

# *Community projects: an experimental analysis of a fair implementation process*

Article

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1 **Community Projects**

2 **An Experimental Analysis of a Fair Implementation Process**

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7 **Abstract** We define and experimentally test a public provision mechanism that  
8 meets three basic ethical requirements and allows community members to influ-  
9 ence, via monetary bids, which of several projects is implemented. For each project,  
10 participants are assigned personal values, which can be positive or negative. We  
11 provide either public or only private information about personal values. This pro-  
12 duces two distinct public provision games which are experimentally implemented  
13 and analysed for various projects. In spite of the complex experimental task, par-  
14 ticipants do not rely on bidding their own personal values as an obvious simple  
15 heuristic whose general acceptance would result in fair and efficient outcomes.  
16 Rather, they yield to strategic underbidding. Although underbidding is affected  
17 by projects' characteristics, the provision mechanism leads to the implementation  
18 of the most efficient project mostly.

19 **Keywords** Public Provision · Procedural Fairness · Experiment

20 **JEL classification:** C91; C72; D63.

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## 22 1 Introduction

23 In the real world projects that may benefit one party but harm another party  
24 are frequently observed. Such projects may give rise to the so-called “Not In My  
25 Backyard” (NIMBY) syndrome if they improve general welfare but generate costs  
26 for the individuals living close to the project who, as a consequence, oppose its  
27 implementation (e.g., Frey and Oberholzer-Gee, 1997). As an example, building a  
28 new railway may improve the general welfare of the community. However, while it  
29 may benefit some individuals, such as the traders in the community, at the same  
30 time, it may harm farmers whose land is needed to build it. Therefore, farmers  
31 might oppose and try to prevent the implementation of the railway.

32 Following the seminal work of Rapoport and Chammah (1965) on the Pris-  
33 oner’s Dilemma, the provision of public goods has been the object of a variety of  
34 experimental studies. Generally, participants in a public goods game are asked to  
35 contribute to a public good that generates positive externalities for the potential  
36 contributors, irrespectively of the actual amount contributed (Bergstrom *et al.*,  
37 1986). The public good is usually assumed to yield benefits to all participants and  
38 the size of benefits is usually found to positively affect the contributions to the  
39 public good (see, for a review, Ledyard, 1995). In an attempt to replicate field  
40 conditions, experimental studies have introduced extensions to this basic setting,  
41 investigating among other the effect of heterogeneous valuations of the good (e.g.,  
42 Bagnoli and McKee, 1991; Rondeau *et al.*, 1999) and of negative externalities (e.g.,  
43 Andreoni, 1995; Sonnemans *et al.*, 1998). However, the empirically relevant case of  
44 public projects yielding benefits to some and harming other participants has only  
45 recently been addressed in the experimental literature (e.g., Güth *et al.*, 2011).

46 For projects that benefit some and harm others, it is essential that the rules  
47 governing the choice and the allocation of the overall benefit from the project  
48 are fair and that equal weight is attributed to each participant. Güth and Kliemt  
49 (2013) axiomatically derive a procedurally fair institution. Individuals involved in  
50 decision-making within this institution bid on the provision of a set of projects,

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51 whose provision points are publicly known. Through their bids, participants state  
52 the maximum contribution they are willing to make to the project given the in-  
53 formation available.<sup>1</sup> The bids can be negative and, if low enough, veto the imple-  
54 mentation of the project.

55 Assuming the common measuring rod of money for whatever the concerns are,  
56 fairness is guaranteed with respect to the publicly observable bids. The fairness  
57 condition implies that participants obtain the same net benefit with respect to  
58 their bids. The “status quo” is maintained when the bids do not justify provision,  
59 whereas when bids render implementation justifiable, the set of projects with the  
60 largest surplus, i.e. the largest difference between the sum of the bids and the  
61 costs, is selected.

62 The procedurally fair institution of Güth and Kliemt (2013) constitutes the  
63 game form implemented experimentally by Güth *et al.* (2011) and also in this  
64 paper (see Section 2.1 for a detailed description). Güth *et al.* (2011) compare  
65 bids and provision rates for a public good project that harms some and benefits  
66 others and for a less efficient traditional public good project. The authors label the  
67 latter “mixed feelings” project. Güth *et al.* (2011) experimentally study bids and  
68 provision rates in the simple case where two players, who have common knowledge  
69 about personal values, bid for two projects, with one player always having higher  
70 values than the other. Their results show that, while participants generally succeed  
71 in selecting the most efficient project, the provision frequency of the mixed-feelings  
72 project reduces when in competition with the traditional public good.

73 Compared to Güth *et al.* (2011), we investigate mixed feelings in a much richer  
74 experimental setting, with groups of three players that bid for seven projects over  
75 five different sets of personal values and costs (we call these sets “prospects”).  
76 Moreover, unlike Güth *et al.* (2011), we study behaviour in two alternative infor-  
77 mation conditions: a public information setting and a private information setting.  
78 In both, participants know the project costs, but in the private information setting

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<sup>1</sup> Kunreuther and Portney (1991) in the context of the NIMBY literature propose a similar approach to guide decision making for the siting of noxious facilities.

79 they are only aware of their own personal values, whereas in the public information  
80 setting they also know others' personal values and are, thus, able to calculate the  
81 social benefits of each project. This innovation in the experimental design allows us  
82 to verify the applicability of the institution in absence of the common knowledge  
83 requirements of game theory and to control for the impact of social preferences.  
84 Furthermore, the complex experimental setting adopted brings us closer to field  
85 conditions and allows us to investigate the role of costs, heterogeneity in values,  
86 negative personal values, and social benefits on bidding and provision.

87 Our results show that there is a general tendency to post a bid lower than  
88 one's own personal value (i.e., underbidding), and, in turn, this affects the cre-  
89 ation of surplus. Negative personal values promote underbidding and endanger  
90 the implementation of efficient projects. Also heterogeneous valuations have a  
91 negative impact on bids, echoing an established finding in the experimental lit-  
92 erature on public goods according to which homogeneity increases contributions  
93 (Ledyard, 1995). Furthermore, variance in personal values may explain failures to  
94 provide the most efficient project because it inhibits coordinating on bids that  
95 ensure implementation. We find that when all personal values are the same, the  
96 most efficient project has the highest implementation rate across all prospects.  
97 With reference to the two information conditions, our results show that common  
98 knowledge of others' evaluations does not substantially affect bidding behaviour  
99 and project implementation. When deciding how much to bid, participants seem  
100 to focus on their own personal values. Behaviour of this kind is compatible with  
101 the axiomatic derivation of game forms rather than proper games formalised in  
102 Güth and Kliemt (2013) that does not require common knowledge assumptions.

103 The paper is organised as follows: Section 2.1 presents the theoretical basis  
104 (game format) underlying the experiment; Section 2.2 outlines the experimental  
105 design and the behavioural predictions; Section 2.3 describes the procedure fol-  
106 lowed to conduct the experiment; Section 3 presents the results of the experiment;  
107 Section 4 discusses and concludes.

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## 108 2 Method

### 109 2.1 The Game Format

110 To derive our mechanism, we postulate three requirements, two of which are rather  
 111 obvious. Each participant  $i \in N = \{1, \dots, n\}$  with  $n \geq 2$  submits a bid  $b_i(S)$   
 112 for each different combination (subset)  $S$  of a certain finite number of possible  
 113 measures  $\Omega$ . Each subset is associated with known costs  $(C(S))$ .<sup>2</sup>

114 **Requirement 1** *Efficiency with respect to bids*

115 If  $\forall \emptyset = S \subset \Omega$ ,

$$116 \sum_{i=1}^n b_i(S) < C(S), \text{ then } S^* = \emptyset$$

117 Otherwise,  $S^* \neq \emptyset$  and  $\forall S \subset \Omega$

$$118 \sum_{i=1}^n b_i(S^*) - C(S^*) \geq \sum_{i=1}^n b_i(S) - C(S).$$

119 This ensures that for a subset which is implemented the sum of all bids must be  
 120 equal or higher than its costs. Among all subsets, only a subset  $S^*$  with the highest  
 121 surplus is selected. In the experiment, the surplus ( $SP$ ) of each project is defined  
 122 as the difference between the sum of the bids for that project by the  $n$  participants  
 123 in a group ( $\sum_{i=1}^n b_i$ ) and the cost  $C$  of that project ( $SP = \sum_{i=1}^n b_i - C$ ). Requirement  
 124 1 states that the project with the highest surplus, when this is non-negative, is  
 125 implemented. If the highest surplus is negative, no project is implemented.

126 **Requirement 2** *Cost balancing*

$$127 \sum_{i=1}^n p_i(S^*) = C(S^*)$$

128 If  $S^* \neq \emptyset$ , denote by  $p_i(S^*)$  the payment required from each  $i \in N$ . Require-  
 129 ment 2 ensures that the sum of all payments covers the costs.<sup>3</sup>

130 **Requirement 3** *Equal payoff with respect to bids*

$$131 b_i(S^*) - p_i(S^*) = b_j(S^*) - p_j(S^*) = \Delta \text{ for all } i, j = 1, \dots, n$$

<sup>2</sup> Costs could be negative, for example, when implementation is generating revenues rather than costs. However, this possibility is neglected here.

<sup>3</sup> One could allow for taxing or subsidising public provision; for example in the form of  $\sum_{i=1}^n p_i(S^*) + c = C(S^*)$  for some given  $c \in \mathbb{R}$ . However, this is neglected here.

132 The main requirement, allowing to characterise many institutions in practical  
 133 use for centuries (Güth, 2011), postulates equal treatment of all parties according  
 134 to what can be monitored objectively, i.e. the bids. The difference  $\Delta$  between the  
 135 bid and the actual payment, i.e., the players' payoff with respect to bids, must be  
 136 the same for all participants.<sup>4</sup> From these requirements it follows for the selected  
 137 subset  $S^*$ , if it is not empty, that the payment is the bid minus an equal share of  
 138 the highest non-negative surplus.<sup>5</sup> Thus, the payments are computed as follows:  
 139  $p_i(S^*) = b_i(S^*) - \left( \sum_{j=1}^n b_j(S^*) - C(S^*) \right) / n$  for all  $i \in N$ .<sup>6</sup>

140 In order to implement this mechanism in the experimental setting, we need to  
 141 assign exogenously given personal values  $v_i(S)$  to participants. Personal values  
 142 measure the pleasure or displeasure for each participant in case the subset is  
 143 implemented. To illustrate this point, take the example of a community that is  
 144 made up of families living in a block of flats. A family living on the third floor  
 145 will benefit more from an elevator than a family living on the ground floor. In our  
 146 experiment this will be translated in a higher personal value for the family living  
 147 on the third floor.<sup>7</sup>

148 The overall benefit to the community, social benefit ( $SB(S)$ ), is captured by the  
 149 difference between the sum of the personal values and the cost. The overall benefit  
 150 to the individual is captured by her payoff, understood as net gains compared to the  
 151 status quo denoted by  $\emptyset$ . The payoff  $\pi_i$  for participant  $i$  is the difference between  
 152 her personal value and her payment for the selected subset:  $\pi_i = v_i(S^*) - p_i(S^*)$ ,

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<sup>4</sup> Note that this implies envy-free net-trades according to bids (Güth, 1986) and truly equal payoffs in case of each bidder  $i$  bidding for each subset  $S$  his exogenously given personal value. Furthermore, it is an essential feature of our approach to allow for negative bids. Any proportionality principle would require an arbitrary lower bound for bids and this questions the universal application of the mechanism.

<sup>5</sup> This proves an important voluntariness property or veto principle since by bidding sufficiently low one can veto all sets  $S \neq \emptyset$ .

<sup>6</sup> Requirement 3 implies  $b_i(S^*) - p_i(S^*) = \Delta \in \mathbb{R}$  or  $b_i(S^*) = p_i(S^*) + \Delta$  for all  $i \in N$ . Due to  $\sum_{i=1}^n b_i(S^*) = \sum_{i=1}^n p_i(S^*) + n\Delta$  and  $\sum_{i=1}^n p_i(S^*) = C(S^*)$ , we obtain  $\Delta = \left( \sum_{j=1}^n b_j(S^*) - C(S^*) \right) / n \geq 0$  and thus  $p_i(S^*) = b_i(S^*) - \left( \sum_{j=1}^n b_j(S^*) - C(S^*) \right) / n$  for all  $i \in N$ .

<sup>7</sup> Personal values should not be interpreted as endowments, but as benefits/ disbenefits from implementing a certain project, irrespective of the reasons that led to this valuation.



153 with  $v_i(\emptyset) - p_i(\emptyset) = 0 - 0 = 0$ . Given the definition of payments  $p_i(S^*)$ , we get:  
 154  $\pi_i = v_i - b_i + \frac{SP}{n}$  with  $SP = \sum_{i=1}^n b_i(S^*) - C(S^*)$  for  $i = 1, \dots, n$ . Although we will  
 155 introduce personal values for all possible alternatives, the mechanism proposed for  
 156 voluntary public provision does not need such exogenously given evaluations to  
 157 collectively provide community projects. In this sense, our mechanism resembles  
 158 democratic voting rules which only define the set of voters and how many votes  
 159 are required for certain outcomes. In game-theoretic terminology, this means that  
 160 the mechanism analysed here only defines a game form but no proper (Bayesian)  
 161 game.

162 For exogenously given personal values, the mechanism would yield a well-  
 163 defined game — and not just a game form — when these values are assumed  
 164 to be commonly known. We will implement this well-defined game experimentally  
 165 in one of our two treatments, the public information treatment, where all personal  
 166 values and costs are known to all participants. If the personal values are only pri-  
 167 vately known, as in our private information treatment, a well-defined (Bayesian)  
 168 game would have to rely on commonly known (consistent or inconsistent) beliefs  
 169 concerning them. Our mechanism like democratic voting rules and, more gener-  
 170 ally, legally codified mechanisms does not require well-defined games (see Güth,  
 171 2011, for a discussion of public procurement auctions in this sense). It is an impor-  
 172 tant advantage of our approach that the mechanism is applicable, irrespectively  
 173 of whether the requirements of common knowledge are granted.<sup>8</sup>

174 Under standard assumptions, every bidding strategy  $b_i(\cdot)$  specifying bids  $b_i(S)$   
 175 higher than the personal value of bidder  $i$  for some subset  $S$  is weakly dominated,  
 176 i.e. the bidding mechanism is overbidding proof.<sup>9</sup> However, the mechanism is not  
 177 incentive-compatible since bidders can gain by underbidding their personal values.  
 178 In case of commonly known personal values and at least one subset  $S$  of  $\Omega$  which is

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<sup>8</sup> The same applies to democratic election rules and, more generally, to legally codified mechanisms which must be applicable across the board, i.e. even to the usual “ill-defined cases”.

<sup>9</sup> Overbidding may result in a pocket-money loss in the experiment and in a disadvantageous final allocation for those overbidding relative to those not overbidding. This makes overbidding quite unlikely also for individuals endowed with conventional social preference.

179 efficient according to personal values, the most efficient subset  $S^*$  can be guaran-  
 180 teed by usually a large multiplicity of equilibria in weakly undominated strategies,  
 181 similar to what typically happens in threshold public goods.<sup>10</sup> For each of these  
 182 equilibria, the sum of the bids would exactly cover the cost of the most efficient  
 183 subset  $S^*$  with — due to overbidding proofness — no individual bid  $b_i(S^*)$  exceed-  
 184 ing  $i$ 's true personal value  $v_i(S^*)$  and similar provisions for all alternative subsets.  
 185 But, as already stressed above, practically implementable mechanisms should be  
 186 applicable across the board, that is, even without the common knowledge require-  
 187 ments of game theory.<sup>11</sup>

## 188 2.2 Experimental Design and Behavioural Predictions

189 In our experiment we consider a community  $N = \{1, 2, 3\}$  with three members and  
 190 five different prospects. Each prospect contains seven subsets of measures. Here-  
 191 after, for simplicity, we refer to each subset of measures as a project. Each project  
 192 is associated with costs ( $C$ ) and personal values ( $v_1, v_2, v_3$ ). Participants are ran-  
 193 domly matched in groups of three. Two alternative experimental treatments are  
 194 implemented in a between-subjects design. In one condition participants are in-  
 195 formed only of their own personal values (*Private information*). In the alternative  
 196 condition participants are informed also of the personal values of the other two  
 197 group members and are aware that the others are informed too (*Public informa-*  
 198 *tion*).

199 When introducing and justifying our mechanism it should be clear that we do  
 200 not subscribe to the usual request for a game theoretic benchmark. Actually, for  
 201 one treatment, namely the one with commonly known personal values, a multi-  
 202 plicity of equilibria exists that all implement the most efficient subset  $S^*$  of  $\Omega$   
 203 as characterised informally above. We could single out the one with equal payoffs

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<sup>10</sup> A project is efficient according to personal values when the sum of the personal values for some  $S$  at least covers its cost  $C(S)$ .

<sup>11</sup> This, of course, applies also to mechanisms which are dominance solvable. However, such mechanisms are more often than not impossible (see Güth, 2011).

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204 for all bidders (according to personal values rather than only according to bids)  
205 if one cares for a unique benchmark solution. This equilibrium requires that all  
206 bidders underbid their personal value for  $S^*$  by the same amount. For the case of  
207 privately known personal values, a benchmark solution would require commonly  
208 known prior beliefs, which we intentionally did not try to induce experimentally  
209 to demonstrate the general applicability of our approach, irrespective of the em-  
210 pirically unrealistic assumption of common knowledge.

211 The institution we experimentally investigate is based on three requirements  
212 leading to a fair and efficient outcome with respect to bids. Fairness is defined  
213 with reference to bids (procedural fairness) and can lead to different payoffs, i.e.,  
214 it does not necessarily lead to fair outcomes with respect to payoffs. However, if all  
215 participants bid their personal values, the payoffs are equal. Thus, general bidding  
216 of one's personal values would generate a "fair and efficient outcome" both with  
217 respect to bids and with respect to personal values. We focus here on procedural  
218 fairness as resulting from the equality of payoffs with respect to bids.

219 While procedural fairness is still quite unexplored in economic studies, a lot  
220 of attention has been paid in recent years to outcome-based fairness and to so-  
221 cial preferences in general. Several sources of fairness have been identified in the  
222 literature, like inequity aversion (e.g., Fehr and Schmidt, 1999; Bolton and Ock-  
223 enfels, 2000), altruism (e.g., Andreoni and Miller, 2002), and welfare-enhancing  
224 preferences (e.g., Charness and Rabin, 2002). In our framework, other regarding  
225 concerns are not exogenously given but a result of analysing a given social decision  
226 problem. Actually, one of the intuitions of procedural fairness is that procedural  
227 fairness may crowd out other regarding concerns. This can be seen from sports  
228 contests or markets which are usually procedurally fair and hardly ever offer evi-  
229 dence of other regarding concerns, at least when entitlement is granted. We do not  
230 provide here a direct test of outcome-based social preferences, but the two infor-  
231 mation treatments provide us with some control of their relevance in the setting  
232 under investigation. While in the private information condition considerations of

233 this kind should not play a relevant role, in the public information treatment they  
234 could.<sup>12</sup> Thus, differences in bids between the two conditions may potentially be  
235 ascribed to social preferences based on outcomes.

236 With reference to cognitive aspects of the decision process, the complexity of  
237 the mechanism seems to require a substantial amount of resources when choosing  
238 a specific course of actions. In particular, underbidding requires quite complex  
239 strategic considerations which participants might want to avoid. Bidding one's  
240 own personal values could therefore qualify as an obvious heuristic (see, more  
241 generally, on heuristics, Gigerenzer and Todd, 2000). Hence, this is a possible  
242 focal "fair" benchmark to start from.<sup>13</sup> Indeed, one of the reasons to study rather  
243 complex prospects is to provide a basis for relying on heuristics rather than on  
244 strategic underbidding. However, bidding personal values is not in general a (Nash)  
245 equilibrium.<sup>14</sup>

246 For example, if the costs of the project are 15 and the personal values of the  
247 three players are 12, -4 and 25, respectively, bidding personal values leads to a  
248 surplus of 18 and a payoff per person of 6. However, in this situation, players have  
249 an incentive to underbid. If the participant with personal value of 12 lowers her  
250 bid from 12 to 0, the project would still be implemented but she would earn more,  
251 namely  $12+2=14$  instead of 6. However, she can do even better by bidding -6. In  
252 this case, she would get all the social benefit (18).<sup>15</sup>

253 This example clearly demonstrates that bidding personal values is weakly dom-  
254 inated and that one should expect strategic underbidding (bid shading), similarly  
255 to what happens in the provision point literature (Bagnoli and Lipman, 1989;  
256 Marks and Croson, 1998; Cadsby and Maynes, 1999) and experimental first-price  
257 auctions (Kagel, 1995). It has to be expected that many participants will under-

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<sup>12</sup> We thank an anonymous reviewer for pointing out this issue.

<sup>13</sup> The same outcome would be achieved if all participants under- or overbid by the same amount; however, this seems rather unlikely, even when personal values are commonly known and quite unimaginable when not.

<sup>14</sup> Exceptional cases are when personal values add up to the costs.

<sup>15</sup> The same logic applies to participants with negative personal values that may try to increase their payoff by posting a negative bid smaller than their personal value, provided of course that the other bids cover the costs and compensate her negative bid.

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stand such underbidding incentives and even more so with more familiarity. Thus, even when first considering bidding personal values as an easy option they later might tend to underbid their personal value. While we expect that, behaviourally, participants will take their personal values as a reference for their bids, we also expect systematic underbidding, especially when personal values are only privately known. According to the anchoring heuristic (Tversky and Kahneman, 1974), participants may underbid by some amount (see also Güth *et al.*, 2011), even though the extent of underbidding can hardly be predicted. In contrast, overbidding should be very unlikely as it is weakly dominated and can even lead to negative payoffs. Rondeau *et al.* (1999) in their review of the provision point literature find that contributions range from 40.2% to 85.0% of the induced values.

In our work, we focus on the effects of the information setting (private versus public) and of different prospects on bidding behaviour. We expect that knowing other participants' values will affect bidding behaviour because participants can calculate the social benefit of each project. This should render implementing the most efficient project more likely. We thus expect more equal underbidding and higher implementation rates of the most efficient projects in the public than in the private information setting (Hypothesis 1). Other-regarding concerns like inequity aversion and welfare enhancement may further promote the emergence of such a pattern. We also expect the size of costs and personal values to influence bidding behaviour and provision.

[Table 1 about here]

Table 1 provides a description of the 5 prospects implemented in our experiment. Prospect 1 is our baseline prospect and the values in prospects from 2 to 5 in Table 1 are obtained as variations of Prospect 1. In Prospects 1 to 4 we keep the social benefit of the most efficient project (with respect to social benefit) constant (namely 54). The aim is to explore how the implementation of projects with the same potential welfare gain (expressed by the social benefit) is affected by different patterns of personal values and costs. In Prospects 2 to 4 we adjust both

287 personal values and costs to test how different patterns of these affect bidding and  
288 implementation. Changing both personal values and costs allows us to explore a  
289 wider range of settings. Its drawback is that we cannot directly disentangle the  
290 effect of variations in costs and personal values by comparing the prospects, but  
291 only do so by using a multivariate regression analysis. In Prospect 5 we explore  
292 the effects on implementation of three projects with relatively high social benefit,  
293 one higher and the other lower than 54.

294 In Prospect 2 we keep the social benefit of all the projects the same as in  
295 Prospect 1 by reducing the costs. Keeping the social benefit the same as in Prospect  
296 1 requires an equivalent change in the sum of personal values. By this manipulation  
297 we want to explore the impact of a cost reduction while keeping the social benefit  
298 unchanged. Experimental evidence has shown that lower implementation thresh-  
299 olds in public goods games, while decreasing contributions, increase the probability  
300 that public goods are implemented (Ledyard, 1995). In our context, the cost of a  
301 project may be interpreted as an implementation threshold. If people focus more  
302 on costs than on social benefits, it may be, in analogy to what happens in thresh-  
303 old public goods games, that projects with lower costs generate lower bids, but  
304 still are more likely to be implemented (Hypothesis 2). Of course, we cannot draw  
305 any conclusion directly from a comparison of the Prospects since more than one  
306 dimension needs to be changed at the same time. For this purpose, one has to refer  
307 to the regression analysis.

308 In Prospect 3, all participants enjoy the same positive personal values but the  
309 social benefit of the projects is the same as in Prospects 1 and 2. Our main aim is to  
310 check for the impact of “equal personal values”. Highly unbalanced personal values  
311 render predictions about others’ behaviour more difficult and bidding behaviour  
312 more variable. When all participants are assigned the same personal value, it  
313 should be easier for them to predict other participants’ behaviour and to coordinate  
314 on bids ensuring project implementation or even equilibrium bids. Relying on  
315 evidence collected in public goods games, we expect higher variance in personal

316 values to negatively affect contributions and, as a consequence, to have a negative  
317 effect on implementation. Thus, Prospect 3 should have the highest contribution  
318 levels and implementation rates (Hypothesis 3).<sup>16</sup>

319 Prospect 4 comprises the largest number of negative personal values. Evidence  
320 about loss aversion and framing (e.g., Kahneman *et al.*, 1991) suggests that nega-  
321 tive personal values should have a stronger impact on bids and on the implemen-  
322 tation than corresponding positive values. Particularly in the private information  
323 setting, negative personal values are expected to lead to higher underbidding (Hy-  
324 pothesis 4a).

325 The seminal work of Schelling (1958) highlighted the importance of focal points  
326 for coordination and efficiency in strategic interactions. In this perspective, be-  
327 haviour in Prospects 4 and 5 allows us to test whether the salience of the most  
328 efficient project affects its likelihood of being implemented. In Prospect 4, the  
329 difference between the social benefit of the most efficient project and the second  
330 most efficient project is much larger than in prospects 1,2 and 3 (45 versus 15). We  
331 expect that the prominence of the most efficient project will improve coordination  
332 on this project (Hypothesis 4b). Further evidence about the importance of salience  
333 for the implementation of the most efficient project may come from Prospect 5.  
334 In this prospect, three projects ( $AB$ ,  $AC$  and  $BC$ ) generate relatively high social  
335 benefits, with project  $BC$  being the most efficient (in terms of social benefit) and  
336  $AB$  being second most efficient, with a social benefit equal to the highest social  
337 benefit in the other prospects. This may endanger the implementation of the most  
338 efficient project because its salience is attenuated by the other efficient projects  
339 (Hypothesis 5).

340 Beyond the effects of costs, heterogeneity in values, negative values, and social  
341 benefit, however, the experiment should be understood as an exploratory study of a  
342 procedurally fair institution. The key objective is to learn about bidding behaviour

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<sup>16</sup> In experimental bargaining games, asymmetries in payoffs often lead to bargaining failures (Kagel *et al.*, 1996; Schmitt, 2004). While in the bargaining literature this failure may be attributed to conflicting fairness norms, this is not the case in our game, where the only salient fair and efficient behaviour is bidding one's personal value, even if it is negative.

343 in the institution and to verify whether applying the proposed mechanism provides  
344 the project that delivers the highest social benefit.

### 345 2.3 Participants and Procedures

346 The experiment was run in Jena (Germany) at the laboratory of the Max Planck  
347 Institute of Economics. Participants were recruited among students of the Friedrich  
348 Schiller University of Jena using the ORSEE system (Greiner, 2004). The com-  
349 puterised experiment was programmed and conducted using the z-Tree software  
350 (Fischbacher, 2007). A total of 57 participants took part in two experimental ses-  
351 sions in which the two information conditions were separately administered: 30  
352 individuals participated in the public information condition and 27 in the private  
353 information condition.

354 Upon their arrival at the laboratory, participants were randomly allocated to  
355 cubicles inhibiting interaction with other participants. Each participant received  
356 written instructions and read them privately. After that, a member of staff read  
357 the instructions aloud and participants were given the opportunity to privately  
358 ask staff members for clarifications. The experiment started only after each par-  
359 ticipant had answered a control questionnaire checking their understanding of the  
360 instructions.

361 Each participant in the experiment was exposed to all prospects and to all  
362 personal values of Table 1 over 15 independent rounds.<sup>17</sup> During the experiment  
363 participants received no feedback (about the project implemented or bids of others  
364 in the group). We thus did not study learning dynamics but only wanted to check  
365 whether more familiarity with the complex setup affects behaviour and outcomes.  
366 At the end of the experiment, one of the 15 rounds was randomly selected for  
367 payment and participants were informed about the project that was implemented  
368 and about their payoff for that project. Payoffs in the experiment were added

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<sup>17</sup> A series of Wilcoxon Rank Sum tests reveals that rounds based on the same prospect can be pooled together.



369 to a €5 show-up fee and payments were privately dispensed in cash at the end  
370 of the experiment. The instructions reminded participants that earnings in the  
371 experiment could be negative. In case of negative earnings, the following procedure  
372 was used: first, the show-up fee was used to cover the losses; second, when losses  
373 exceeded the show-up fee, participants could pay the difference out of pocket  
374 money or take part in a boring task (i.e., computing the frequency of letter “t”  
375 in a text), with the length of the task being proportional to losses not covered by  
376 the show-up fee.

### 377 **3 Results**

#### 378 **3.1 Bids**

379 Figures 1 and 2 show the distribution of bids for each combination of prospects  
380 and projects in the private and public information condition, respectively. The  
381 boxplots in each cell provide the conventional representation of the distributions  
382 of bids for each personal value (identified by a filled circle).

383 [Figure 1 about here]

384 In Figure 1, the median is always below the personal value. This signals a  
385 tendency to underbid one’s own personal value. This tendency seems to be stronger  
386 for higher (absolute) personal values.

387 [Figure 2 about here]

388 Comparing Figures 2 and 1, introducing common knowledge of personal values  
389 does not heavily affect bidding behaviour. The same pattern of choices emerging  
390 for the private information condition is observed also for the public information  
391 condition (Wilcoxon Rank Sum tests, all p-values  $\geq 0.429$ ).<sup>18</sup> This provides evi-  
392 dence against Hypothesis 1.

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<sup>18</sup> To warrant independence of observations, the tests are performed employing average values at the individual level.

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### 3.2 Bids and Personal Values

Figure 3 focuses on relative deviations between bids and personal values. Specifically, a measure of relative deviation for each project ( $R_i$ ) is computed by taking the ratio of the difference between the bid for a given project  $b_i$  and the personal value for that project  $v_i$  and the absolute value of the personal value ( $R_i = \frac{b_i - v_i}{|v_i|}$ ). Figure 3 portrays the distribution of the individual-level average  $R_i$ , in the five distinct prospects of the private information and public information condition.

[Figure 3 about here]

Figure 3 confirms the prevalence of underbidding in participants' behaviour. The distributions of relative deviations are generally located under the threshold (dashed line) separating overbidding from underbidding, both in the public and private information conditions. When comparing the two information conditions, no major differences are observed. The average relative deviations in the two conditions are very similar (continuous line) and no significant differences are observed when comparing the two conditions prospect by prospect (Wilcoxon Rank Sum tests, all p-values  $\geq 0.243$ ).

A series of Wilcoxon Signed Rank tests highlights some significant differences in relative deviations across distinct prospects. In the private information condition, underbidding is stronger for Prospect 2 than for all other prospects (all p-values  $< 0.05$ ). In the public information condition, stronger underbidding is observed for Prospect 2 than for all other prospects (all p-values  $< 0.05$ ), but Prospect 1 (p-value=0.171). In line with Hypothesis 2, lower costs seem to deplete bids. As noted in 2.2, the results are indicative more than conclusive with regard to our hypotheses, as more than one dimension has changed.

### 3.3 Implemented Projects

The tendency of participants to post bids that are lower than their personal values negatively affects the creation of surplus and endangers the implementation of

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420 projects. Figure 4 provides a comparison between the average surplus and the  
421 social benefit of each project in the two information conditions.

422 [Figure 4 about here]

423 Figure 4 shows how the strong underbidding observed in the experiment nega-  
424 tively affects the creation of a positive surplus, even for projects delivering positive  
425 social benefits. In terms of surplus creation, no major differences are observed be-  
426 tween the public and private information conditions. To complement the analysis  
427 of surplus creation, Table 2 reports on the frequency of implementation of each  
428 project. The frequencies in the table are computed taking into account all possible  
429 combinations of bids collected for that project in each round, irrespectively of the  
430 group to which participants belonged.<sup>19</sup>

431 [Table 2 about here]

432 Table 2 shows that the project delivering the highest social benefit is the most  
433 frequently implemented project, both in the public and private information con-  
434 dition. The highest frequency of implementation for the socially most desirable  
435 projects is registered in Prospect 3, for both information conditions (evidence in  
436 support of Hypothesis 3). In contrast, the lowest frequency of implementation for  
437 these projects is registered in Prospect 2 and in Prospect 5 for the private and  
438 public information condition, respectively. The latter points in the direction of  
439 Hypothesis 5, while the implementation problems registered in Prospect 2 conflict  
440 with our Hypothesis 2. The highest rate of failure is registered in Prospect 4 for  
441 both information conditions, probably due to the high number of projects with  
442 negative value in this prospect (see Hypothesis 4a).

443 When comparing the frequency of implementation of the most efficient project  
444 across information conditions, no significant differences emerge (Wilcoxon Rank

---

<sup>19</sup> Given that participants did not receive any feedback during the experiment, groups do not affect choices over the course of the experiment. Consequently, a better measure of project implementation is obtained by taking into account all possible combinations of bids for a given project in a given round and not only the bids in each group of three participants. This implies that, in each round and for each project,  $10^3$  and  $9^3$  triplets of bids are obtained in the public and private information conditions, respectively.

445 Sum tests, all p-values  $> 0.255$ ).<sup>20</sup> Similarly, no significant differences are ob-  
446 served when comparing failure frequencies for all projects across the two con-  
447 ditions (Wilcoxon Rank Sum tests, all p-values  $> 0.289$ ). These results provide  
448 strong evidence against Hypothesis 1.

449 The comparison of implementation frequencies of the most efficient project  
450 across prospects highlights some significant differences. In the public information  
451 condition, we register highly significant differences when comparing Prospect 2 to  
452 Prospects 3 and 4 (Wilcoxon Signed Rank test, p-values equal to 0.021 and 0.031,  
453 respectively). These results support our Hypotheses 3 and 4b.

454 Weakly significant differences are registered when comparing Prospect 3 to  
455 Prospect 1 and Prospect 5 (Wilcoxon Signed Rank test, p-values equal to 0.065  
456 and 0.051, respectively). In the private information condition, we register a weakly  
457 significant difference when comparing Prospect 4 to Prospect 3 (Wilcoxon Signed  
458 Rank test, p-value equal to 0.072). These results support Hypotheses 3 and 5.

### 459 3.4 Regression Analysis

460 The descriptive analysis reported above underlines some patterns of behaviour  
461 with respect to bidding and project implementation. In this section, a regres-  
462 sion analysis investigates the determinants of bidding behaviour, with particular  
463 attention paid to deviations from personal values. A better understanding of bid-  
464 ding behaviour provides us with insights about the source of surplus creation and  
465 project implementation.

466 Table 3 presents the results of a regression analysis based on a linear mixed-  
467 effects model with random effects to control for repeated observations at the in-  
468 dividual level. The dependent variable in the model is the relative deviation of  
469 bids ( $b_i$ ) from personal values ( $v_i$ ) expressed in percentage terms. A positive sign

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<sup>20</sup> To warrant independence of observations, we computed the frequency of implementation of the socially most desirable projects at the group level for both information conditions. The difference in the central tendencies of the distributions thus computed was then tested with the support of a non parametric test. The same procedure was followed for the other tests reported in this section.

470 for the dependent variable identifies overbidding, while a negative sign identifies  
 471 underbidding.<sup>21</sup> The dependent variable is regressed on the following explanatory  
 472 variables: *Personal.value* is the personal value assigned to a subject for the project;  
 473 *Project.cost* is the cost of the project; *Personal.values.SD* is the standard devia-  
 474 tion of personal values for the project considered; *Personal.value.NEG* is equal to  
 475 1 if the personal value is negative, and is equal to 0 otherwise; *Soc.benefit* is the  
 476 social benefit and measures the efficiency of the project; *Public.info* is equal to 1  
 477 for the public information setting, and it is equal to 0 for the private information  
 478 setting; *Round*, indicates in which of the 15 rounds choices were made. In addition  
 479 to main effects, some interactions between explanatory factors are considered in  
 480 the regression, with particular attention paid to the impact of public information.  
 481 Finally, *Prospect #* provides us with a control on the prospect in which bids were  
 482 collected.

483 [Table 3 about here]

484 The regression output reported in Table 3 confirms the overall tendency to  
 485 underbid, as can be seen from the negative and highly significant intercept co-  
 486 efficient. Furthermore, as shown by the coefficient of *Personal.value.NEG*, more  
 487 aggressive underbidding is registered among those with negative personal values  
 488 (in support of Hypothesis 4a). When personal values fall in the positive domain,  
 489 an increase in personal values reduces relative underbidding (*Personal.value*). By  
 490 contrast, higher negative personal values trigger stronger relative underbidding  
 491 (*Pers.value* × *Pers.val.NEG*). Both higher costs for the project (*Project.cost*) and  
 492 higher variance in personal values (*Personal.values.SD*) foster relative underbid-  
 493 ding (evidence in support of Hypothesis 2 and Hypothesis 3, respectively).

494 Concerning the impact of information, common knowledge of others' values has  
 495 a significant impact on bidding behaviour via awareness of the variance in personal  
 496 values (*Pers.val.SD* × *Public.info*), but not via awareness of the social benefits gen-

<sup>21</sup> The dependent variable  $Rel.dev_i = \frac{b_i - v_i}{|v_i|} \times 100$  cannot be computed for those having a personal value equal to zero. Accordingly, the regression analysis is conducted on 5757 observations out of the 5985 available.

497 erated by the projects (*Soc.benefit*×*Public.info*) (evidence against Hypothesis 1).  
498 When compared to the baseline condition provided by Prospect 1, two prospects  
499 have a significant impact on relative deviations: Prospect 2 strongly promotes un-  
500 derbidding, while Prospect 3 mitigates deviations from personal values, even if  
501 only marginally significant.

#### 502 **4 Discussion and Conclusions**

503 Based on three requirements for an ethically desirable mechanism to regulate pub-  
504 lic provision, we have derived a common game format. One could claim—using  
505 jargon of social psychology—that this game format is procedurally fair. As for  
506 procedurally fair sports contests, this could crowd-in material opportunism in the  
507 sense that the parties involved are mainly motivated by their own material, here  
508 monetary, incentives.

509 Although bidding personal values would seem an obvious simple heuristic that  
510 would lead to fair and efficient outcomes, this is hardly ever observed. Rather,  
511 nearly all participants understood the incentives for strategic underbidding and  
512 yielded to them.

513 Our experimental setting allows us to identify a few project characteristics  
514 affecting underbidding and, as a consequence, creation of surplus. In particular,  
515 underbidding seems to be weaker for positive than for negative personal values.  
516 Moreover, higher positive personal values induce less relative underbidding, while  
517 the opposite holds for negative values.

518 With respect to the impact of information, we observe common knowledge of  
519 others' values to induce more underbidding for a given level of dispersion in per-  
520 sonal values. In terms of surplus creation, there are no striking differences when  
521 comparing the private and public information treatments: for both, the most ef-  
522 ficient project is most frequently implemented, with rates comparable to those  
523 reported by Güth *et al.* (2011). Outcome-based social preferences should affect  
524 behaviour in the public information condition only. The overall consistency of

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behaviour and outcomes across information treatments suggests that in our complex and thereby more realistic setting, social preferences of this kind do not play a relevant role and are, possibly, crowded-out by the procedural fairness of the mechanism. However, further research is needed to understand how the two concepts of fairness interact and when they matter.

When assessing behaviour across prospects, a few patterns emerge. First, Prospect 3, characterised by homogeneous positive personal values, is the prospect most frequently resulting in the most efficient project. Second, in Prospect 5 there is a competing project which is similar in terms of social benefits to the most efficient project. This seems to negatively affect implementation of the most efficient project, in line with the hypothesis of a positive impact of saliency on implementation. Third, Prospect 2 provides a larger underbidding margin before endangering implementation of efficient projects.<sup>22</sup> Accordingly, participants underbid more, on average, in this prospect than in others. For this prospect, the general tendency to underbid less, in relative terms, for lower project costs is countervailed by strategic considerations triggered by underbidding margin.

Altogether, heterogeneity in personal values and negative values seem to endanger implementation of efficient projects. Knowing the value of others does not seem to matter much as one mainly conditions on her own value when bidding. With heterogeneous personal values, projects with very high social benefits are less endangered by underbidding than projects with positive, but smaller, social benefits.

Some inefficiency due to the difficulties to coordinate underbidding had to be expected since the mechanism, as characterised by the three requirements, is not incentive-compatible. Nevertheless, large social benefits serve as a safeguard, allowing provision even in case of underbidding. Altogether, our experiment reveals some surprising practical functionality of the proposed mechanism which guaran-

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<sup>22</sup> As a measure of underbidding margin, we compute the relative underbid which, when jointly implemented, generates nil surplus. In Prospect 2, the average underbidding margin across projects is equal to 0.339, while for other prospect the same measure is always smaller than 0.250.

552 tees citizen sovereignty in public provision, similar to what happens for private  
553 goods, and generally warrants the implementation of the most efficient projects.



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**References**

- 554 **References**
- 555 Andreoni, J. (1995). Warm-glow versus cold-prickle: The effects of positive and  
556 negative framing on cooperation in experiments. *Quarterly Journal of Eco-*  
557 *nomics*, **110**(1), 1–21.
- 558 Andreoni, J. and Miller, J. (2002). Giving according to GARP: an experimental  
559 test of the consistency of preferences for altruism. *Econometrica*, **70**:737–753.
- 560 Bagnoli, M. and McKee, M. (1991). Voluntary contribution games: Efficient private  
561 provision of public goods. *Economic Inquiry*, **29**(2), 351–366.
- 562 Bagnoli, M. and Lipman, B. (1989). Provision of public goods: Fully implementing  
563 the core through private contributions. *Review of Economic Studies*, **56**, 583–  
564 601.
- 565 Bergstrom, T., Blume, L., and Varian, H. (1986). On the private provision of  
566 public goods. *Journal of Public Economics*, **29**(1), 25–49.
- 567 Bolton, G. E. and Ockenfels, A. (2000). Erc: A theory of equity, reciprocity, and  
568 competition. *The American Economic Review*, **90**(1):pp. 166–193.
- 569 Cadsby, C. and Maynes, E. (1999). Voluntary provision of threshold public goods  
570 with continuous contributions: experimental evidence. *Journal of Public Eco-*  
571 *nomics*, **71**, 53–73.
- 572 Charness, G. and Rabin, M. (2002). Understanding social preferences with simple  
573 tests. *The Quarterly Journal of Economics*, **117**(3):817–869.
- 574 Fehr, E. and Schmidt, K. M. (1999). A theory of fairness, competition and coop-  
575 eration. *The Quarterly Journal of Economics*, **114**(3):817–868.
- 576 Fischbacher, U. (2007). z-Tree: Zurich Toolbox for Ready-made Economic Exper-  
577 iments. *Experimental Economics*, **10**(2), 171–178.
- 578 Frey, B. S. and Oberholzer-Gee, F. (1997). The cost of price incentives: An empir-  
579 ical analysis of motivation crowding-out. *American Economic Review*, **87**(4),  
580 746–755.
- 581 Gigerenzer, G. and Todd, P. M. (2000). *Simple heuristics that make us smart*.  
582 Oxford University Press, USA.

- 
- 583 Greiner, B. (2004). An Online Recruitment System for Economic Experiments. In  
584 K. Kremer and V. Macho, editors, *Forschung und wissenschaftliches Rechnen*  
585 *2003*. GWDG Bericht 63, Göttingen : Ges. für Wiss. Datenverarbeitung.
- 586 Güth, W. (1986). Auctions, public tenders, and fair division games: An axiomatic  
587 approach. *Mathematical Social Sciences*, **11**(3), 282–294.
- 588 Güth, W. (2011). Rules (of bidding) to generate equal stated profits: An axiomatic  
589 approach. *Journal of Institutional and Theoretical Economics*, **167**(4), 608–612.
- 590 Güth, W., Koukoulis, A., and Levati, M. V. (2011). “One man’s meat is another  
591 man’s poison.” An experimental study of voluntarily providing public projects  
592 that raise mixed feelings. Jena Economic Research Papers # 2011–034.
- 593 Güth, W. and Kliemt, H. (2013). Consumer sovereignty goes collective: ethi-  
594 cal basis, axiomatic characterization and experimental evidence. In M. Held,  
595 G. Kubon-Gilke, and R. Sturn, editors, *Jahrbuch Normative und Institutionelle*  
596 *Grundfragen der Ökonomik. Band 12. Grenzen der Konsumentensouveränität*.  
597 Metropolis.
- 598 Harsanyi, J. C. (1967). Games with incomplete information played by bayesian  
599 players. *Management Science*, 14(3):159–182.
- 600 Kagel, J. H. (1995). Auctions: A survey of experimental research. In J. H. Kagel  
601 and A. E. Roth, editors, *The Handbook of Experimental Economics*, chapter 7.  
602 Princeton University Press.
- 603 Kagel, J. H., Kim, C., and Moser, D. (1996). Fairness in ultimatum games with  
604 asymmetric information and asymmetric payoffs. *Games and Economic Behav-*  
605 *ior*, **13**, 100–110.
- 606 Kahneman, D., Knetsch, J. L., and Thaler, R. H. (1991). Anomalies: The en-  
607 dowment effect, loss aversion, and status quo bias. *The Journal of Economic*  
608 *Perspectives*, **5**(1), pp. 193–206.
- 609 Kunreuther, H. and Portney, P. (1991). Wheel of misfortune: A lottery/auction  
610 mechanism for siting of noxious facilities. *Journal of Energy Engineering*,  
611 **117**(3), 125–132.

- 
- 612 Ledyard, J. O. (1995). Public goods: A survey of experimental research. In J. H.  
613 Kagel and A. E. Roth, editors, *The Handbook of Experimental Economics*, chap-  
614 ter 4. Princeton University Press.
- 615 Marks, M. and Croson, R. (1998). Alternative rebate rules in the provision of a  
616 threshold public good: An experimental investigation. *Journal of Public Eco-*  
617 *nomics*, **67**, 195–220.
- 618 Rapoport, A. and Chamah, A. M. (1965). *Prisoner's Dilemma. A study in*  
619 *conflict and cooperation*. Ann Arbor, The university of Michigan Press.
- 620 Rondeau, D., Schulze, W. D., and Poe, G. L. (1999). Voluntary revelation of the  
621 demand for public goods using a provision point mechanism. *Journal of Public*  
622 *Economics*, **72**(3), 455–470.
- 623 Schelling, T. C. (1958). The strategy of conflict prospectus for a reorientation of  
624 game theory. *The Journal of Conflict Resolution*, 2(3):203–264.
- 625 Schmitt, P. (2004). On perceptions of fairness: The role of valuations, outside  
626 options, and information in ultimatum bargaining games. *Experimental Eco-*  
627 *nomics*, **7**, 49–73.
- 628 Sonnemans, J., Schram, A., and Offerman, T. (1998). Public good provision and  
629 public bad prevention: The effect of framing. *Journal of Economic Behavior &*  
630 *Organization*, **34**(1), 143–161.
- 631 Tversky, A. and Kahneman, D. (1974). Judgment under uncertainty: Heuristics  
632 and biases. *Science*, **185**, 1124–1130.

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## 633 5 Instructions (Translated)

634 Welcome to this experiment! You will receive €5.00 for showing-up on time.

635 We kindly ask you to read the instructions carefully. Communication with other  
636 participants is not permitted during the experiment. If you have doubts or if you  
637 want to ask a question, please raise your hand. An experimenter will come and  
638 answer your question. Please switch off your mobile phones. If you do not comply  
639 with these rules, we will have to exclude you from the experiment and you will  
640 not get any payment.

641 How much you are going to earn will depend upon your decisions and also  
642 upon decisions of other participants. Both your choices and choices of the others  
643 will remain anonymous and will never be associated to your name.

644 During the experiment, all monetary amounts are expressed in ECU (experi-  
645 mental currency units) and not in Euro. At the end of the experiment 1 ECU will  
646 be exchanged with 1 Euro.

647 In the experiment you are matched with two more participants whose identity  
648 will not be revealed. The three participants in a group are called Participant 1,  
649 Participant 2, and Participant 3. You will be told whether you are Participant 1,  
650 Participant 2 or Participant 3 in the upper right-hand corner of the screen.

651 The experiment extends over 15 rounds. At the end of the experiment, only  
652 one of the 15 rounds is randomly drawn to compute your actual earnings in the  
653 experiment.

654 The interaction in each round

655 In each of the 15 rounds, 7 projects with their corresponding costs and personal  
656 values are going to be displayed on your screen. The structure of the screen is  
657 the same in each round, but the costs and personal values associated with the  
658 different projects may vary in each round. Of the seven projects three are single  
659 projects and four are combinations of single projects. For each project you are  
660 given information about the cost associated with its implementation and about  
661 your personal evaluation of the project. The evaluation of the project is a positive  
662 number if you gain from its implementation and a negative number if you suffer  
663 a loss from its implementation. This number is called personal value ( $V_i$ ). [*Public*  
664 *Information only*] You are also informed about the personal values of the other  
665 two participants in your group. Based on the information you are given, you are  
666 requested to submit a bid ( $b_i$ ) for each project. Your bids and the bids of the two  
667 other participants in your group determine your payoff. Bids can be expressed only  
668 as integer values, either positive or negative (for example: ..., -1, 0, 1, ...).

669 Payoffs

670 The surplus of each project is defined as the difference between the sum of the bids  
671 for that project by the three participants in a group ( $b_1 + b_2 + b_3$ ) and the cost of  
672 that project ( $c$ ). Thus, the surplus is given by the formula  $S = (b_1 + b_2 + b_3) - c$ .  
673 The project with the highest non-negative surplus is implemented. If the highest  
674 surplus is negative, no project is implemented and your payoff will be 0 ECU.

675 When a project is implemented, the earnings of a participant are determined  
676 as follows:

- 677 – You receive your value ( $V_i$ ) for the chosen project plus one third of the surplus
- 678 of the chosen project ( $S/3$ )
- 679 – From this we subtract your bid for the chosen project
- 680 – Therefore you earn in total:  $V_i + S/3 - b_i$

681 The following is an example of the kind of computer screen you will see during  
682 the experiment:

Project	Cost	Personal value (participant 1)	Personal value (participant 2)	Personal value (participant 3)	My bid
A	15	-12			<input type="text"/>
B	5	13			<input type="text"/>
C	7	-9			<input type="text"/>
A,B	19	3			<input type="text"/>
A,C	23	-18			<input type="text"/>
B,C	13	5			<input type="text"/>
A,B,C	25	-7			<input type="text"/>

683

684 *In the Public Information condition the values of the other participants are dis-*  
685 *played on the screen.*

686 Suppose you are Participant 1 and consider your choice for project A. If the  
687 project were implemented, it would cost 15 ECU. You have a negative personal  
688 value for the project (-12). If the project were implemented, you would suffer a  
689 damage of 12 ECU. You must bid for the project. The amount you bid is relevant  
690 for the implementation of the project and for the amount you will have to pay  
691 or you will receive if the project is implemented. Suppose that the overall surplus  
692 of this project amounts to 30 ECU and that this is the highest surplus. This  
693 means that Project A is implemented. Each participant gets an equal share of the  
694 surplus thus, each member of the group receives 10 ECU. If you bid -14 ECU for  
695 the project, your payoff is calculated as follows:  $-12 + 10 - (-14) = 12$ . It is made  
696 up of the following elements: in your role as Participant 1, you will suffer a damage  
697 of  $V_1 = -12$  ECU from project A, your share of the surplus is 10 ECU and you  
698 have bid -14 ECU. Since 1 ECU equals 1 Euro, you would earn 12 Euro.

699 As a second example, suppose that Project B had the highest surplus and is,  
700 thus, implemented. Assume, furthermore, that the overall surplus of the project

701 is 6 ECU. If your bid was 13 ECU, your payoff will be  $13+2-13=2$  ECU. You will  
702 have to bid for all seven projects in the column “My bid”.

703 It can be the case that the payoff for one or more participants is negative.  
704 However, this can only occur if the participant submits a bid that is higher than  
705 his personal value, that is  $b_i > V_i$  (for instance, when the personal value  $V_i$  for the  
706 project is 17 and the bid  $b_i$  is larger than 17 or when the personal value  $V_i$  for the  
707 project is -10 and the bid  $b_i$  is larger than -10). If you submit a bid equal to your  
708 personal value or lower, you cannot get a negative payoff. If you, nevertheless, get  
709 a negative payoff, this will be dealt with in the following way:

- 710 – first, the amount you lose will be deducted from the 5 Euro that you receive  
711 for showing-up on time
- 712 – if your negative payoff exceeds 5 Euro, there are two alternatives. The first is  
713 that you pay the difference out of your own pocket. The second is that you  
714 carry out an additional task before you leave the laboratory to make up for  
715 the remaining difference. This additional task consists of looking for a specified  
716 letter in a longer text and counting the number of times it occurs. You will get  
717 1.00 Euro for each sentence that you process correctly. Please note that the  
718 task is for settlement of potential negative payoffs only. Under no circumstance  
719 is it possible to carry out the task to increase a positive payoff.

#### 720 Final payment

721 At the end of the experiment, one of the 15 rounds is randomly drawn for payment.

722 You are going to be informed about:

- 723 1. the project which was implemented in that round (if any);
- 724 2. the surplus of the project;
- 725 3. your own bid;
- 726 4. your personal value;
- 727 5. and your payoff.

728 This information will only be displayed for the round that was randomly drawn.  
729 You will not be given any information on the bids of the other members of your  
730 group or on whether any project was implemented in the other rounds.

731 The payoff in the randomly drawn round is converted in Euro (for example,  
732 15 ECU are 15 Euro). Your earnings will be privately paid in in cash, so that no  
733 other participant will know the size of your pay-out.

**Table 1** Prospects

Project	$C(S)$	$v_1(S)$	$v_2(S)$	$v_3(S)$	$SB(S)$
Prospect 1					
A	30.00	30.00	-30.00	45.00	15.00
B	60.00	0.00	24.00	45.00	9.00
C	36.00	6.00	18.00	18.00	6.00
AB	90.00	30.00	-6.00	105.00	39.00
AC	45.00	36.00	-12.00	75.00	54.00
BC	96.00	6.00	42.00	63.00	15.00
ABC	135.00	36.00	12.00	75.00	-12.00
Prospect 2					
A	15.00	27.00	18.00	-15.00	15.00
B	30.00	27.00	0.00	12.00	9.00
C	18.00	9.00	6.00	9.00	6.00
AB	45.00	-6.00	30.00	60.00	39.00
AC	24.00	60.00	-12.00	30.00	54.00
BC	48.00	33.00	3.00	27.00	15.00
ABC	69.00	33.00	18.00	6.00	-12.00
Prospect 3					
A	30.00	15.00	15.00	15.00	15.00
B	63.00	24.00	24.00	24.00	9.00
C	48.00	18.00	18.00	18.00	6.00
AB	105.00	48.00	48.00	48.00	39.00
AC	45.00	33.00	33.00	33.00	54.00
BC	93.00	36.00	36.00	36.00	15.00
ABC	138.00	42.00	42.00	42.00	-12.00
Prospect 4					
A	30.00	-24.00	-30.00	-6.00	-90.00
B	60.00	0.00	24.00	45.00	9.00
C	36.00	6.00	18.00	18.00	6.00
AB	90.00	-24.00	-6.00	36.00	-84.00
AC	45.00	-18.00	-12.00	12.00	-63.00
BC	96.00	18.00	60.00	72.00	54.00
ABC	135.00	-9.00	33.00	75.00	-36.00
Prospect 5					
A	30.00	78.00	-30.00	-12.00	6.00
B	60.00	0.00	24.00	45.00	9.00
C	36.00	-6.00	18.00	18.00	-6.00
AB	63.00	30.00	-18.00	105.00	54.00
AC	45.00	6.00	-24.00	105.00	42.00
BC	57.00	15.00	42.00	60.00	60.00
ABC	141.00	72.00	12.00	51.00	-6.00

Notes: The table shows the five different prospects, each one including seven projects, from A to ABC, among which one might be chosen for implementation. For each project,  $C(S)$  represents the cost associated to its implementation, while  $v_1(S)$ ,  $v_2(S)$ , and  $v_3(S)$  are the personal values of participant 1, 2, and 3 for a given project, respectively.  $SB(S)$  is the social benefit, namely the sum of personal values of participants 1, 2, and 3 minus the cost.

**Table 2** Frequency of Project Implementation

%	Prospect 1		Prospect 2		Prospect 3		Prospect 4		Prospect 5	
	Publ	Priv	Publ	Priv	Publ	Priv	Publ	Priv	Publ	Priv
None	19.9	21.9	10.0	8.2	17.5	11.7	27.0	36.3	9.2	10.7
A	1.8	2.2	4.3	3.5	1.7	0.1	0.0	0.0	2.4	2.0
B	0.6	0.3	0.5	0.3	0.0	0.0	1.6	2.1	0.1	0.0
C	0.0	0.1	1.2	0.0	0.0	0.0	2.1	0.1	0.0	0.0
AB	12.5	9.6	23.4	28.6	1.5	0.3	0.0	0.0	29.3	18.8
AC	<b>62.7</b>	<b>65.9</b>	<b>59.4</b>	<b>59.3</b>	<b>79.2</b>	<b>87.8</b>	0.0	0.0	2.7	4.9
BC	2.5	0.0	1.2	0.1	0.0	0.0	<b>69.3</b>	<b>61.5</b>	<b>56.3</b>	<b>63.5</b>
ABC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Notes: The table reports the frequencies of implementation for each project in all five prospects.

The private and the public information treatments are kept separate in the table.

A bold font identifies the project with the highest social benefits for a given prospect.



**Table 3** Determinants of relative deviations (linear mixed-effects model)

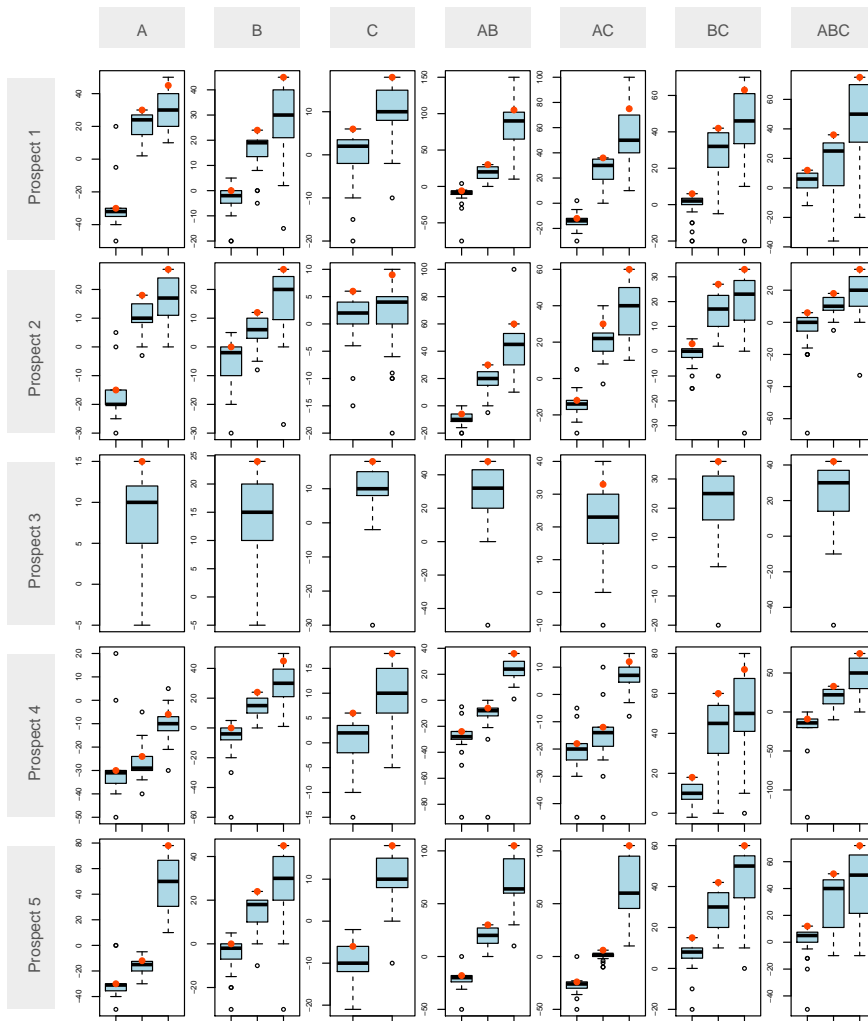
<i>Rel.dev</i> ~	Coef (Std. Err.)
(Intercept)	-55.379 (7.695)***
<i>Personal.value</i>	0.743 (0.056)***
<i>Project.cost</i>	-0.205 (0.033)***
<i>Personal.values.SD</i>	-0.210 (0.107)*
<i>Personal.value.NEG</i>	-15.297 (5.417)**
<i>Soc.benefit</i>	0.102 (0.048)*
<i>Public.info</i>	6.819 (9.282)
<i>Round</i>	-0.154 (0.239)
<i>Pers.value</i> × <i>Pers.val.NEG</i>	-3.932 (0.276)***
<i>Pers.val.SD</i> × <i>Public.info</i>	-0.300 (0.103)**
<i>Soc.benefit</i> × <i>Public.info</i>	-0.051 (0.055)
<i>Prospect 2</i>	-9.477 (3.398)**
<i>Prospect 3</i>	7.156 (4.224) <sup>o</sup>
<i>Prospect 4</i>	5.653 (3.578)
<i>Prospect 5</i>	-0.562 (3.303)
Num. Obs.	5757 (Subj=57)
Wald $\chi^2$ (p-value)	< 0.001

Notes: The dependent variable is the relative deviation of bids from personal values expressed in percentage terms; *Personal.value* captures the personal value assigned to a subject for the project; *Project.cost* captures the cost of the project; *Personal.values.SD* is the standard deviation of personal values for the project considered; *Personal.value.NEG* is equal to 1 if the personal value is negative, and to 0 otherwise; *Soc.benefit* captures social benefits of the project; *Public.info* is equal to 1 for the public information setting, and to 0 for the private information setting; *Round*, indicates in which of the 15 rounds choices were made. Three interaction terms between explanatory factors are then added in the regression and *Prospect #* denotes the prospect in which bids were collected.

Significance levels: \*\*\* 0.001; \*\* 0.01; \* 0.05; <sup>o</sup> 0.1

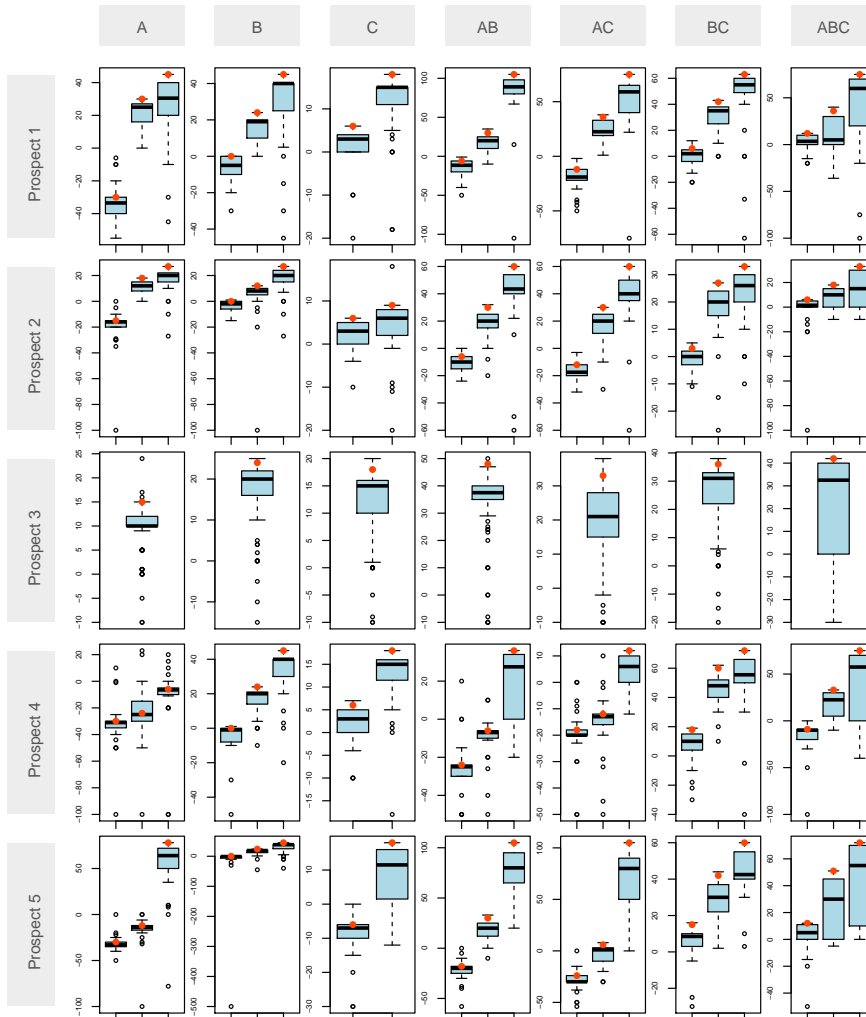


Fig. 1 Bids (Private Information)



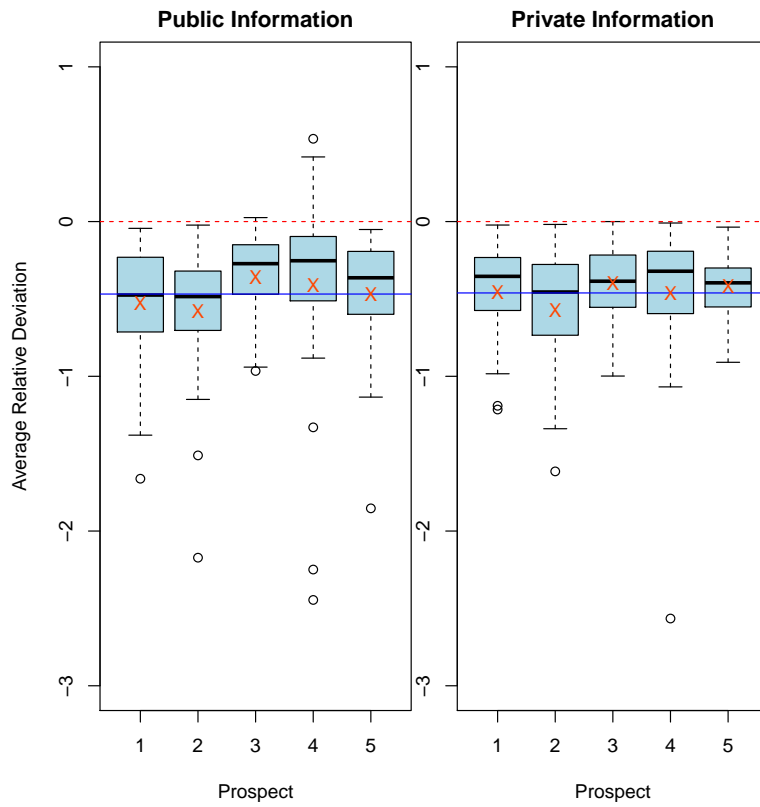
Notes: The figure reports the boxplots of the distributions of bids. Each cell corresponds to a project (from A to ABC) of a specific prospect (from 1 to 5). The three boxplots portray the distributions of bids for each individual personal value, with the first plot from left referring to  $v_1(S)$  and the last plot from left to  $v_3(S)$ . The filled circle in each boxplot represent the personal value. Values refer to the private information treatment.

Fig. 2 Bids (Public Information)



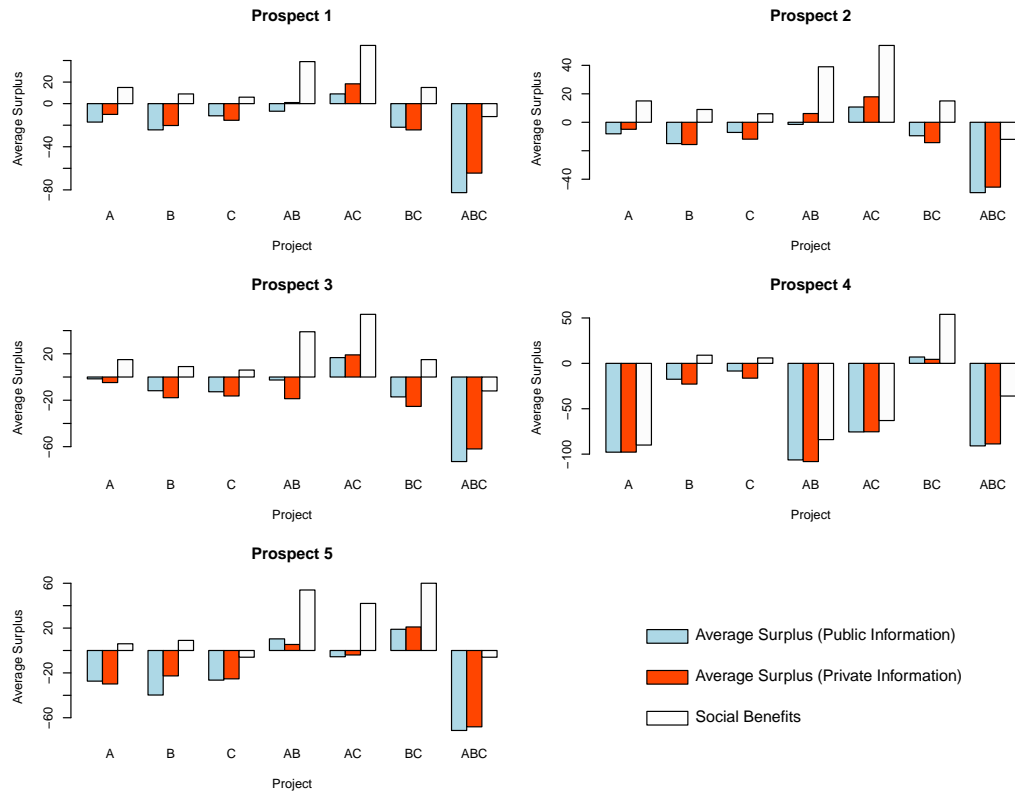
Notes: The figure reports the boxplots of the distributions of bids. Each cell corresponds to a project (from A to ABC) of a specific prospect (from 1 to 5). The three boxplots portray the distributions of bids for each individual personal value, with the first plot from left referring to  $v_1(S)$  and the last plot from left to  $v_3(S)$ . The filled circle in each boxplot represent the personal value. The values refer to the public information treatment.

Fig. 3 Relative Deviations



Notes: The figure shows the distribution of the individual-level average relative deviation of the bid from the personal value:  $R_i = \frac{b_i - v_i}{|v_i|}$ . The dashed horizontal line separates the overbidding area (above the line) from the underbidding area (below the line).

Fig. 4 Surplus



Notes: The figure reports the surplus (sum of the bids minus the cost for the project) and the social benefit (sum of the personal values minus the cost) for all projects within a prospect.