ be a finite set of m (≥ 2) indivisible public projects, and let $N = \{1, \ldots, n\}$ denote a group of n (≥ 2) individuals facing the problem of determining which $P_\ell \in \Omega$ ($\ell = 1, \ldots, m$), if any, should be provided.[8] We

[6] This is akin to the initial lump sum transfer before free-contracting runs its efficiency generating course according to the so-called second theorem of welfare economics.

[7] Of course, the transaction cost proviso applies. Yet, it applies in both cases if we take the externality issue seriously.

[8] In our specification, P_ℓ is a single element of Ω. It is also possible to let the individuals choose among all non-empty subsets of a given set of projects, but this would require further

assume that the cost of providing any particular $P_\ell \in \Omega$, denoted by $C(P_\ell) \in \mathbb{R}$, is commonly known, and that, if no project is provided, $C(\emptyset) = 0$.

Each individual $i \in N$ can influence the choice of P_ℓ by reporting the maximum that he is willing to pay for each project. Thus, each i submits a bid vector $\boldsymbol{b}_i = (b_i(P_\ell) \in \mathbb{R} : P_\ell \in \Omega)$. Without loss of generality, we set $b_i(\emptyset) = 0$ for all $i \in N$. The bid vectors of all n group members result in the bid profile $\boldsymbol{b} = (\boldsymbol{b}_1, \dots, \boldsymbol{b}_n)$. We refer to the difference between the sum of bids for P_ℓ and its cost as the surplus that P_ℓ generates "with respect to bids", $S^{\boldsymbol{b}}(P_\ell) = \sum_{i=1}^n b_i(P_\ell) - C(P_\ell)$.

For all possible profiles $\boldsymbol{b}$, the provision rule must specify, first, which project $P_\ell^* := P_\ell^*(\boldsymbol{b}) \in \Omega$ should be provided, and, second, which amount $c_i(P_\ell^*, \boldsymbol{b}) \in \mathbb{R}$ should be paid by each group member i. We perform the analysis to derive this rule in objective terms, namely in terms of observable monetary bids, and disregard the subjective valuations for the public projects (which are hardly ever commonly known). The reason is that we want the rule itself (not necessarily the final outcome) to guarantee an equitable allocation of the surplus with respect to the maximal contributions that the individuals are willing to make. Hence, we define fairness with respect to bids and characterize the provision rule by the following three axioms.

(A.1) *Profitability with respect to bids* requires that the chosen P_ℓ^* satisfies

$$\sum_{i=1}^{n} b_i(P_\ell^*) - C(P_\ell^*) = \max_{P_\ell \in \Omega} \{0, S^{\boldsymbol{b}}(P_\ell)\},$$

i.e., P_ℓ^* guarantees the maximal non-negative surplus with respect to bids.

(A.2) The basic *equality axiom* affirms that if P_ℓ^* is provided, then

$$b_i(P_\ell^*) - c_i(P_\ell^*, \boldsymbol{b}) = b_j(P_\ell^*) - c_j(P_\ell^*, \boldsymbol{b}) \quad \forall i, j \in N \text{ and } \boldsymbol{b}.$$

That is, the difference between bid and payment (or one's net benefit with respect to bids) should be the same for all group members.

(A.3) *Cost balancing* means that the individual payments for the provided P_ℓ^*

assumptions about the complementarity or substitutability between the individual projects in the subset.

add up to its cost.[9] Formally,

$$\sum_{i=1}^{n} c_i(P_\ell^*, \boldsymbol{b}) = C(P_\ell^*).$$

Thus, if there is no $P_\ell \in \Omega$ such that $\sum_{i=1}^{n} b_i(P_\ell) \geq C(P_\ell)$, no public project is provided and $c_i(P_\ell^*, \boldsymbol{b}) = 0$ for all $i \in N$.[10] If, instead, there exists a $P_\ell^* \in \Omega$ such that $\sum_{i=1}^{n} b_i(P_\ell^*) \geq C(P_\ell^*)$ and $\sum_{i=1}^{n} b_i(P_\ell^*) - C(P_\ell^*) \geq \sum_{i=1}^{n} b_i(P_k) - C(P_k)$ for all $P_k \in \Omega$, then (A.2) can be reformulated as

$$b_i(P_\ell^*) - c_i(P_\ell^*, \boldsymbol{b}) = \Delta \quad \forall i \in N. \tag{1}$$

Aggregating over all n group members yields

$$\sum_{i=1}^{n} b_i(P_\ell^*) - \sum_{i=1}^{n} c_i(P_\ell^*, \boldsymbol{b}) = n\Delta,$$

which, using (A.3), can be written as

$$\Delta = \frac{\sum_{i=1}^{n} b_i(P_\ell^*) - C(P_\ell^*)}{n}.$$

Substituting for Δ in Eq. (1) we obtain

$$\begin{aligned} c_i(P_\ell^*, \boldsymbol{b}) &= b_i(P_\ell^*) - \frac{\sum_{j=1}^{n} b_j(P_\ell^*) - C(P_\ell^*)}{n} \\ &= b_i(P_\ell^*) - \frac{S^{\boldsymbol{b}}(P_\ell^*)}{n} \quad \forall i \in N. \end{aligned} \tag{2}$$

Hence, the procedurally fair provision rule selects the public project that generates the maximal non-negative surplus with respect to bids, and imposes on each group member the payment given in Eq. (2).

Since $S^{\boldsymbol{b}}(P_\ell^*) > 0$ is equally distributed among all group members, no group member has to pay more than his bid. Actually, by bidding either negatively or even sufficiently low for a specific project $P_\ell \in \Omega$ each member can either prevent it from being implemented or demand compensation in case it gets implemented. The provision rule therefore grants "veto rights" to all group members.[11]

[9] We impose this axiom, although one does not have to rule out taxing or subsidizing public project provision. See Güth et al. (2012) for an experiment investigating the robustness of procedurally fair bidding to the introduction of taxes and subsidies.

[10] If no project is provided, (A.2) and the assumption $b_i(\emptyset) = 0$ imply $0 - c_i(P_\ell^*, \boldsymbol{b}) = 0 - c_j(P_\ell^*, \boldsymbol{b})\ \forall i, j \in N$. Thus, $c_i(P_\ell^*, \boldsymbol{b}) = c_j(P_\ell^*, \boldsymbol{b}) = 0$ due to $C(\emptyset) = 0$ and cost balancing.

[11] The principle of universal voluntary consent has also inspired the 'action mechanism

Sections 4 to 6 report on experimental studies based on the above-described procedurally fair provision rule.[12] Obviously, implementing the rule in the laboratory entails specifying a proper game with experimentally induced valuations for the public projects. For each player $i \in N$, let $v_i(P_\ell) \in \mathbb{R}$ denote i's induced valuation for $P_\ell \in \Omega$. Then, under our provision rule, the payoff function of i is:

$$\pi_i(\boldsymbol{b}) = \begin{cases} 0 & \text{if } \sum_{i=1}^n b_i(P_\ell) < C(P_\ell) \quad \forall P_\ell \in \Omega, \\ v_i(P_\ell^*) - b_i(P_\ell^*) + \dfrac{\sum_{j \in N} b_j(P_\ell^*) - C(P_\ell^*)}{n} & \text{if } \sum_{i=1}^n b_i(P_\ell^*) \geq C(P_\ell^*) \\ & \text{and } \sum_{i=1}^n b_i(P_\ell^*) - C(P_\ell^*) \geq \sum_{i=1}^n b_i(P_k) - C(P_k) \quad \forall P_k \in \Omega. \end{cases}$$

Finally, an additional property of the rule is overbidding proofness, meaning that any bid vector prescribing overbidding for a project is weakly dominated.[13]

4 Do mixed feelings matter more than efficiency?

The main aim of the experimental study by Güth et al. (2011) is to explore whether, under the procedurally fair provision rule delineated above, a public project that causes mixed feelings stands a fair chance of being provided in the face of competition from a less efficient collective good (benefiting all involved parties). Efficiency is measured in terms of the project's social benefit, defined as the sum of the induced valuations for the project minus its provision cost (i.e., $\sum_{i=1}^n v_i(P_\ell) - C(P_\ell)$).

4.1 Experimental design and parameters

The authors focus on the simplest possible scenario, that with two players, $N = \{1, 2\}$, and two public projects, $\Omega = \{x, y\}$. The players' induced valuations for the two projects are $v_1(x) = -40$, $v_2(x) = 140$, $v_1(y) = 40$, and $v_2(y) = 80$. In words, the provision of x yields mixed feelings, whereas the provision of y benefits both players. Since $C(x) = 30$ and $C(y) = 70$, the social benefit

for public goods' proposed by Smith (1977). Here, however, this principle is implied by our axioms (it is not an additional requirement).

[12] All three experiments were programmed in z-Tree (Fischbacher 2007) and conducted in the experimental laboratory of the Max Planck Institute of Economics (Jena, Germany). Participants were recruited from the undergraduate population at the University of Jena.

We note from the start that we do not aim at comparing the different experiments (they are not sufficiently similar for a clean comparison).

[13] The provision point rule, however, is not incentive compatible because it is not underbidding proof. Imposing, additionally, incentive compatibility would result in impossibility statements. Note that legal mechanisms typically do not satisfy incentive compatibility (public tenders, for instance, rely on the lowest bid-price rule with overbidding incentives).

generated by x exceeds that generated by y $(-40+140-30>40+80-70)$.[14]

In the main treatment, labeled M, each player $i \in N$ submits bids for both projects, $b_i^M(x)$ and $b_i^M(y)$. In the two control treatments, labeled X and Y, only one project is at stake. Each player i submits $b_i^X(x)$ in treatment X and $b_i^Y(y)$ in treatment Y. Bids are always integer numbers between -200 and 200 ECUs.

The three treatments are run one-shot in a within-subject design. Instead of considering all possible permutations of X, Y, and M, the authors implement only treatment sequences where M is played either first or last. They refer to the MXY and MYX (XYM and YXM) between-subject sequences as the M^F (M^L) sequences. At the beginning of each session, each participant is assigned the role of either low-value or high-value bidder, a role that he retains throughout the session. The matching protocol ensures that nobody meets the same participant more than once.

To minimize path dependence and learning effects, subjects did not receive any feedback about the others' bids, the provided project, and the resulting payoffs until the end of the session. To discourage portfolio diversification possibilities, one treatment was selected at random for payment at the end of the session.

Inducing common knowledge of the experimental payoffs yields a complete information game with many pure strategy equilibria. In particular, in treatment M, besides non-provision equilibria in which the bidders veto both projects, there exists an abundance of provision equilibria requiring bids that (a) result in a non-positive surplus with respect to bids for one project, and (b) add up to the project's cost for the other project.

4.2 Results

The authors run one session for each of the four sequences (MXY, MYX, XYM, and YXM). Each session involves 32 inexperienced participants matched in pairs. Statistical tests indicate that the data can be pooled according to whether M is played first or last. Thus, the analysis relies on 64 independent observations per sequence (32 for low-value and 32 for high-value bidders).

There is an interesting order effect for $b_i^M(y)$: the M-treatment bids for y tend to be larger when M is played last. The histograms in Figure 1 show that while negative bids for y are far from being rare in the M^F sequence (left pane), they are non-existent in the M^L sequence (right pane). Experiencing both

[14]Valuations and costs are expressed in terms of ECUs (Experimental Currency Unit), with 5 ECUs = €1.

projects separately induces participants to increase the likelihood of providing y when the two projects are made available in tandem. This result holds more strongly for the high-value bidders.

[Figure 1 about here.]

Are bids for x affected by the availability of y? Figure 2 compares kernel density plots of the observed bids for x in treatments X and M, conditioned on whether M is played first (left pane) or last (right pane). Even though the M^F sequences exhibit a gap between the M- and the X-treatment estimates, a binomial sign test indicates no significant difference between the two sets of bids. The same holds for the M^L sequences for which the kernel density estimates are very close.

[Figure 2 about here.]

How do individuals modify their bids for x between treatments? In the M^F sequences, the majority of subjects either increase (42.2%) or do not change (28.1%) their bids when moving from M to X. In the M^L sequences, 39.1% of the participants bid the same amount in both treatments. Switching from X to M, 29.7% of the participants increase their bids by an average amount of 19.4 ECUs, and 31.3% of them decrease their bids by an average amount of 53.7 ECUs (thus the overall effect is negative). In sum, participants bid less for x when it faces competition from y but this difference is not statistically significant.

Actually, the finding that players do not differentiate their bids for x holds even when the sample is restricted to either the low-value or the high-value bidders. This is evident from the inspection of Figure 3, which also reveals that low-value bidders place predominantly negative bids.

[Figure 3 about here.]

Bidders veto the project that causes mixed feelings more often than the alternative public project, but vetoing is far from common practice. This is reminiscent of Buchanan's (1975) contractarian paradigm and suggests that people do not attempt to impose their will on others: if the agent that attaches a negative value to project x is sufficiently compensated by the other party, then he has no reason to a priori reject an agreement.

We now turn to the inspection of the provision rates of the two projects. Table 1 displays the percentage of successful provision of x and y in each of the three treatments under both sequences. The provision rate of x in treatment

X is quite high (65.6% and 87.5% in the M^F and M^L sequences, respectively) and similar in magnitude to the provision rate of y in treatment Y (68.8% and 81.3%, respectively). Hence, it is rather the coordination problem than the presence of mixed feelings that should be held responsible for the provision failure of x in X. Further evidence that participants assign little importance to mixed feelings is given by the fact that in M they provide x more often than y.

[Table 1 about here.]

Thus, the presence of mixed feelings is not detrimental to cooperation, provided of course (as the authors assume) that the project causing these feelings is relatively efficient, and that the party that gains from the project can compensate the party that suffers.

5 Are the results sensitive to the definition of Ω or the type of provided information?

Cicognani et al. (2012) enrich Güth et al.'s (2011) experimental setting to examine (a) how bid levels and provision rates are affected by changes in the induced valuations associated with Ω, and (b) whether the implementation of the most efficient project depends on the arguably unrealistic assumption of complete information.

5.1 Experimental design and parameters

Cicognani et al. (2012) consider groups of three individuals, $N = \{1, 2, 3\}$, and five alternative Ω sets, each one of them consisting of seven public projects.[15] Let us indicate the generic set of projects by $\Omega^s = \{P_1^s, \dots, P_7^s\}$, $s = 1, \dots, 5$. For each P_ℓ^s, where $\ell = 1, \dots, 7$ and $s = 1, \dots, 5$, Table 2 reports the project's cost, $C(P_\ell^s)$, the induced valuations for the project, $v_i(P_\ell^s)$ $\forall i \in N$, and the resulting social benefit, $\sum_{i=1}^{3} v_i(P_\ell^s) - C(P_\ell^s)$.[16]

[Table 2 about here.]

Ω^1 is the reference set from which all other sets are derived. The projects in Ω^2 are equally efficient with but less costly than those in Ω^1. P_1^3 is a public bad, that is all group members attach a negative value to it. The projects in Ω^1

[15] Actually, Cicognani et al. assume that each set consists of three projects and consider the seven possible non-empty subsets of each set. We regard each subset as an alternative project in order to be consistent with the other experiments presented in the paper.

[16] All monetary amounts are expressed in ECUs, with 1 ECU = €1.

and Ω^4 generate identical social benefits, the projects in Ω^4 however are valued the same by all group members. Finally, while the maximal social benefit in Ω^1 to Ω^4 equals 54, Ω^5 contains the most efficient project (namely P_6^5 with a social benefit of 60).

Each participant is exposed to all five project sets and to all three induced valuations, implying that the experiment is conducted over a sequence of 15 independent periods. In each period, each group member $i \in N$ submits a bid vector $\boldsymbol{b}_i$ with seven elements, one element for every project in Ω^s. The bids are not restricted to a pre-specified interval. In line with Güth et al. (2011), (a) participants receive no feedback throughout the session, and (b) one of the 15 periods is randomly selected for payment at the end of the session.

To assess the efficacy of the provision rule in informationally limited settings, two treatments are implemented in a between-subject design. Participants in a public information ($PUBL$) treatment know the other group members' induced valuations, whereas participants in a private information ($PRIV$) treatment have no knowledge about any valuation other than their own.

5.2 Results

The authors ran one session per treatment: 30 (27) students participated in the treatment with public (private) information. Since the participants experienced all three induced valuations, their numbers correspond to the number of independent observations in the two treatments.

For all $i \in N$ and $P_l^s \in \Omega^s$, the relative deviation between observed bid and induced valuation is measured by the variable $R_i(P_\ell^s) = \frac{b_i(P_\ell^s) - v_i(P_\ell^s)}{|v_i(P_\ell^s)|}$. Figure 4 shows boxplots of the average (over subjects and projects) $R_i(P_\ell^s)$ values for all project sets and information conditions. There is a widespread, strong tendency to underbid, i.e., to post bids which are lower than one's own valuations of the projects.[17]

Underbidding is particularly prevalent in the case of Ω^2, a project set that comparatively allows for more underbidding before provision is jeopardized. On the other hand, the magnitude of the average underbid is slightly smaller in the case of Ω^4, where the group members' induced valuations are all positive and homogeneous. These findings suggest that negative and heterogeneous induced valuations are likely to result in more underbidding, irrespective of the information condition.

[Figure 4 about here.]

[17]The data are therefore not consistent with the hypothesis that in a complex environment subjects use the simple heuristic of truthful bidding.

Even if underbidding behavior may endanger the provision of any public project, the data of the present study show otherwise. In Table 3,[18] the sum of all seven projects' provision rates ranges from 63.7% (Ω^3, private information) to 91.8% (Ω^2, private information). Moreover, for each Ω set and for both information conditions, the most frequently provided project is the most efficient one.

[Table 3 about here.]

We conclude that private information about valuations does not significantly affect either bidding behavior (players underbid by roughly the same amount in both information conditions) or the proportion of successful provision. The participants apparently focus on their own valuations when deciding on their bids.

6 Is efficiency jeopardized in the presence of revenue-generating projects?

The experiments discussed in the previous sections have revealed that the proposed procedurally fair provision rule is rather effective in implementing the most efficient project. Güth et al. (2013) test the robustness of these findings to the inclusion of projects with negative "costs" (namely revenue-generating projects).

6.1 Experimental design and parameters

Subjects are divided into groups of two, $N = \{1, 2\}$, and confronted with two alternative Ω sets only once. Each Ω^s ($s = 1, 2$) consists of four projects, $\Omega^s = \{P_1^s, \ldots, P_4^s\}$. Table 4 displays, for each Ω^s, the costs, induced valuations, and resulting social benefits of each of the four constituent projects.[19]

[Table 4 about here.]

The projects in Ω^1 can be ordered by their efficiency, the most efficient being the project that causes mixed feelings and has positive costs. Two projects in Ω^2 are equally maximally efficient (P_2^2 and P_4^2), and both have positive provision costs. The other two projects (P_1^2 and P_3^2) generate the same (lower) social

[18] The numbers in the table are computed by randomly matching participants in three-person groups; the actual groups are disregarded. This procedure is justified on the grounds that participants received no feedback.

[19] All variables are expressed in ECUs with 5 ECUs = €1.

benefit, and both cost -25. Additionally, while P_1^2 and P_2^2 cause mixed feelings, P_3^2 and P_4^2 benefit both players. By comparing $b_i(P_2^2)-b_i(P_1^2)$ to $b_i(P_4^2)-b_i(P_3^2)$, the authors can examine whether a project with negative "costs" affects bidding behavior differently depending on whether mixed feelings are present or not.

In the one-shot experiment, each group member i $(= 1, 2)$ submits two bid vectors $\boldsymbol{b}_i$, one for every Ω set. Each vector has four components. Bids are always integer numbers between -500 and 500 ECUs. Each participant is assigned one of the two roles (either bidder 1 or bidder 2) in both Ω sets, allowing the authors to investigate whether low-value bidders are more likely than high-value bidders to be affected by the presence of revenue-generating projects.

Although Cicognani et al.'s (2012) study finds no significant difference in bidding behavior when the others' valuations are known and unknown, the question can be raised as to whether or not this result would hold up in the presence of projects with negative "costs". To shed light on this question, Güth et al. (2013) compare two treatments in a between-subjects design: one where valuations are public information (treatment $PUBL$) and the other where valuations are private information (treatment $PRIV$).

6.2 Results

The authors ran two sessions per treatment ($PUBL$ and $PRIV$). Each session involved 32 participants matched in pairs so that, in total, the analysis relies on 64 individuals (32 low-value and 32 high-value bidders) in each of the two treatments.

The provision rates of the four projects in the two Ω sets are displayed in Table 5, separately for the two information conditions.

[Table 5 about here.]

Regardless of the Ω set and the information condition, provision rates are the highest for the revenue-generating projects. Specifically, participants are first attracted by negative "costs", and then, given that the projects generate the same revenue, they provide the more efficient between them.

Is the influence of negative "costs" different depending on whether mixed feelings are present or not? To answer this question, the authors concentrate on Ω^2 and take into account the difference between $b_i(P_2^2) - b_i(P_1^2)$ and $b_i(P_4^2) - b_i(P_3^2)$. A graphical representation of these differences is given in Figure 5, which suggests that $b_i(P_2^2) - b_i(P_1^2)$ and $b_i(P_4^2) - b_i(P_3^2)$ are rather similar for both information conditions. The lack of significant difference is confirmed by two-sided Wilcoxon rank-sum tests: the p-values equal 0.247 for $PUBL$ and 0.809 for $PRIV$.

[Figure 5 about here.]

Turning to the differences in bids between low-value and high-value bidders, the authors find that for the projects with negative "costs" low-value bidders tend to overbid (relative deviations are positive) and high-value bidders tend to underbid (relative deviations are negative), whatever the Ω set and the information condition. In contrast, there is a generalized tendency to underbid for the projects entailing positive costs.

Finally, as to the impact of private information on bid levels when some projects have negative "costs", Figure 6 hints that the average surplus with respect to bids does not differ between the two information conditions. Wilcoxon rank sum tests confirm that switching from public to private information does not affect bids for the same project (all p-values exceed 0.528).

[Figure 6 about here.]

7 Conclusions

Individuals' choices usually affect not only one's own well-being, but also others'. One extreme possibility is to grant individuals private spheres in which they can do whatever they like, and then allow them to negotiate if their choices cause inefficiencies. Here, however, we focused on the opposite polar case of collective actions, but based on individual bids. Monetary bids assume the "measuring rod of money", according to which all concerns can be expressed in monetary equivalents. This has the advantage of allowing for objective interpersonal comparability.

By imposing intuitive requirements, a mechanism has been derived that guarantees equal gains according to bids and individual veto power. The experimental studies conducted so far mainly served to evaluate the practicability of this mechanism. They demonstrate its potential not only to induce high rates of successful provision, but also to implement the most efficient project. Yet, the latter holds only when the public project entails positive costs. Güth et al. (2013) show, indeed, that the presence of revenue-generating projects endangers the provision of the more efficient, but costly, projects.

The mechanism can be easily applied to specific situations such as international voluntary activities for environmental protection. This application requires (i) a set of public projects directed at, e.g., reducing pollutants or securing renewable energy supply (like solar and wind), and (ii) a group of cooperating countries. The individual veto rights (which are implied, rather than required, by our axioms) allow each country in the group to prevent the implementation of a project that it deems undesirable. Thus, participating in such a group is rather unproblematic. Additionally, although the possibility of veto may confer power upon a single country, our experiments show that the procedural fairness of the mechanism causes the involved parties to not a priori reject an agreement.

The experiments are first steps towards a broader exploration of procedurally fair bidding in real world mechanisms. Additional experiments should show how the equal ability to bid in the process and the guaranteed equality of gains with respect to bids fare with real people in many and diverse other contexts, and where the limits of such mechanisms lie (as far as for instance numbers of participants are concerned etc.). So far the experiments indicate that procedurally fair mechanisms seem to be broadly acceptable for those exposed to them. And, this seems important, since generally speaking political institutions must be supported by a sense of justice (Rawls 1971) or an ideology (North 1988).

In his article "ideology and political/economic institutions" Douglass C. North identifies ideology with "the subjective perceptions that people have about what the world is like and what it ought to be; ideology therefore affects people's perceptions about the fairness or justice of the institutions of a political economic system" (North 1988, p. 15). North then goes on to explain "how the west grew rich" (see on this also Rosenberg and Birdzell 1986) in terms of reductions in transaction costs as brought about by institutional structure, in particular by the institutional enforcement of "three fundamental laws of nature, that of the stability of possession, of its transference by consent, and of the performance of promises" (see Hume 1896, book III, part ii, Sect. VI).

But North is aware that markets and the other transaction cost reducing institutions do not drop from heaven for free. They need ideological support to survive politics. "(I)t should be pointed out right away that the institutions that have made possible relatively low costs of transacting in turn depend upon even more fundamental political economic institutions, ones that undergird the entire system. It is this complex of institutions … that is at issue when we examine the perceptions people have about the fairness and justice of the institutional structure" (North 1988, p. 17).

Government and the democratic process will intervene into markets if they are perceived as unfair. Therefore it matters very much whether or not the system as a whole is perceived as fair. Yet in times in which the number of losers of market dynamics increases, support by fairness perceptions (ideology) suffers. Citizens do not (any longer) adopt the view that what happens on markets is a private matter and should be left alone by politics. The external effects of inter-individual agreements of "consenting adults" are not anymore respected (because of their external effects, and also because starting positions are perceived as too unequal).

In such a situation politics tends to reclaim its ground. This is unavoidable. We may, however, speculate whether there are institutions that embody the ideal of mutual respect in politics. The vision of "politics as exchange" in terms of a procedurally fair bidding mechanism should bring the ideal closer to real world procedures which then, along with market institutions, may hopefully find the ideological support they need.

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Table 1: Rates of provision of projects x and y in all treatments and sequences

	M		X	Y
	x	y		
M^F sequences	43.8	15.6	65.6	68.8
M^L sequences	50.0	43.8	87.5	81.3

Note Güth et al. (2011, Table 4).

Table 2: Alternative Ω^s, $s = \{1, \ldots, 5\}$, presented to the participants

Set	P_ℓ^s	$C(P_\ell^s)$	$v_1(P_\ell^s)$	$v_2(P_\ell^s)$	$v_3(P_\ell^s)$	$\sum_{i=1}^3 v_i(P_\ell^s) - C(P_\ell^s)$
	P_1^1	30	30	-30	45	15
	P_2^1	60	0	24	45	9
	P_3^1	36	6	18	18	6
Ω^1	P_4^1	90	30	-6	105	39
	P_5^1	45	36	-12	75	54
	P_6^1	96	6	42	63	15
	P_7^1	135	36	12	75	-12
	P_1^2	15	27	18	-15	15
	P_2^2	30	27	0	12	9
	P_3^2	18	9	6	9	6
Ω^2	P_4^2	45	-6	30	60	39
	P_5^2	24	60	-12	30	54
	P_6^2	48	33	3	27	15
	P_7^2	69	33	18	6	-12
	P_1^3	30	-24	-30	-6	-90
	P_2^3	60	0	24	45	9
	P_3^3	36	6	18	18	6
Ω^3	P_4^3	90	-24	-6	36	-84
	P_5^3	45	-18	-12	12	-63
	P_6^3	96	18	60	72	54
	P_7^3	135	-9	33	75	-36
	P_1^4	30	15	15	15	15
	P_2^4	63	24	24	24	9
	P_3^4	48	18	18	18	6
Ω^4	P_4^4	105	48	48	48	39
	P_5^4	45	33	33	33	54
	P_6^4	93	36	36	36	15
	P_7^4	138	42	42	42	-12
	P_1^5	30	78	-30	-12	6
	P_2^5	60	0	24	45	9
	P_3^5	36	-6	18	18	-6
Ω^5	P_4^5	63	30	-18	105	54
	P_5^5	45	6	-24	105	42
	P_6^5	57	15	42	60	60
	P_7^5	141	72	12	51	-6

[Note] Cicognani et al. (2012, Table 1).

Table 3: Rates of provision of the seven projects in each Ω^s, $s = \{1, \ldots, 5\}$, and information condition

Proj.	Ω^1		Ω^2		Ω^3		Ω^4		Ω^5	
	PUBL	*PRIV*	*PUBL*	*PRIV*	*PUBL*	*PRIV*	*PUBL*	*PRIV*	*PUBL*	*PRIV*
P_1^s	1.8	2.2	4.3	3.5	0.0	0.0	1.7	0.1	2.4	2.0
P_2^s	0.6	0.3	0.5	0.3	1.6	2.1	0.0	0.0	0.1	0.0
P_3^s	0.0	0.1	1.2	0.0	2.1	0.1	0.0	0.0	0.0	0.0
P_4^s	12.5	9.6	23.4	28.6	0.0	0.0	1.5	0.3	29.3	18.8
P_5^s	**62.7**	**65.9**	**59.4**	**59.3**	0.0	0.0	**79.2**	**87.8**	2.7	4.9
P_6^s	2.5	0.0	1.2	0.1	**69.3**	**61.5**	0.0	0.0	**56.3**	**63.5**
P_7^s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note Cicognani et al. (2012, Table 3). The bold font identifies the most efficient project in each Ω^s.

Table 4: Alternative Ω^s, $s = \{1, 2\}$, presented to the participants

Set	P_ℓ^s	$C(P_\ell^s)$	$v_1(P_\ell^s)$	$v_2(P_\ell^s)$	$\sum_{i=1}^2 v_i(P_\ell^s) - C(P_\ell^s)$
Ω^1	P_1^1	-25	-20	100	105
	P_2^1	20	-20	160	120
	P_3^1	-25	20	50	95
	P_4^1	20	20	110	110
Ω^2	P_1^2	-25	-10	90	105
	P_2^2	20	-10	150	120
	P_3^2	-25	15	65	105
	P_4^2	20	15	125	120

Note Güth et al. (2013, Table 1).

Table 5: Rates of provision of the four projects in each Ω^s, $s = \{1, 2\}$, and information condition

Project	Ω^1		Ω^2	
	PUBL	*PRIV*	*PUBL*	*PRIV*
P_1^s	43.7	40.6	31.2	40.6
P_2^s	**9.4**	**18.7**	**18.7**	**12.5**
P_3^s	31.2	31.2	46.8	40.6
P_4^s	12.5	6.2	**12.5**	**12.5**

Note Güth et al. (2013, Table 2). The bold font identifies the most efficient project(s) in Ω^s.

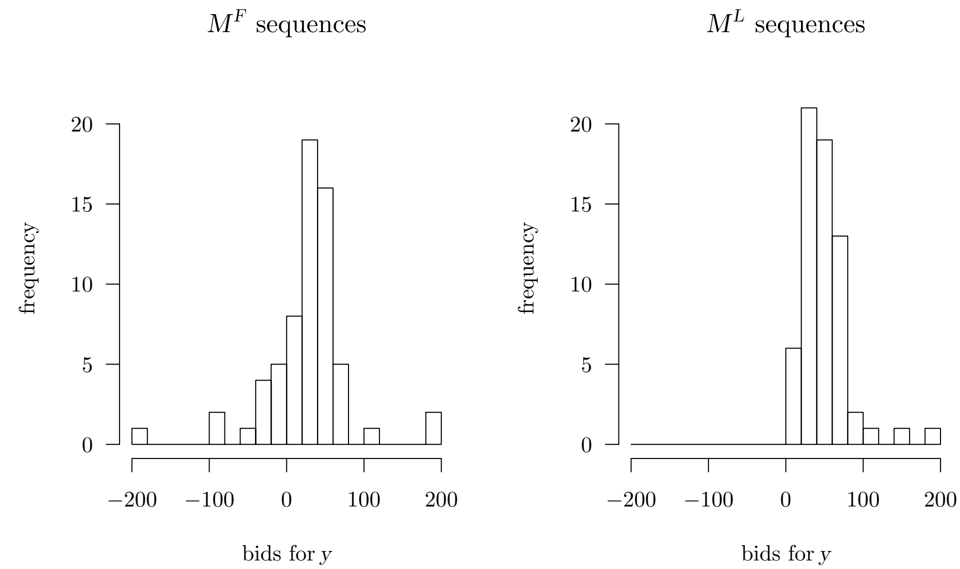

Figure 1: Histograms of bids for y in treatment M, separately for the M^F and M^L sequences (Güth et al. 2011, Figure 1).

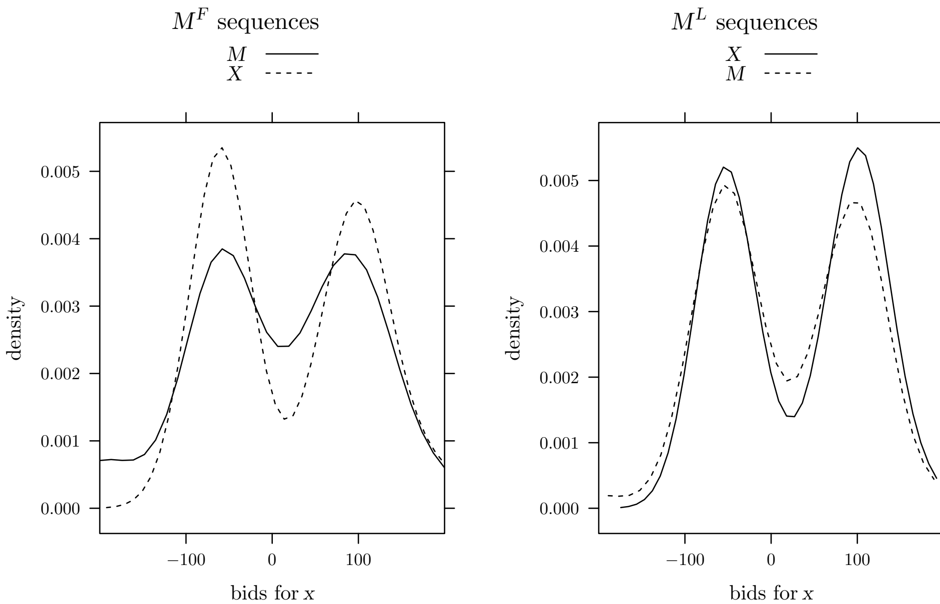

Figure 2: Kernel density estimates of bids for x in treatments M and X, separately for the M^F and M^L sequences (Güth et al. 2011, Figure 2).

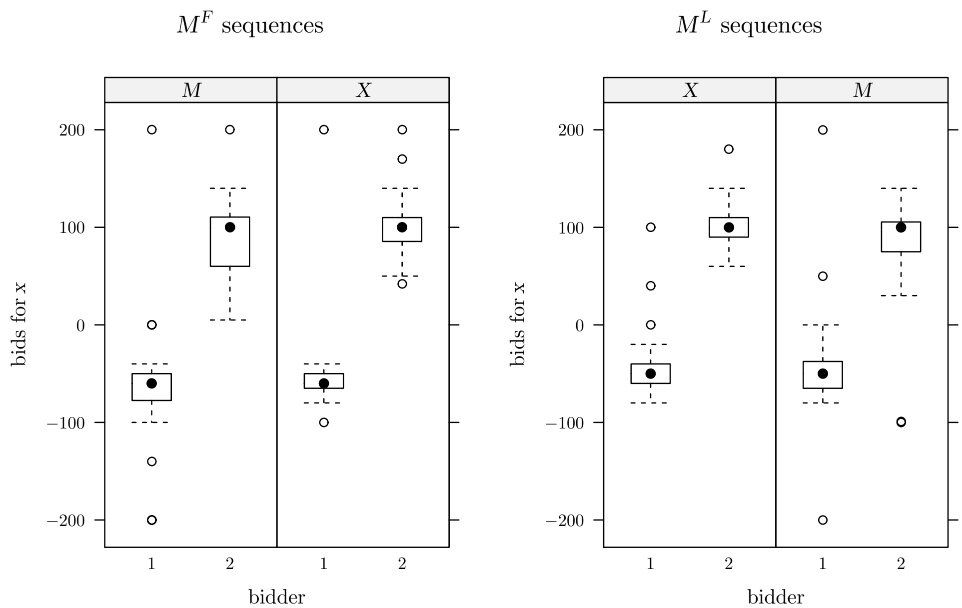

Figure 3: Boxplots of bids for x in treatments M and X, separately for low-value (labeled 1) and high-value (labeled 2) bidders (Güth et al. 2011, Figure 3).

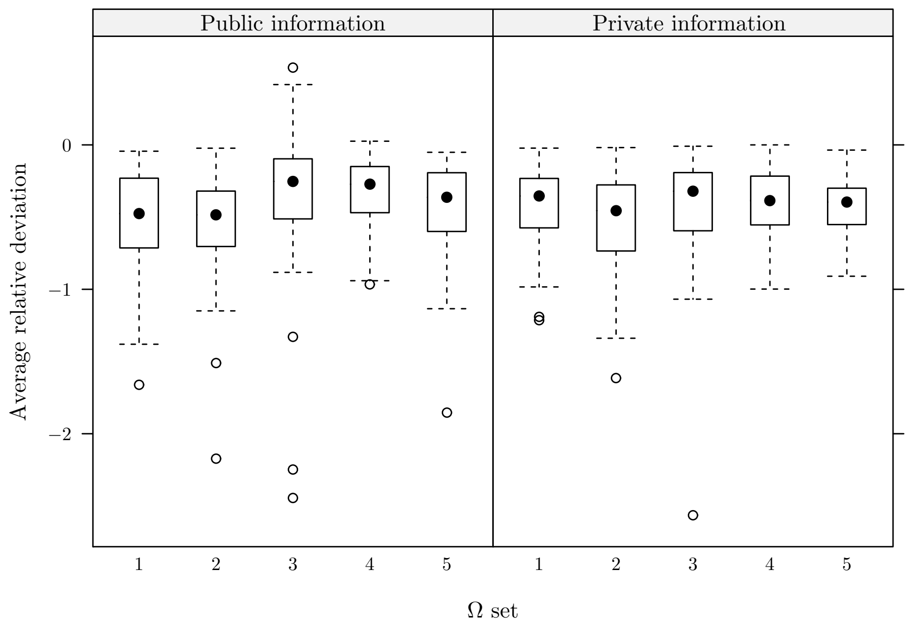

Figure 4: Boxplots of the average $R_i(P_\ell^s)$ values, representing the relative deviations of observed bids from induced valuations, separately for each Ω set and each information condition (Cicognani et al. 2012, Figure 3).

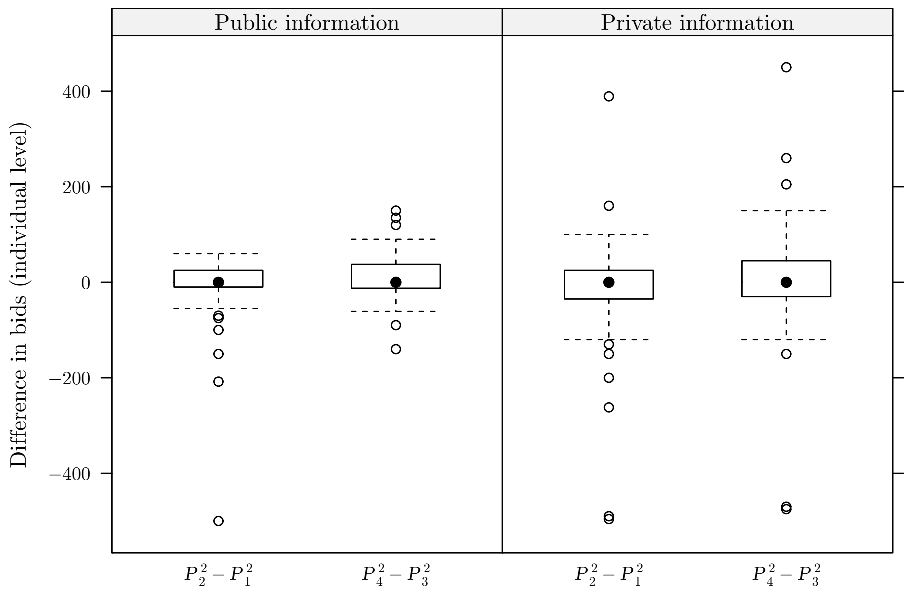

Figure 5: Boxplots of the differences in bids between projects with positive costs and projects with negative costs, separately for mixed-feelings projects and projects benefiting everyone (Güth et al. 2013, Figure 1).

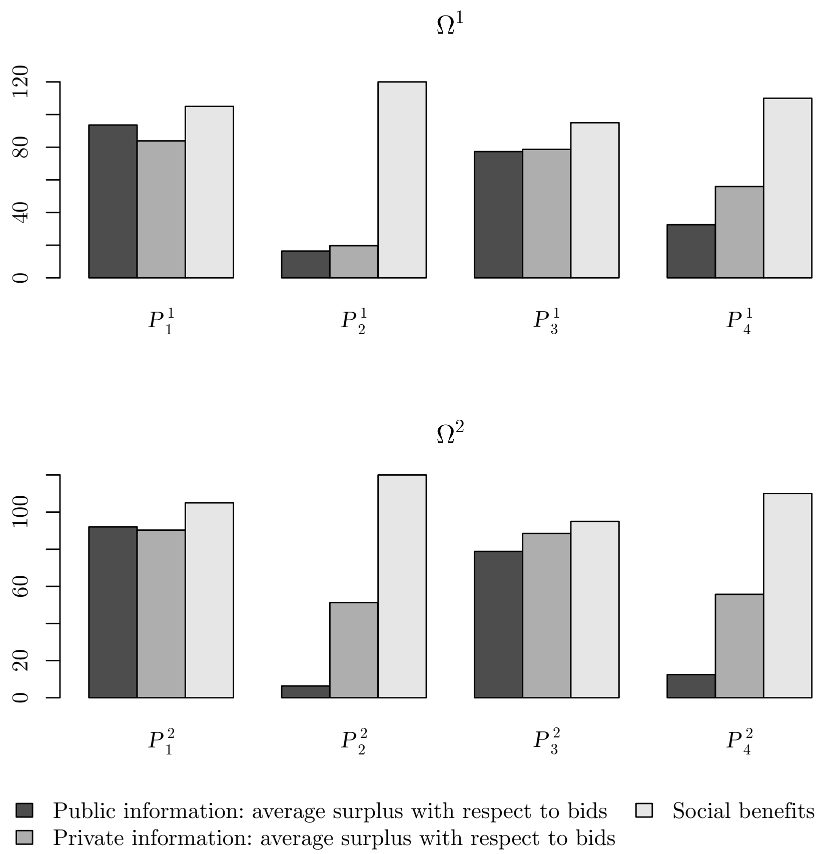

Figure 6: Average surpluses with respect to bids and corresponding social benefits for each project, each Ω set, and each information condition (Güth et al. 2013, Figure 2).