Working Papers in Economics & Finance
2020-10

Experimental effects of institutionalizing co-determination by a procedurally fair bidding rule

Federica Alberti, University of Portsmouth

Werner Güth, LUISS and Max Planck Institute for Research on Collective Goods

Kei Tsutsui, University of Bath

Portsmouth Business School
https://www.port.ac.uk/about-us/structure-and-governance/organisational-structure/our-academic-structure/faculty-of-business-and-law/portsmouth-business-school

Experimental effects of institutionalizing co-determination by a procedurally fair bidding rule

Federica Alberti[1], Werner Güth[2,3], and Kei Tsutsui*[1,4]

[1]University of Portsmouth

[2]LUISS

[3]Max Planck Institute for Research on Collective Goods

[4]University of Bath

May 26, 2020

Abstract

We experimentally investigate corporate governance of a co-determined firm. The experimental setup confronts the firm's manager with three employees as stakeholders. There are two investment opportunities, each of which could affect the stakeholders either positively or negatively. First, the manager states his or her demand of the total value of each investment. Then the three stakeholders, knowing the manager's demands, state their claims via bidding. The bidding rule is procedurally fair by treating all three stakeholders equally as long as stakeholders truthfully state their own values, but offers underbidding incentives. We find that most stakeholder-participants do underbid. The total bids are not significantly different from the managers' claims. Contrary to game theoretical prediction, manager-participants demand a fair share of the value rather than almost the entire investment value. [126 words]

Keywords: corporate management, co-determination, procedural fairness, laboratory experiments

JEL-Codes: J52, J54, C92

*Corresponding Author: k.tsutsui@bath.ac.uk, +44 (0)1225 386402

We thank Ria Stangneth, Sara Eisermann and Maya Tsutsui for assistance in conducting the experiment. We are grateful to Francesco Guala, Giuseppe Attanasi, and Marie Claire Villeval for their constructive feedback.

Funding: This study was funded by Max Planck Gesellschaft.

Conflict of interest: The authos declare that they have no conflict of interest.

1 Introduction

Studies of co-determination have been centered on the relation between the firm and its employees as stakeholders, treating the latter as a unity. Analyses of the effects of co-determination on redistribution within the firm have placed strong emphasis on how the total revenue or value from an investment is allocated between the management and the stakeholders (Freeman, 1984; Addison et al., 2001; Gorton and Schmid, 2000, 2004; Fauver and Fuerst, 2006; Hübler and Jirjahn, 2003; Jirjahn, 2017), but not on how much of the value is retained by individual stakeholders who are involved in decision-making for the firm.

In many settings, the allocation problem is constrained by individual characteristics of the stakeholders. Think, for example, of a project that generates different value to different employees by adding to human capital in different ways.[1] If the total value is positive, it is efficient to go ahead with the project. Employees make bids in order to accept (or not) the project. Those who would earn more from the project may hide this by underbidding strategically to increase their profits. This, in turn, might discourage others to accept the project. The project will be under-invested, so a quite profitable investment opportunity may fail.

An understudied problem in co-determination is how stakeholders share the burden of financing investments. Back to the example above, the manager claims, on behalf of the shareholders or owners, a share of the total value from the project. For the project to be acceptable, the employees must be willing to collectively forego an amount of the total value that satisfies the claim by the manager. In this respect, an employee's bid for the project can be seen as expressing his or her willingness to comply with the manager. In more general terms, this is similar to splitting the cost of a public good with heterogeneous players (Bagnoli and Lipman, 1989; Bagnoli and McKee, 1991; Croson and Marks, 2001). In the specific context of co-determination, an investment is a public good that generates value for all. By bidding less than his or her individual investment value, a stakeholder makes a claim toward the total investment value. In this respect, the lower the bid the higher the claim, under the assumption that the sum of individual bids is sufficient to cover the manager's claim.

A related issue in co-determination is how stakeholders cooperate in supporting an investment that adversely impacts some of them (while being beneficial for the whole firm). For example, a project that does not add to the skills of an employee might harm him or her. In this case,

[1] We are in the context of an employee's decision to invest (or not) in human capital. In this situation, co-determination is seen as solution to the so-called 'hold-up problem' (see Becht et al., 2003; Chang, 1992; Grossman and Hart, 1986), i.e. employees not investing in human capital for fear of losing the outcome of their investment when the relation with the firm comes to an end. Even in a co-determined firm where employees have power to influence corporate decisions, the management can try to exploit employees by high claims of the total value from an investment (Dilger, 2003).

others, who benefit from the project, might be willing to underbid less to both guarantee satisfying the demand by the manager and compensate employees who would be worse off. In this respect, bids may be seen as monetary valuations of employees for the project, which also capture their willingness to lose when overbidding but also their claims of how much to gain from a project when underbidding strategically. Therefore, ovderbidding can be seen as altruistic for the sake of an investment that generates a positive value in total.

Güth and Kliemt (2011) propose a procedurally fair mechanism that allows both positive and negative evaluations, in which those who gain from a project can subsidise those who lose. The mechanism is relatively simple and works as follows: each individual bids for a project for which s/he has a certain individual value. Individual bids can be interpreted as objective and interpersonally comparable measures of evaluating the project and how much bidders minimally want to gain from it. For the project to be acceptable, all individuals together must bid no less than its cost. The mechanism has the following characteristics:

- It is voluntary as no individual will ever pay more than s/he bids;
- It guarantees equal treatment with respect to bids as all individuals get the same net gain from the project if everyone bids equal to his or her value.
- It is overbidding-proof as overbidding one's value is weakly dominated;

Common truthful bidding would reveal the true surplus of the project's total value minus its cost. The surplus would be equally distributed among the bidders yielding equal net benefits for them. Otherwise, bidders would only share equally the amount by which the total bid exceeds the cost of the project. The mechanism is fair also because it grants veto power to those who are negatively impacted by a project, who can block a project or obtain a compensation from the others by bidding a sufficiently low amount.[2] The cost of a project is exogenously given.

Here we propose a procedurally fair bidding mechanism for co-determination with similar features.[3] Unlike Güth and Kliemt (2011), our co-determination mechanism gives the manager ultimatum power to influence acceptability by claiming a share of the the investment value as first-mover. Specifically, our mechanism implements the following three-stages process for each investment option:

1. the manager decides how much to claim of the total value from the investment;
2. each stakeholder bids, being aware of the manager's claim and of his or her own value from the investment;

[2] In general, procedural fairness can be compared to a legal system where rules are common knowledge and accepted as 'fair' by all parties involved (Carothers, 1998).

[3] See Güth et al. (2011, 2014a); Cicognani et al. (2015); Güth et al. (2014b) for related mechanisms.

3. the manager decides whether (or not) to implement the investment, provided that the sum of bids is no less than his or her claim, in which case the investment is acceptable.[4][5]

We aim to answer two main research questions. The first question is about the manager's demand:

Question 1: Will a manager claim almost the entire value from an investment?

In other words, will the manager exploit his or her first-mover advantage? An opportunistic manager would essentially state a claim just below the total value, leaving the lowest positive amount to the stakeholders, like the proposer in ultimatum bargaining. However, such profit-maximizing strategy would pose a threat to acceptability of an investment for at least two reasons. Firstly, like in ultimatum bargaining (see Camerer, 2003; Güth and Kocher, 2014, for a review of experimental results), a stakeholder may bid a sufficiently low amount in response to a high claim to reject the investment. The procedurally fair bidding mechanism grants each stakeholder veto power. If a stakeholder thinks the manager's claim is unfairly large, s/he can punish the manager by blocking the investment. Secondly, increasing the claim makes it harder for the stakeholders to bid enough to finance the claim. This is an insight from experimental studies on threshold public goods games where an increase in the cost relative to the value of a project would decrease the chance of its successful provision (see Isaac et al., 1989; Croson and Marks, 2000; Rauchdobler et al., 2010).

We also explore the bidding decisions by the stakeholders:

Question 2: Will stakeholders ever bid truthfully, i.e. their individual value for the investment?

Or, will they behave opportunistically by bidding 'just enough' to render an investment acceptable? The stakeholders face a trade-off in our setup. If they prioritize equality among them, the stakeholders should bid truthfully as the procedurally fair bidding mechanism guarantees equal net gains in case of common truthtelling. However, truthful bidding is not an equilibrium strategy (e.g. Güth, 2011). A profit-maximizing stakeholder will underbid until the surplus of the total bid minus the manager's claim becomes nil. Of course, this presupposes awareness of others' bids or knowledge of how others' bids are determined by random values in the spirit of equilibria in games with incomplete information.

We test the implentability of our mechanism in a laboratory experiment.[6] In the experiment, groups of four participants – one manager and three stakeholders – decide about the acceptance of two investments (as alternative to the status quo of 'no investment'). Decisions are made in

[4] In Güth and Kliemt (2011), the mechanism selects the project that is most efficient, i.e. the project with the largest surplus, thus this decision stage is unnecessary.

[5] Procedurally fair corporate governance does not require a manager. A joint venture firm, for example, could be managed purely by its stakeholders via bidding. In our scenario this would simply mean that a manager's claim is zero.

[6] See Plott (1994) for 'testbed' experiments of market institutions.

successive rounds, varying investment evaluations and information conditions. More specifically, we consider three types of investments, in which:

- all gain from all investment options;
- only one loses from all investment options;
- each can lose depending on the investment that is implemented.

This serious heterogeneity in evaluations allows us to assess how stakeholders cope with having to meet the demands by the manager. In general, we expect less cooperation, and hence a lower chance of acceptability, with more heterogeneity and more conflicting interests among stakeholders. Although the procedurally fair mechanism ensures net equal pay via monetary compensations, this holds only if all stakeholders bid truthfully. It is an empirical question whether a stakeholder's underbidding incentive increases when s/he loses from the investment.

The other treatment variable is information about stakeholder's individual investment values, which can be more or less commonly or only privately known. Specifically, we consider three information conditions:

- public information condition: individual values are common knowledge between the manager and all the stakeholders.
- semi-private information condition: individual values are private information of the respective stakeholders. The manager only knows the total values, and
- private information condition: individual values are private information of the respective stakeholders. The manager does not even know the total values.

In the semi-private and private information conditions, a stakeholder does not know the investment values of the other stakeholders. Will the lack of knowledge about others' values make it more difficult for stakeholders to collectively accept an investment? In addition, expecting this difficulty among stakeholders, will the manager claim less, even though s/he knows the total values in the semi-private condition? In the private information condition, the manager does not even know the total values. The latter is a particularly relevant scenario, given that in reality stakeholders may not reveal their private values to the manager to raise their bargaining power. So the manager may have to state a claim without knowing to what the investment yields.[7]

Our results show that, in response to Question 1, the manager claims significantly less than the total value from an investment (only about 29.5% of the total value, on average), suggesting that

[7]There are few experimental studies of ultimatum games with asymmetric information in which the proposer is not informed about the pie size. Güth et al. (2017) report that the uninformed proposer tends to demand less, while Klempt et al. (2019) find the effect is insignificant.

most of the value from an investment goes to stakeholders.[8] Concerning Question 2, stakeholders are found to shade their bids, with the total bid being lower than the total value from an investment. The total bid is not significantly different from the manager's claim, with a project being acceptable in 56.7% of all cases. Even though stakeholders do not truthfully bid, how does the procedurally fair mechanism redistribute the investment value? It is estimated that (only for cases where the manager's claim is met), of every additional unit of individual value, the manager receives 0.253, whereas the individual employee receives 0.465 when the individual value is positive. This is smaller than 0.747, i.e. what the manager leaves, but larger than 0.235 (= 0.747/3), the marginal gain in case of common truthful bidding. When the individual value is negative, the marginal gain for the individual stakeholder is only 0.098 instead of 0.465. In other words, s/he would lose only 0.098 when his or her individual value goes down by 1 unit, as the loss in his or her own value is mostly covered by other stakeholders.

Furthermore, we find the following treatment effects. In terms of varying investment evaluations, a stakeholder with negative value tends to shade even more, that results in a lower probability of satisfying the manager's claim. With asymmetric information, the ratio of manager claim to total value decreases by around 4.3 percentage points. Additionally, stakeholders bid higher to raise their chances of meeting the claim. The lower claim and higher bids increase in the surplus , i.e. total bid minus manager claim. Since the stakeholders receive (and equally share) this surplus, there seems to be an incentive for stakeholders to hide their values.

The reminder of the paper is as follows. Section 2 describes the procedurally fair bidding mechanism for co-determination and its properties: voluntariness, equal benefits to stakeholders, and overbidding proofness. Section 3 is dedicated to the experimental implementation of the mechanism. Section 4 presents the experimental results. Section 5 summarizes and concludes.

2 Co-determination by a procedurally fair bidding rule

We consider a scenario where a manager and three (other) stakeholders choose between two investment alternatives, one safe and one risky, each of which could substitute the status quo of no investment.[9] The procedurally fair bidding mechanism asks the manager to state demands for each investment; then the stakeholders submit monetary bids which essentially are also minimal claims or aspirations when underbidding.[10] The mechanism renders bids and payoffs objectively

[8] This is in line with the results from previous studies (see Gorton and Schmid, 2000, 2004; Fauver and Fuerst, 2006).

[9] Combining the two investments can be interpreted as a third alternative. Here we have considered the simplest case of two alternatives to limit the cognitive burden for the sake of our participants.

[10] Similar to bids in post-price auctions which can be interpreted as aspirations for the case of winning the auction (i.e. what one aspires to gain is the difference between one's value and the bid.

and inter-personally comparable by an internal reward unit to measure the payoffs of the various firm members. Co-determination via bidding allows the three stakeholders to render an investment acceptable or unacceptable. The manager can implement any acceptable investment but is not obliged by acceptance.

In the following we denote by:

- M as the only manager-participant, and
- non-Ms, 1, 2 and 3, as the three (other) stakeholder-participants.

All four members collectively represent a commercial firm which can

- maintain its status quo with 0-payoffs for its M and non-Ms 1, 2 and 3, or engage in
- a safe investment S with stakeholder values v_1^s, v_2^s and v_3^s, or alternatively
- a risky investment R whose stakeholder values are
  - v_1^a, v_2^a and v_3^a in random event A and
  - v_1^b, v_2^b and v_3^b in random event B

with $v_i^{\#} \in \mathbb{R}$ for $\# = s, a, b$ and $i = 1, 2, 3$. By $v_i^{\#} < 0$, we allow that an overall efficient investment S or R may harm one or more stakeholders. We may think of the two random events A as "boom" and B as "doom" since v_i^a-values are, on average, substantially larger than v_i^b-values. Although the mechanism does not require this,[11] we experimentally induce an objective and commonly known probability of at most $p = 1/3$ for event A and at least $1 - p = 2/3$ for event B.

We test the implementability of our mechanism via a laboratory experiment which varies the values of stakeholders 1, 2 and 3 and the information of the parties (within-subjects) from public to private information. Specifically, we consider three information conditions: public (*Pub*), semi-private (*SemiPri*), and private (*Pri*). These are summarized in Table 1.

[Table 1 about here.]

In *Pub*, M and non-M participants know the monetary gains or losses from the safe investment as well as from the two realizations of the risky investment, and their total values. In *SemiPri*, non-M participants are only informed of their own monetary values from the safe investment and the two realizations of the risky investment, while participant M is only informed about the total values for each investment and random state. Finally, *Pri* is like *SemiPri* for non-M participants,

[11] Game theoretically a mechanism defines only a game form and not an informationally closed game (the latter is required by mechanism design based on the revelation principle).

but M no longer knows the total values. We test whether non-M participants are better off by not having revealed their private values to the manager and the other stakeholders.

For each given information condition, the decision process consists of three stages:

Stage 1: M states his or her demands for the safe investment S, denoted by $m^s \in \mathbb{R}$, and for each of possible events A and B in the risky investment R, denoted by m^a and $m^b \in \mathbb{R}$;

Stage 2: Knowing M's demands m^s, m^a, m^b, non-M participants state their bids $\beta_i^s, \beta_i^a, \beta_i^b \in \mathbb{R}$; investments S and R are only acceptable when the sum of the corresponding bids guarantees M's claim respectively, e.g.

- safe investment S is acceptable if $\sum_i^3 \beta_i^s \geq m^s$ and
- risky investment R is acceptable if both hold: $\sum_i^3 \beta_i^a \geq m^a$ *and* $\sum_i^3 \beta_i^b \geq m^b$.

Stage 3: M can implement one accepted investment alternative or not; if not, the status quo is maintained as in case of no acceptable investment.

The implications of these choices are:

- if no investment is acceptable or if M does not realize any acceptable investment, the status quo is maintained which, without loss of generality, is assumed to yield 0-payoffs for all, M and non-Ms participants;
- if safe investment S is acceptable and realized by M, then
  - M earns his or her demand m^s and
  - non-M participant $i = 1, 2, 3$ earns

$$v_i^s - \beta_i^s + \frac{\sum_j^3 \beta_j^s - m^s}{3};$$

- if risky investment R is accepted and realized by M, then payoffs depend on the random move A or B:
  - M earns his or her demand $m^{\#}$ and
  - non-M participant $i = 1, 2, 3$ earns

$$v_i^{\#} - \beta_i^{\#} + \frac{\sum_j^3 \beta_j^{\#} - m^{\#}}{3},$$

where $\#$ is a if the randomly selected event is A, otherwise b.

The minimal claim by non-M participant $i = 1, 2, 3$ as

$$c_i^{\#} = v_i^{\#} - \beta_i^{\#} \quad \text{for} \quad \# = s, a, b.$$

It is minimal since participant i gains at least $c_i^{\#}$ when the investment is realized.

The mechanism has three characteristics:

Characteristic 1: *(Voluntariness)*: since investing requires acceptability one always has $\sum_i^3 \beta_i^{\#} - m^{\#} \geq 0$ for $\# = s, a, b$, that guarantees:

$$\beta_i^{\#} - \frac{\sum_j^3 \beta_j^{\#} - m^{\#}}{3} \leq \beta_i^{\#}$$

i.e. non-M participant i never pays more than his or her bid $\beta_i^{\#}$ for $\# = s, a, b$ and can actually block an investment by bidding 'low enough.'

Characteristic 2: *(Equal net gains with respect to bids* of common truthful bidding): if $v_i^{\#} = \beta_i^{\#}$ for $\# = s, a, b$ and $i = 1, 2, 3$, non-M participants would earn the same, namely

$$v_i^{\#} - \beta_i^{\#} + \frac{\sum_j^3 \beta_j^{\#} - m^{\#}}{3} = \frac{\sum_j^3 v_j^{\#} - m^{\#}}{3}$$

when investment S or R is realized, respectively 0 when the status quo is maintained.

The procedurally fair mechanism disregards the values (normally private information) that employees attach to investments and treats employees equally according to their objective and interpersonally comparable bids.

Characteristic 3: *(Overbidding proofness)*: Any bidding strategy with bid $\beta_i^{\#}$ exceeding i's value for $\# = s, a$ or b is weakly dominated for $i = 1, 2, 3$ and $\# = s, a, b$.

Overbidding proofness is only one requirement of incentive compatibility and does not exclude strategic underbidding incentives. In fact, a stakeholder can even block an investment by bidding low enough. By bidding sufficiently below the own value a stakeholder can either block an investment, or get a substantial compensation when the investment is implemented. Previous experiments (see Güth et al., 2011; Cicognani et al., 2015) report robust evidence of strategic underbidding.

Altogether the setup seems fair by allowing both M and non-Ms to state what they demand when an investment is implemented. Actually, M always s/he gets what s/he demanded via $m^{\#}$ wheres non-Ms only state their minimal demands $c_i^{\#}$. In spite of overbidding proofness the mechanism does not rule out overbidding which could be motivated by intrinsic (corporate identity) concerns letting stakeholders abstain from blocking an investment that seems rather profitable for the firm.

3 The experiment

3.1 Parameters

All participants go through nine decision rounds. Each round consists of the three stages of the decision process described in Section 2. At the beginning of the experiment, participants are randomly divided into groups of four, then are randomly assigned the roles of either M or one of three non-Ms. Group matching and roles are maintained throughout the experiment.

[Table 2 about here.]

The nine decision rounds are divided in three phases of three rounds each (see Table 2). Phases 1, 2 and 3 rely on information conditions *Pub*, *SemiPri* and *Pri*, respectively, as described in Section 2. The three phases are preceded by a practice phase of three rounds with information condition *Pub*. [12] 51 own individual value v_i^s, v_i^a and v_i^b, while M only knows the total sum of individual values. Finally, in phase 3 (*Pri*), again, non-M participants are informed of their own individual value, while M knows neither any value nor their sums (for the information conditions, see Table 1). We use the same investment values across phases. By the time the experiment reaches Phase 3, M has observed the total values for nine rounds (including the practice phase). This could allow M to estimate the distribution of total values in *Pri*.

[Table 3 about here.]

The three rounds in each phase vary in the distribution of values of investments. Specifically, in Round 1, all non-M participants gain from all of the investment options; in Round 2, only one non-M loses from all investment realizations; and in Round 3, all non-Ms can lose depending on the investment result (see Table 3). We are interested in the effects of conflicting interests among non-Ms (Rounds 2 and 3) on non-M's bidding and M's claims.[13]

In each round, non-M participants are randomly assigned monetary values of Set 1, 2 and 3. To avoid confronting participants with values already experienced previously, each value is perturbed

[12] The practice phase offers participants an opportunity to familiarize with the experiment. The practice phase is identical to Phase 1, but the play is only hypothetical; participants are not monetary rewarded.

[13] Güth et al. (2011) and Güth et al. (2014a) find no significant effects of conflicting interests on contribution levels in their threshold public projects experiments.

by noise via randomly determined error term $\epsilon_i^{\#}$ from the set {−40, −30, −20, −10, 0, 10, 20, 30, 40}.[14]

3.2 Procedures

Each participant was paid the sum of earnings made in three randomly selected rounds in addition to a €5 show-up fee. Specifically, one round was randomly selected in each of three phases for payment. The conversion rate was 100 experimental currency unit (ECU) per €. Negative earnings were subtracted from the show-up fee. To exclude losses exceeding the show-up fee of €5 (= 500 ECU), a non-M participant, $i = 1, 2, 3$, was not allowed to overbid by more than 166 ECU: $\beta_i^{\#} - v_i^{\#} \leq 166$ for $\# = s, a, b$.

Participants were students at [name deleted to maintain the integrity of the review process], who were recruited using ORSEE (Greiner, 2015). The experiment was computerized using z-Tree (Fischbacher, 2007). Upon arrival, participants were randomly allocated to a cubicle and seated in front of a computer. Participants were given written instructions (see the translated instructions in Appendix A). Instructions were also read aloud to make them common knowledge. After reading the instructions, some extra time enabled participants to read the instructions at their own pace. After everyone finished reading the instructions, eight control questions (see Online Appendix B) had to be answered before randomly assigning participants to groups (firms) of 4 and roles (either M or non-M) for the whole duration of the experiment. The average duration of sessions was about two hours. The average payment was €11.61 (including the €5 participation-fee).

We ran eight sessions in total. The number of participants were 32 in seven sessions and 28 in one session, hence 252 in total.

The instructions abstained from alerting participants to the three characteristics of the procedurally fair bidding mechanism (voluntariness, equal treatment with respect to bids, overbidding proofness) to avoid possible demand effects. Participants just learned about the co-determination mechanism via reading the instructions, answering the control questions related to it, and experiencing three practice rounds before confronting the incentivized decision tasks. In four sessions, we added a paragraph in the instructions (see the paragraph in section What are the payoffs? of Online Appendix A), specifically assuming negative monetary values (which might cause some additional cognitive challenge for the participants) and illustrated the possible loss when overbidding a negative value and how one can avoid this by not overbidding. We refer to these sessions as 'nudging sessions', since the amended instructions discourage overbidding in case of lowest and

[14] Although participants know that the investment values are randomly assigned, they are unaware of the rule of random assignment, i.e. they are neither aware of the three sets of values, nor the distribution of error terms $\epsilon_i^{\#}$.

negative values.[15] However, we do not confirm significant effects of this additional paragraph in the instructions (Section C.2 of the Online Appendix reports the regression analysis).

3.3 Theoretical analysis

Let us begin by assuming all participants to be opportunistic in the sense of own (expected) payoff maximization, and to commonly know this in the epistemic game theoretic sense, meaning that general opportunism applies, that this is known to all players, that all players know that they all know this, ad infinitum.

This implies for all information conditions, *Pub*, *SemiPri* and *Pri*:

Conjecture 1: Non-M participant $i = 1, 2, 3$ will underbid his or her value by at least 1, the smallest monetary unit:

$$\beta_i^{\#} < v_i^{\#} \quad \Leftrightarrow \quad c_i^{\#} > 0.$$

This follows from all bidding strategies specifying a bid equal or above a stakeholder's value are weakly dominated by the strategy letting the stakeholder underbid this value by 1 unit. Conjecture 1 only requires stakeholder opportunism, not that it is commonly known.

In case of *Pub* or *SemiPri* with commonly known opportunism the set up provides sufficient information, letting M exploit his or her first-mover advantage by claiming the total of the non-Ms' values minus 3. Stakeholders should expect this and claim $c_i^{\#}$ of 1, like in ultimatum games. As in ultimatum games, there can be other equilibria which involve weakly dominated strategies.

Conjecture 2: M will claim the total value of non-Ms minus 3, expecting that all non-Ms bid their values minus 1, when the total value exceeds 3 units:

$$m^{\#} = \sum_{i}^{3} v_i^{\#} - 3, \tag{1}$$

and

$$\beta_i^{\#} = v_i^{\#} - 1 \quad \Leftrightarrow \quad c_i^{\#} = 1$$

$$\text{if } \sum_{i}^{3} v_i^{\#} > 3.$$

For *Pri* only Conjecture 1 applies since M is unaware of non-Ms' total value. Behaviorally, one could expect that M in *Pri* may infer from previous tasks the range of non-Ms' total value (see Table 3) and cautiously demand less than the expected total value. This, in turn, should induce non-Ms

[15] This was intended to rule out the possibility that such case-dependent, crowding-in effect of underbidding a negative value is due to cognitive problems (i.e. mis-reacting to negative values).

to underbid their values by at least 1 unit without, however, engaging in excessive underbidding that would risk to end up with the status quo and 0-payoffs.

3.4 Research questions

In this study, we are interested in answering two main research questions:

Question 1: Will a manager claim almost the entire value from an investment?

The aim of Question 1 is to examine Conjecture 2. Specifically we ask if M claims equal to $m_i^{\#}$ as in Eq. (1). Behaviorally, M might lower his or her claim because this would increase the chance of acceptance.

Question 2: Will stakeholders ever bid truthfully, i.e. their individual value for the investment?

Characteristic 2 of the procedurally fair mechanism implies equal net gains with respect to bids in case of truthful bidding:

$$\beta_i^{\#} = v_i^{\#} \quad \Leftrightarrow \quad c_i^{\#} = 0. \tag{2}$$

Alternatively, non-M participants might underbid strategically (see Conjecture 1) up to the point where the total bid meets M's claim:

$$\sum_i^3 \beta_i^{\#} = m^{\#} \quad \text{if} \quad m^{\#} \leq \sum_i^3 v_i^{\#} - 3. \tag{3}$$

If non-Ms try to achieve an equilibrium that satisfies Eq. (3) rather than bidding truthfully (Eq. 2), they face a difficult coordination problem due to the many different ways in which non-Ms can account for the claim by M. This problem is likely exacerbated by differences in monetary values which increase over Rounds (see Table 3). Because of this, we may expect non-Ms to 'struggle' more in Rounds 2 and 3 than in Round 1.[16] However, in Phase 1 (*Pub*), where M knows each non-M's value, M might be willing to claim less in Rounds 2 and 3 if s/he believes that non-Ms find it more difficult to bid high enough to accept M's claim. For this reason, we are unable to predict the effects of heterogeneous investment values on the probability of acceptance of an investment.

In Phase 2 (*SemiPri*), M may claim less than in Phase 1. This is because, without knowing the investment value of each non-M, M cannot exclude the possibility of heterogeneous investment evaluations. In Phase 3 (*Pri*), where M does not even know the total value of investments, M may claim even less. If M is risk averse, his or her claim might decrease in *Pri* compared to *Pub* and *SemiPri*. However, this effect might be mitigated by experience of nine rounds of play (including the practice phase) before M encounters Phase 3 (*Pri*).

[16] In threshold public goods games, different valuations across group members reduce the likelihood that total contributions reach the threshold (see Marks et al., 1999).

4 Results

4.1 Main findings

To address Question 1, we compare M's claim ratio, i.e. M's claim divided by the total value, $m^{\#} \Big/ \sum_i^3 v_i^{\#}$, to $1 - 3 \Big/ \sum_i^3 v_i^{\#}$ as predicted (see Conjecture 2). Figure 1 plots the claim ratio against the total value of safe and risky investments (for its two random realizations A and B) for non-M participants in each round of the three information conditions (i.e. *Pub*, *SemiPri*, and *Pri*). In all information conditions, almost all data points lie well under the line of Eq. (1), showing that M claims were systematically lower than the total value of non-Ms minus 3. The average claim ratio is 29.5%. A one-sample t-test rejects Eq. (1): M claims are significantly lower than predicted (see the first column of Table 4).

Result 1: Managers claim significantly less than the total investment values.

[Figure 1 about here.]

[Table 4 about here.]

Now let us turn to Question 2. Do non-M participants bid truthfully? Figure 2 is a scatter plot diagram of non-M bids against their values. Most bids are below the 45-degree line of truthful bidding (see Eq. 2). Underbidding is confirmed by a bootstrap test (see the second column of Table 4).[17]

Result 2: Stakeholders bid significantly less than their values.

[Figure 2 about here.]

If non-M participants are underbidding their values, are they profit maximizing and relying on one (of many) Nash equilibrium that satisfies Eq. (3)? In Figure 3, the vertical axis is the ratio of the surplus of non-M total bids minus M claims and non-M total value: $\left(\sum_i^3 \beta_i^{\#} - m^{\#}\right) \Big/ \sum_i^3 v_i^{\#}$. On average, the surplus appears to be quite close to the equilibrium level of zero. This is confirmed by a bootstrap test (see the third column of Table 4). We cannot reject the null hypothesis of Eq. (3). While the average surplus does not differ from zero, we observe substantial heterogeneity of the surplus around the zero benchmark in Figure 3.

[Figure 3 about here.]

[17] The evidence of strategic underbidding is consistent with previous experiments on procedurally fair bidding in threshold public projects game (Güth et al., 2011; Cicognani et al., 2015).

The rejection rate of M claims is 43.3%,[18] while the prediction is 100% acceptance at least in *Pub* and *SemiPri* (see Conjecture 2), since total values always exceed 3 units. Probit analysis shows that acceptance probability is lower when M claims more (see Table 5). We propose two possible explanations of this correlation:

1. Our experiment features an ultimatum game with the M participant as a proposer and non-Ms as responders. Typically, responders tend to punish their proposer in case of an unfair offer (see Camerer, 2003; Güth and Kocher, 2014).

2. Alternatively, non-M bidding at Stage 2 can be compared with contributing to a threshold public good. As Croson and Marks (2000) report, contributions tend to fail to coordinate at an equilibrium of the provision point mechanism when the threshold is large.[19]

We reckon that the second motive is significant. Figure 4 shows the histograms of the ratio of M claim to non-M total value in two cases: (1) M's claim is accepted and (2) M's claim is not accepted. Even if M claims less than a quarter of total value, which implies an equal split among M and three non-Ms, there are many rejections. Regression (1) predicts the acceptance probability is only 61.1% when M's claim ratio is 25%. In the ultimatum game literature, we are not aware of such a low acceptance probability when the proposer offers an equal split of the pie.

[Figure 4 about here.]

In fact, our statistical analysis indicates that non-M decisions are affected by the outcome of previous play. If non-Ms rejected M's claim in the previous round, they tend to raise their bid in the current round and vice versa, even when M has not changed his or her claim (for a detailed analysis, see Section C.1 of Online Appendix). If non-Ms are only concerned with equality, they should not change their bids as long as M claims the same. This evidence is further support for the second motive: After failing to coordinate at the equilibrium (Eq. 3), non-Ms increase their bids to more likely accept M's claim in the following round.

[Table 5 about here.]

We also find M claims to be positively correlated with the surplus in the previous round. Thus, generating a positive surplus by bidding truthfully seems to invite M participants to claim more in the following round. In other words, 100% acceptance of to M claims ($\leq \sum_i^3 v_i^{\#} - 3$) by truthful

[18]737 claims out of all 1701 claims by Ms are not accepted.

[19]Croson and Marks (2000) define the Step Return (SR) as aggregate group payoff from the public good divided by a total contribution threshold. In Stage 2 of our setup, SR = $\sum_i^3 v_i^{\#} \Big/ m^{\#}$, thus a higher claim means lower SR. Croson and Marks find that reducing SR renders successful provision less likely, even in case of full refunding if the provision point is not met, like our setup.

bidding would let the play converge to the prediction of Conjecture 2, that non-Ms should and will try to avoid.

Facing a real threat of rejection by non-Ms, how do M participants decide their claims? To examine whether M claims are profit maximizing, we draw Figure 5 by using Regression (1). The horizontal axis is the ratio of M claim to total value. The downward-sloping curve is the estimated acceptance probability. The flat slope implies that even low claims are likely rejected. The inverse U-shape function is the probability multiplied by the claim ratio, i.e. the expected payoff divided by total value. The apparent peak of the expected payoff is where M claims something between 40-50% of the total value. However, not only the median but also the interquartile range of the actual claim ratio are smaller than that.[20]

[Figure 5 about here.]

Although non-M participants do not earn equal net gains, as it would be when commonly bidding truthfully (see Characteristic 2 of our procedurally fair bidding rules), is there any redistribution among them? Figure 6 shows the possible payoffs of non-Ms against the non-M's value when M's claim is accepted. These are all the possible payoffs before M chooses to realize an acceptable investment at Stage 3 which then determines the actual payoffs. On average, M participants claim 29.5% of the total value (see Figure 1), and the ratio goes down to 25.3% if we consider only accepted claims. Hence:

- If there is no redistribution, each non-M participant bids 0.253 to meet M's claim and earns 0.747 for each value unit she receives from the investment.
- If non-Ms bid truthfully, 74.7% of their total value generates the surplus, which is equally divided between the three non-M participants. So, each non-M participants earns $0.747/3 = 0.235$ per unit of investment value.

The slope in Figure 6 is approximately a half. It is even flatter when the value is negative. More precisely, the corresponding linear regression (see Table 6) estimates that the slope coefficient is 0.465 if the value is positive, otherwise $0.465 - 0.367 = 0.098$. Hence, non-Ms are redistributing to a certain extent.

[Figure 6 about here.]

[Table 6 about here.]

[20]Our finding of the low claim by M participants can be compared with the findings of generous offers by the proposer in the ultimatum experiment of Henrich et al. (2001). The reason for making generous offers in the ultimatum game might be a proposer's pessimistic belief that the responder will accept his or her offer (see Costa-Gomes and Zauner, 2001).

Let us summarize our answers to Questions 1 and 2. M-participants are no profit maximizers as described by Conjecture 2. Instead of the equilibrium strategy as in Eq. (1), Ms claim only 29.5% of the total value. Non-M participants do not bid truthfully. They rather engage in bid shading as described by Conjecture 1. We do not find evidence that non-Ms' total bids differ from the equilibrium level but confirm substantial heterogeneity in group outcomes.

4.2 Additional findings

In this section, we analyze how effects on M claims and non-M bidding behavior depend on information condition and investment type.

Table 7 reports the results of linear regressions on M's claim ratio $m^{\#} \Big/ \sum_i^3 v_i^{\#}$, which corresponds to Figure 1. The findings of Regression (5) are as follows:

- The larger the total value of an investment the smaller M's claim ratio. This is statistically significant, though the effect is practically small, e.g. the increase in the total value by 1000 ECU reduces the ratio by approximately 1.35 percentage points for *Pub* and *SemiPri*. This differs from the findings of previous ultimatum bargaining experiments that proposers offer smaller shares when the pie size increases (see, e.g., Andersen et al., 2011). A possible reason is that non-Ms have to coordinate how to reach the threshold given by M's claim, a problem which responders in two-player ultimatum games does not encounter. M participants may predict instead that the chance of acceptance depends on the ratio of the threshold to the pie.[21] When the investment value is large, a risk-averse M may choose to claim less to increase the probability of acceptance.

- The total value of an investment has similar effects in *Pri*, even though M does not exactly know the total value in this information condition. In our view, after experiencing the practice phase, Phases 1 and 2, M can well estimate the total values of investments S and R.

- When M-participants know the investment values of each non-M participant (Phase 1), the claim ratio is significantly smaller in Round 2 and Round 3, although this effect (see Regression 5) is only mildly significant for Round 2. This can be explained by M-participants assuming that non-Ms cooperation in guaranteeing M's known claims will be more difficult if investment values are heterogeneous. In Round 3, where every non-M can lose from an investment, cooperation is expected to be even more difficult compared to Round 2 with only one non-M losing and having to be compensated by the others.

[21] In threshold public goods games, the step return (see Footnote 19) is found to be a strong predictor of successful provision (see Croson and Marks, 2000; Cadsby et al., 2008).

- M reduces his or her claim ratio by 0.0390 in Phase 2 (*SemiPri*) compared to the one in Round 1 of Phase 1 (*Pub*). M is informed about the total values but not of non-M's individual values. So M does not know if non-Ms lose from an investment or not. In our view, M claims less to let non-Ms accept more easily .

- The reduction in M's claim ratio is larger in Phase 3 (*Pri*): 0.0429. In addition, the negative slope coefficient with respect to total value is steeper: -3.08e-05. M tends to be cautious when unaware of the total values. Our finding is consistent with Güth et al. (2017), whose ultimatum proposer, when uninformed about the pie size, reduces his or her claim. We conclude that non-Ms should not reveal their investment values to M participants in order when wanting to enhance their profits.

We also check the influence of different investment types, S and R. Regression (6) has variables for the realizations A and B of the risky investment instead of total value.[22] Since total value and realizations A, B are highly correlated (see Table 3), it is difficult to conclude which variable explains better. In our view, Regression (5) is performing better than (6). Firstly, (5) has higher likelihood. Secondly, if M participants prefer the risky investment to the safe one, we would expect the coefficients for both risky events A and B in Regression (6) to be significantly negative. However, there is also an argument supporting Regression (6). Table 8 reports the regression analysis on non-M's bids. Non-M participants tend to bid less for risky investment's realization A. So, it might be that M participants claim less to adjust to non-Ms lower bids.

[Table 7 about here.]

Both regressions in Table 8 rely on the same models. Regression (7) uses all observed non-M bids. Since the estimated coefficients are highly influenced by five extremely low bids, between -4000 and -9999 just to block an investment, Regression (8) excludes these low bids. We find from the latter regression that:

- If M increases his or her claim by 1 unit, the three non-Ms increase their total bid only by $0.110 \times 3 = 0.330$. Hence, a higher claim ends up with lower probability of acceptance. This is confirmed by probit regressions on the acceptability of M's claim (see the first row of Table 5).

- The slope coefficient of value $v_i^{\#}$ is 0.412 if $v_i^{\#} \geq 0$, otherwise $0.412 + 0.703 = 1.115$. In addition, a bid decreases by 46.12 if the value is negative. This shows strong 'loss aversion' of non-Ms, in the sense of perceiving negative values per se as losses.

[22] The regression model with both total value and risky events A and B suffers from multi-collinearity.

- Non-M participants bid more in *SemiPri* and *Pri*, probably due to non-M participants being not sure whether other non-Ms may have negative investment values when values are private information. Collectively accepting M's claim can be more difficult as non-Ms with negative value significantly underbid, hence non-Ms are willing to bid more.

- The preference for the risky investment is inconclusive. While bidding less for event A than for the safe investment, bidding for event B does not differ significantly. It seems that non-M participants are not very optimistic when betting on event A.

[Table 8 about here.]

Finally, let us look at the effects of heterogeneous investment values and information conditions on the acceptance probability of M's claim. We regress the acceptance by a probit model (see Table 5). The implications of Regression (2) are as follows:

- The acceptance probability is lower in Rounds 2 and 3, irrespective of whether the information condition is *Pub*. In Phase 1 (*Pub*), M claims less in these rounds (see Table 7), but M does not lower his or her claims enough to keep the acceptance probability unchanged when a non-M with negative value bids dramatically less (see Table 8).

- As mentioned above, M claims less in Phase 2 and even less in Phase 3 (see Table 7). Non-Ms bid higher in Phases 2 and 3 (see Table 8). As a result, the acceptance probability is significantly higher, especially in *Pri*. This information condition favors non-Ms because the increase in the surplus (i.e. the total bid minus M's claim) is shared equally between non-Ms. Linear regression estimates suggest that non-M payoffs increases by 19.70 in *Pri* (see Table 6).

We do not find any significant effects of the riskiness of an investment (see Regression 3).

5 Final remarks

Collective decisions in firms can be perceived as 'fair' when they directly involve employees as stakeholders who can even block an investment by bidding sufficiently low. We have proposed a procedurally fair bidding mechanism of co-determination with rules determining how the total value from an investment is shared among the manager and three stakeholders. We have tested the implementability of our mechanism by a laboratory experiment where we manipulate investment values and information about these values.

Our results confirm dominance of strategic underbidding by stakeholders and provide evidence that managers do not claim the whole investment value. Stakeholders' total bid is often not larger than what the manager claims. Collectively, the modal behavior of all stakeholders is to just guarantee the managers' claims. We interpret this as 'opportunistic' behavior of stakeholders who, rather than rendering a manager's claim acceptable, bid 'lowest subject to likely acceptability'. Managers claim significantly less than the total investment value. This could be due to genuine altruism or willingness to enhance the acceptability of an investment (to disentangle these motives is beyond the purpose of this study). An alternative explanation is that stakeholders are trying to limit or even prevent exploitation by the manager. As a result, managers' average accepted claim is only 25.3% of the average total value, that implies equal shares for all four participants on average.

Overall, the mechanism allows both positive and negative evaluations and is robust to limiting information. In fact, it seems to perform even better in terms of 'acceptability' under private information conditions, i.e. when the manager does not know the total value from an investment. In this case, a manager reduces his or her claims and stakeholders bid higher, that increases acceptability and the surplus of an investment. Such behaviour of managers and stakeholders here could be due risk aversion since uncertainty regarding the values of others would render everyone more cautious.

Due to the relative large share of value retained by stakeholders, our mechanism seems to favour increasing labour productivity rather than facilitating investments in capital. This is not far from the reality of large co-determined firms. FitzRoy and Kraft (2005) found that co-determination in Germany has increased labour productivity, which is linked to accumulation of human capital and increasing job satisfaction.

While we have applied procedural fairness to codetermination, the mechanism is also applicable to other types of corporate governance such as large industrial groups like Volkswagen, where the top management of the company negotiates with the heads of its subunits (e.g. Audi, Skoda, ...) whether (or not) to restructure the whole firm (e.g. by substituting fuel engines by environmentally cleaner ones).

6 Compliance with ethical standards

- Conflicts of interest: The authors declare that they have no conflicts of interest.
- Ethical Approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

- Informed consent: Informed consent was obtained from all individual participants included in the study.

References

Addison, J. T., Schnabel, C., and Wagner, J. (2001). Works councils in germany: their effects on establishment performance. *Oxford economic papers*, 53(4):659–694.

Andersen, S., Ertaç, S., Gneezy, U., Hoffman, M., and List, J. A. (2011). Stakes matter in ultimatum games. *American Economic Review*, 101(7):3427–39.

Bagnoli, M. and Lipman, B. L. (1989). Provision of public goods: Fully implementing the core through private contributions. *The Review of Economic Studies*, 56(4):583–601.

Bagnoli, M. and McKee, M. (1991). Voluntary contribution games: Efficient private provision of public goods. *Economic Inquiry*, 29(2):351–366.

Becht, M., Bolton, P., and Röell, A. (2003). Chapter 1 - Corporate governance and control. In Constantinides, G. M., Harris, M., and Stulz, R. M., editors, *Corporate Finance*, volume 1 of *Handbook of the Economics of Finance*, pages 1 – 109. Elsevier.

Cadsby, C. B., Croson, R., Marks, M., and Maynes, E. (2008). Step return versus net reward in the voluntary provision of a threshold public good: An adversarial collaboration. *Public Choice*, 135(3):277–289.

Camerer, C. F. (2003). Behavioral game theory: Experiments in strategic interaction.

Carothers, T. (1998). The rule of law revival essay. *Foreign Affairs*, 77:95.

Chang, C. (1992). Capital structure as an optimal contract between employees and investors. *the Journal of Finance*, 47(3):1141–1158.

Cicognani, S., D'Ambrosio, A., Güth, W., Pfuderer, S., and Ploner, M. (2015). Community projects: An experimental analysis of a fair implementation process. *Social Choice and Welfare*, 44(1):109–132.

Costa-Gomes, M. and Zauner, K. G. (2001). Ultimatum bargaining behavior in Israel, Japan, Slovenia, and the United States: A social utility analysis. *Games and Economic Behavior*, 34(2):238–269.

Croson, R. and Marks, M. (2001). The effect of recommended contributions in the voluntary provision of public goods. *Economic Inquiry*, 39(2):238–249.

Croson, R. T. and Marks, M. B. (2000). Step returns in threshold public goods: A meta-and experimental analysis. *Experimental Economics*, 2(3):239–259.

Dilger, A. (2003). Economic effects of co-determination. *The Changing Contours of German Industrial Relations. München*, pages 119–136.

Fauver, L. and Fuerst, M. E. (2006). Does good corporate governance include employee representation? Evidence from German corporate boards. *Journal of financial economics*, 82(3):673–710.

Fischbacher, U. (2007). z-Tree: Zurich toolbox for ready-made economic experiments. *Experimental economics*, 10(2):171–178.

FitzRoy, F. and Kraft, K. (2005). Co-determination, efficiency and productivity. *British journal of industrial relations*, 43(2):233–247.

Freeman, R. E. (1984). *Strategic Management: A Stakeholder Approach.* Pitman Publishing, Boston, MA.

Gorton, G. and Schmid, F. (2000). Class struggle inside the firm: A study of German codetermination. Technical report, National Bureau of Economic Research.

Gorton, G. and Schmid, F. A. (2004). Capital, labor, and the firm: A study of German codetermination. *Journal of the European Economic Association*, 2(5):863–905.

Greiner, B. (2015). Subject pool recruitment procedures: organizing experiments with ORSEE. *Journal of the Economic Science Association*, 1(1):114–125.

Grossman, S. J. and Hart, O. D. (1986). The costs and benefits of ownership: A theory of vertical and lateral integration. *Journal of political economy*, 94(4):691–719.

Güth, W. (2011). Rules (of bidding) to generate equal stated profits: an axiomatic approach. *Journal of Institutional and Theoretical Economics (JITE)/Zeitschrift für die gesamte Staatswissenschaft*, pages 608–612.

Güth, W. and Kliemt, H. (2011). Procedurally fair provision of public projects: An axiomatic characterization. Technical report, Jena economic research papers.

Güth, W. and Kocher, M. G. (2014). More than thirty years of ultimatum bargaining experiments: Motives, variations, and a survey of the recent literature. *Journal of Economic Behavior & Organization*, 108:396 – 409.

Güth, W., Koukoumelis, A., and Levati, M. V. (2011). "One man's meat is another man's poison": An experimental study of voluntarily providing public projects that raise mixed feelings. Technical report, Jena economic research papers.

Güth, W., Koukoumelis, A., Levati, M. V., and Ploner, M. (2014a). Providing revenue-generating projects under a fair mechanism: An experimental analysis. *Journal of Economic Behavior & Organization*, 108:410–419.

Güth, W., Levati, M. V., and Montinari, N. (2014b). Ranking alternatives by a fair bidding rule: A theoretical and experimental analysis. *European Journal of Political Economy*, 34:206–221.

Güth, W., Pull, K., Stadler, M., and Zaby, A. K. (2017). Blindfolded vs. informed ultimatum bargaining – A theoretical and experimental analysis. *German Economic Review*, 18(4):444–467.

Henrich, J., Boyd, R., Bowles, S., Camerer, C., Fehr, E., Gintis, H., and McElreath, R. (2001). In search of homo economicus: behavioral experiments in 15 small-scale societies. *American Economic Review*, 91(2):73–78.

Hübler, O. and Jirjahn, U. (2003). Works councils and collective bargaining in Germany: The impact on productivity and wages. *Scottish Journal of Political Economy*, 50(4):471–491.

Isaac, R. M., Schmidtz, D., and Walker, J. M. (1989). The assurance problem in a laboratory market. *Public choice*, 62(3):217–236.

Jirjahn, U. (2017). Works councils and collective bargaining in Germany: A simple theoretical extension to reconcile conflicting empirical findings. *Journal of Institutional and Theoretical Economics JITE*, 173(2):322–346.

Klempt, C., Pull, K., and Stadler, M. (2019). Asymmetric information in simple bargaining games: An experimental study. *German Economic Review*, 20(1):29–51.

MacKinnon, J. G. (2002). Bootstrap inference in econometrics. *Canadian Journal of Economics/Revue canadienne d'économique*, 35(4):615–645.

Marks, M. B., Schansberg, D. E., and Croson, R. T. (1999). Using suggested contributions in fundraising for public good. *Nonprofit Management and Leadership*, 9(4):369–384.

Plott, C. R. (1994). Market architectures, institutional landscapes and testbed experiments. *Economic Theory*, 4(1):3–10.

Rauchdobler, J., Sausgruber, R., and Tyran, J.-R. (2010). Voting on thresholds for public goods: experimental evidence. *FinanzArchiv: Public Finance Analysis*, 66(1):34–64.

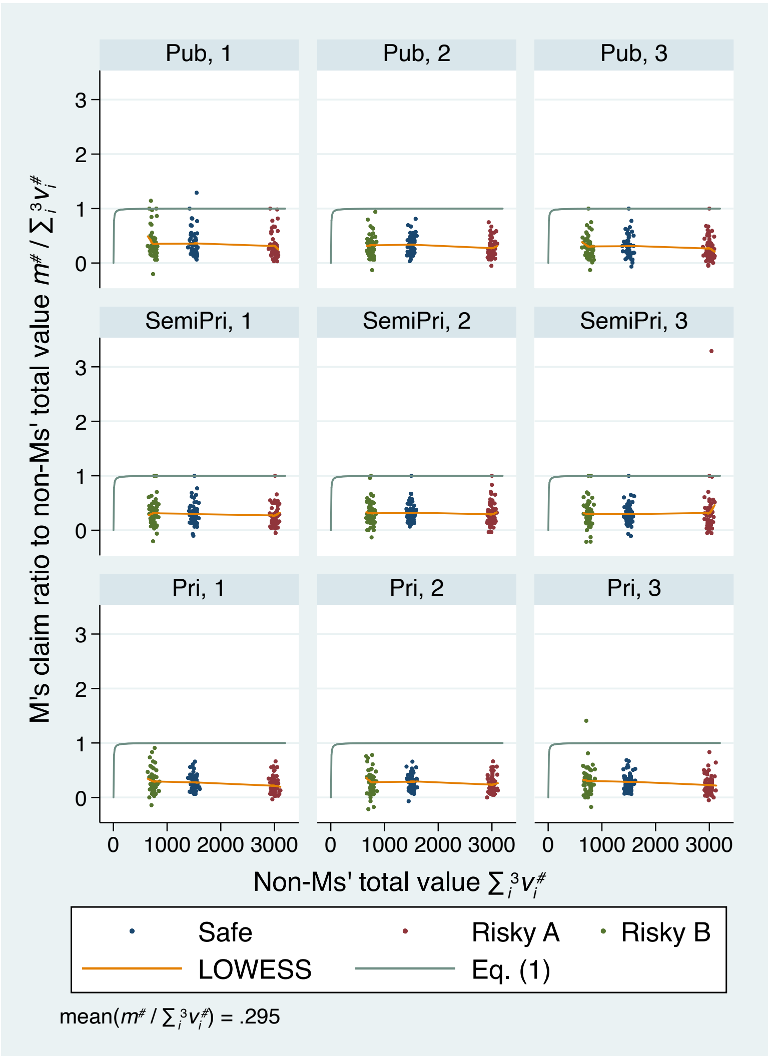

Figure 1: The ratio of M's claim to non-Ms' total value $m^\# \Big/ \sum_i^3 v_i^\#$

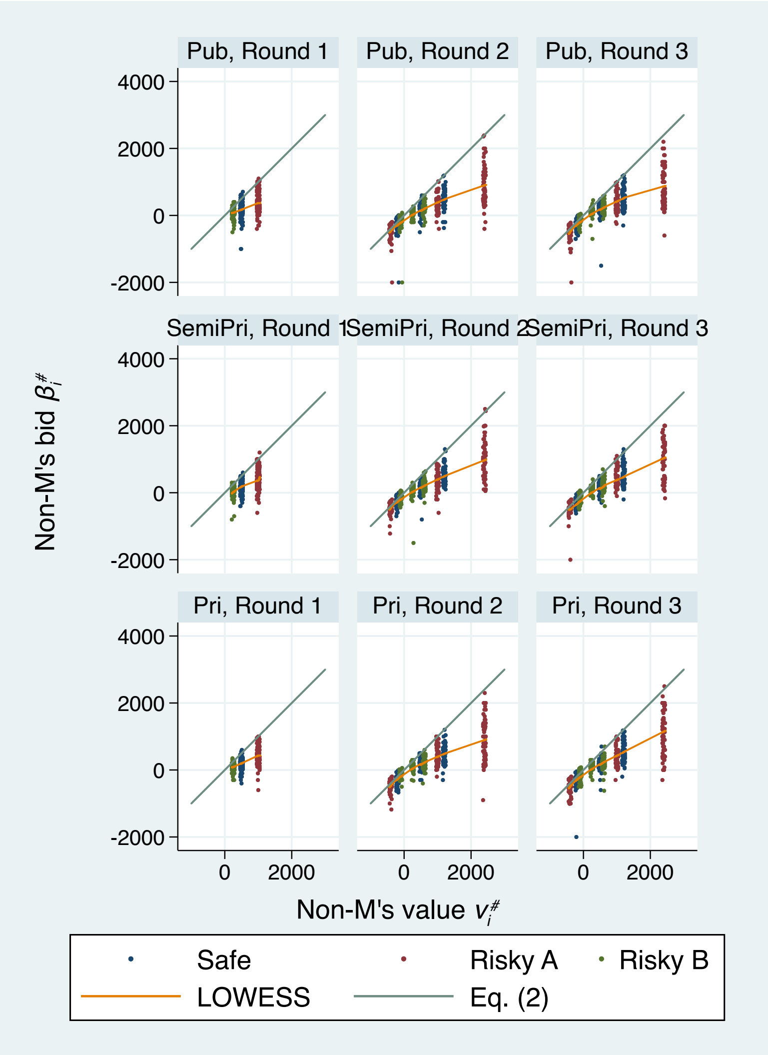

Figure 2: Non-M's bid $\beta_i^\#$ against own investment value $v_i^\#$

Notes: In addition, there are four bids equal to -9999 (the smallest number a non-M player was allowed to input) and one bid equal to -4000. We do not plot these observations to avoid extremely vertically long diagrams.

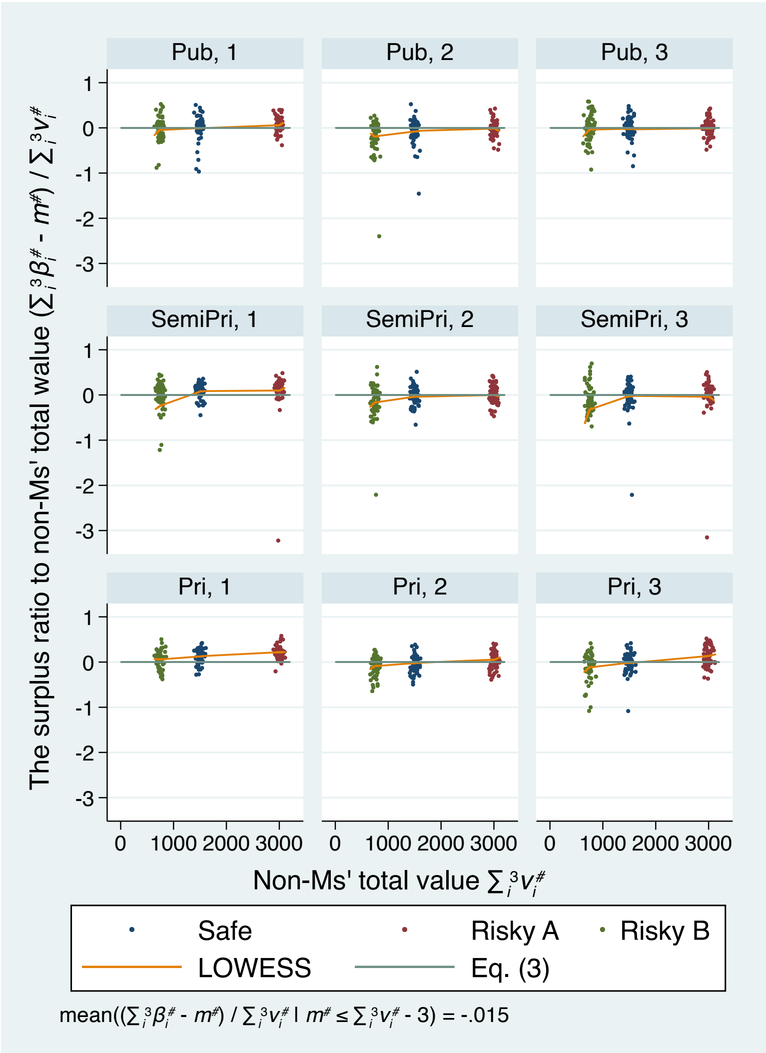

Figure 3: The ratio of the surplus of non-Ms' total bid minus M's claim and non-Ms' total value $\left(\sum_i^3 \beta_i^\# - m^\#\right) \Big/ \sum_i^3 v_i^\#$

Notes: The graphs report only the observations that satisfy $m^\# \leq \sum_i^3 v_i^\# - 3$.

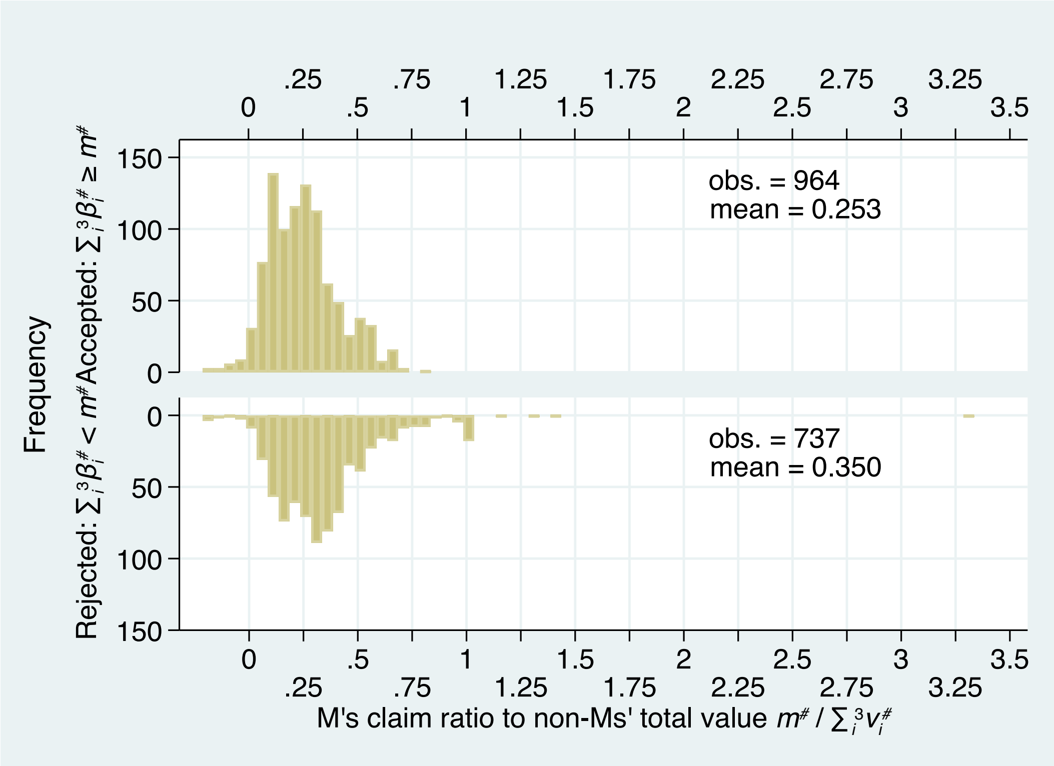

Figure 4: The histogram of the ratio of M participant's claim to non-Ms' total value

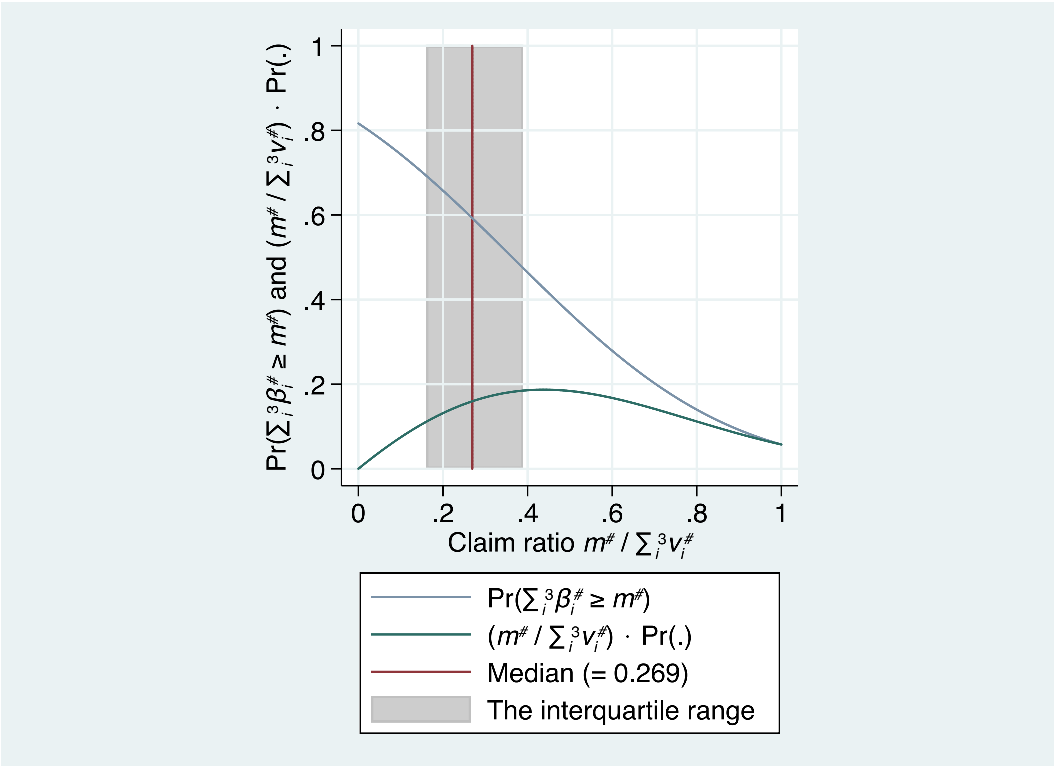

Figure 5: The predictions of the acceptance probability of M's claim and the ratio of M's expected payoff to the total value based on the probit model (Regression 1), and the median and interquatile range of M's actual claim ratio

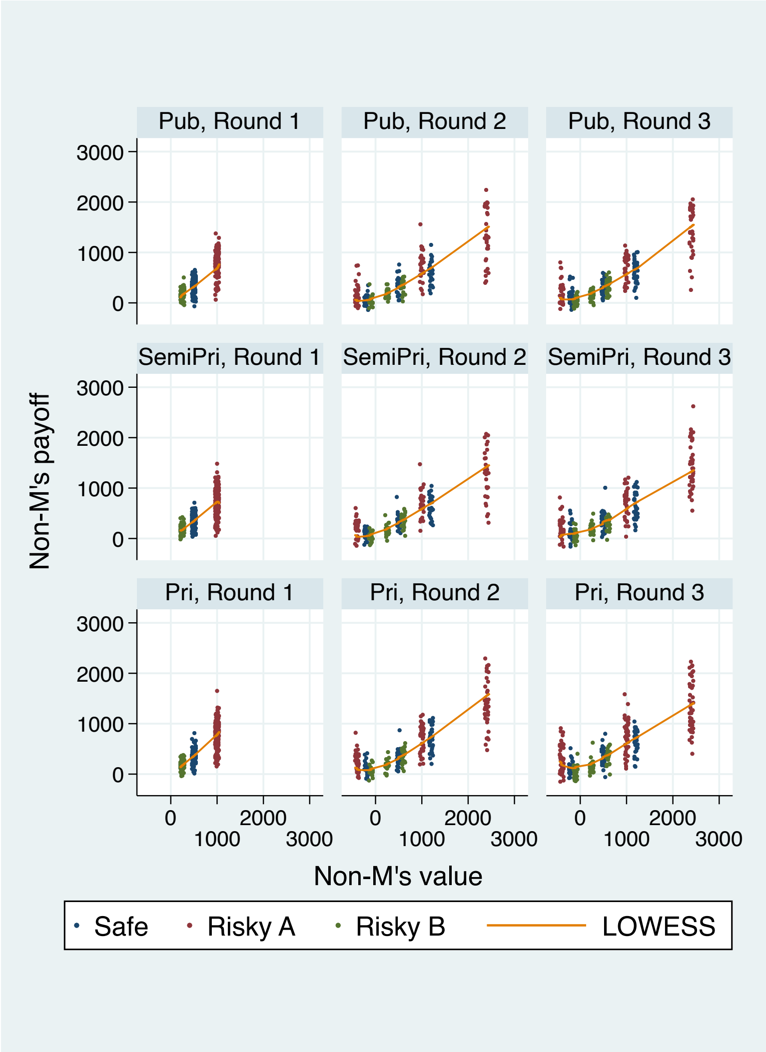

Figure 6: Non-M's possible payoff when M's claim is accepted

Notes: We are reporting all the possible payoffs at Stage 2 of the game. These are not actual payoffs that are determined after M decides whether to implement one accepted investment alternative or not at Stage 3.

Table 1: Information conditions in the experiment

Information condition	M's information	Non-M i's information
Pub	$v_i^{\#}$ for all $\#, i$	$v_j^{\#}$ for all $\#, j$
SemiPri	$\sum_i^3 v_i^{\#}$ for all $\#$	$v_i^{\#}$ for all $\#$
Pri	No information	$v_i^{\#}$ for all $\#$

Table 2: The order of nine decision tasks (and the practice tasks)

Phase	Practice			1			2			3		
Information	*Pub*			*Pub*			*SemiPri*			*Pri*		
Task (Round)	1	2	3	1	2	3	1	2	3	1	2	3

Table 3: Investment value $v_i^{\#}$ in three successive tasks of all phases

Task (Round)	Set	Safe Investment	Risky Investment	
			A	B
1	1	$500 + \epsilon_1^s$	$1000 + \epsilon_1^a$	$250 + \epsilon_1^b$
	2	$500 + \epsilon_2^s$	$1000 + \epsilon_2^a$	$250 + \epsilon_2^b$
	3	$500 + \epsilon_3^s$	$1000 + \epsilon_3^a$	$250 + \epsilon_3^b$
	Total	$1500 + \sum_i^3 \epsilon_i^s$	$3000 + \sum_i^3 \epsilon_i^a$	$750 + \sum_i^3 \epsilon_i^b$
2	1	$1200 + \epsilon_1^s$	$2400 + \epsilon_1^a$	$600 + \epsilon_1^b$
	2	$500 + \epsilon_2^s$	$1000 + \epsilon_2^a$	$250 + \epsilon_2^b$
	3	$-200 + \epsilon_3^s$	$-400 + \epsilon_3^a$	$-100 + \epsilon_3^b$
	Total	$1500 + \sum_i^3 \epsilon_i^s$	$3000 + \sum_i^3 \epsilon_i^a$	$750 + \sum_i^3 \epsilon_i^b$
3	1	$1200 + \epsilon_1^s$	$1000 + \epsilon_1^a$	$-100 + \epsilon_1^b$
	2	$500 + \epsilon_2^s$	$-400 + \epsilon_2^a$	$600 + \epsilon_2^b$
	3	$-200 + \epsilon_3^s$	$2400 + \epsilon_3^a$	$250 + \epsilon_3^b$
	Total	$1500 + \sum_i^3 \epsilon_i^s$	$3000 + \sum_i^3 \epsilon_i^a$	$750 + \sum_i^3 \epsilon_i^b$

Table 4: The block bootstrap of one-sample t-test on Eqs. (1), (2) and (3)

Null-hypothesis	Eq. (1)	Eq. (2)	Eq. (3)
t-value	-49.51***	-55.47***	2.509
	(2.846)	(6.534)	(2.533)
Observations	1,134	6,804	1,679

Notes: Bootstrap standard error in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Replications are 9999 (for the number of bootstrap samples, see MacKinnon, 2002). Block bootstrap is clustered at group level. The test on Eq. (1) excludes Phase 3 (*Pri*) data, in which M participant does not know the total values of investments. The test on Eq. (3) uses the observations that satisfy $m^{\#} \leq \sum_i^3 v_i^{\#} - 3$.

Table 5: Probit models of the accpetability of M's claim

Regressions Variables	(1) Accept	(2) Accept	(3) Accept
M's claim ratio $m^{\#} \Big/ \sum_i^3 v_i^{\#}$	-2.478***	-2.469***	-2.538***
	(0.268)	(0.273)	(0.278)
Total value $\sum_i^3 v_i^{\#}$		0.000231***	0.00104
		(3.62e-05)	(0.000774)
Phase 2 (*SemiPri*)		0.194	0.189
		(0.135)	(0.135)
Phase 3 (*Pri*)		0.377***	0.372***
		(0.137)	(0.138)
Risky investment A			-1.381
			(1.163)
Risky investment B			0.396
			(0.585)
Phase 1 (*Pub*) × Round 2		-0.798***	-0.807***
		(0.141)	(0.142)
Phase 1 (*Pub*) × Round 3		-0.584***	-0.594***
		(0.140)	(0.141)
Phase 2 (*SemiPri*) or 3 (*Pri*) × Round 2		-1.023***	-1.033***
		(0.105)	(0.106)
Phase 2 (*SemiPri*) or 3 (*Pri*) × Round 3		-0.832***	-0.837***
		(0.105)	(0.105)
Constant	0.902***	0.907***	-0.144
	(0.0963)	(0.162)	(1.168)
Observations	1,701	1,701	1,701
Number of groups	63	63	63

Notes: The dependent variable Accept is 1 if non-Ms total bid is equal to or larger than M's claim: $\sum_i^3 \beta_i^{\#} \geq m_i^{\#}$, otherwise 0. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Random effect models clustered at group level.

Table 6: Linear regression of non-M's possible payoff when M's claim is accepted

Regression Variables	(4) Payoff
Investment value $v_i^{\#}$	0.465***
	(0.0285)
Investment value $v_i^{\#}$ $\times$ (Dummy for $v_i^{\#} < 0$)	-0.367***
	(0.0936)
Phase 2 (*SemiPri*)	6.279
	(7.254)
Phase 3 (*Pri*)	19.70***
	(7.497)
Risky investment A	157.7***
	(16.34)
Risky investment B	-47.42***
	(8.947)
Round 2	-32.38***
	(8.542)
Round 3	-24.79***
	(8.569)
Constant	121.9***
	(14.59)
Observations	2,892
Number of groups	63

Notes: Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Clustered at the group level and the subject level. Robust errors are used due to heteroskedasticity. We are reporting all the possible payoffs at Stage 2 of the game. These are not actual payoffs that are determined after M decides whether to implement one accepted investment alternative or not at Stage 3.

Table 7: Linear regressions of the ratio of M's claim to the total value $m^{\#} \Big/ \sum_i^3 v_i^{\#}$

Regressions Variables	(5) Claim ratio	(6) Claim ratio
Total value $\sum_i^3 v_i^{\#}$ × (*Pub* or *SemiPri*)	-1.35e-05***	
	(4.65e-06)	
Total value $\sum_i^3 v_i^{\#}$ × *Pri*	-3.08e-05***	
	(6.58e-06)	
Phase 1 (*Pub*) × Round 2	-0.0293*	-0.0294*
	(0.0151)	(0.0151)
Phase 1 (*Pub*) × Round 3	-0.0471***	-0.0471***
	(0.0151)	(0.0151)
Phase 2 (*SemiPri*)	-0.0390***	-0.0391***
	(0.0123)	(0.0123)
Phase 3 (*Pri*)	-0.0429**	-0.0731***
	(0.0187)	(0.0123)
Risky investment *A*		-0.0412***
		(0.00871)
Risky investment *B*		-0.00119
		(0.00871)
Constant	0.365***	0.355***
	(0.0224)	(0.0215)
Observations	1,701	1,701
Number of groups	63	63
Log likelihood	748.52	747.86

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Random effect models clustered at group level.

Table 8: Tobit regressions of non-M's bid $\beta_i^\#$

Regressions Variables	(7) Bid	(8) Bid
M's claim $m^\#$	0.118***	0.110***
	(0.0243)	(0.0223)
Investment value $v_i^\#$	0.423***	0.412***
	(0.0281)	(0.0254)
Dummy for $v_i^\# < 0$	-81.93***	-46.12***
	(31.45)	(12.81)
Investment value $v_i^\#$ × (Dummy for $v_i^\# < 0$)	0.531***	0.703***
	(0.174)	(0.0658)
Phase 1 (*Pub*) × Round 2	8.051	8.570
	(16.53)	(15.99)
Phase 1 (*Pub*) × Round 3	26.22*	27.00*
	(15.27)	(14.58)
Phase 2 (*SemiPri*)	5.998	32.19**
	(27.84)	(13.67)
Phase 3 (*Pri*)	46.95***	46.50***
	(12.72)	(12.31)
Risky investment A	-57.71**	-32.37***
	(29.44)	(10.86)
Risky investment B	12.88	14.58
	(12.78)	(10.16)
Constant	-91.03***	-89.77***
	(23.36)	(22.18)
Observations	5,103	5,098
Number of groups	63	63

Notes: Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Clustered at the group level and the subject level. Robust errors are used due to heteroskedasticity. The dummy variable in the third row is 1 if $v_i^\#$ is negative, otherwise 0. The upper limit of the tobit model is $v_i^\# + 166$, which is the largest bid a non-M participant is allowed to input. The lower limit is -9999. Regression 7 uses all the observations. Regression 8 excludes 5 observations of outliers in *SemiPri*, which are 4 observations of -9999 and 1 observation of -4000.