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ORIGINAL PAPER

Experimental Effects of Institutionalizing Co-determination by a Procedurally Fair Bidding Rule

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Abstract
From an institutional perspective we contribute to corporate governance of firms by (1) proposing a procedurally fair mechanism that is ethically desirable, and (2) experimentally testing whether procedural fairness crowds-in ethical behavior of managers (on behalf of shareholders) and workers. The experiment sees one 'manager' and three 'workers' (possibly representing three sections of the firm) co-determining an efficiency-enhancing investment which could harm some workers. Firstly, the manager claims a share of the investment surplus, then workers 'bid' for the investment to express their willingness to satisfy the manager's claim in case the investment is implemented. If the sum of workers' bids is less than the manager's claim, the investment is not implementable, which means its surplus will be lost. Workers' behavior is 'ethical' when they veto unfair managerial claims, because the workers have to sacrifice own earnings. Hence, a manager's fair claim is the ethical response to the threat of workers' veto. If the manager claims fairly, workers' ethical behavior is to 'truthfully' bid their investment evaluations; by all doing so, they equally share whatever surplus the manager has left for them. The experimental results show ethical behavior of managers in the form of fair claims. Despite these fair claims, workers behave less ethically by strategically underbidding. So the procedurally fair mechanism only partially crowds-in ethical behavior. This study should interest theorists of stakeholder management, especially those engaged in designing the rules of corporate governance.

Keywords Ethical institutions · Ethical behavior · Fair surplus sharing · Co-determination · Procedural fairness · Laboratory experiments

JEL Classification J52 · J54 · C92

Introduction

Corporate governance may not just involve shareholders (owners) but also workers. In view of the obvious challenges posed by extending decision rights to workers (see e.g., Hansmann, 1989), the problem is to identify a set of rules or an institution that is 'workable' while preserving fair treatment of workers. This paper proposes and experimentally tests a procedurally fair institution with ethically desirable properties, involving co-determination of investments by shareholders and workers. The institution is procedurally fair by granting workers the power to veto an investment. This is closer to full participation of workers in cooperatives, rather than just granting workers access to information and consultation rights as in German co-determined enterprises (see Nuti, 2016; Nutzinger, 1983). The institution could be developed into fair rules that regulate the duties of shareholders and workers and coordinate their performance in large organizations.

There are essentially three reasons for shareholders to let workers participate in corporate decisions (see Jansson, 2005). One is normative: It is not ethical to perceive workers merely as production factors. Workers deserve to be respected as free human beings and to be involved in the decision process (Donaldson & Preston, 1995; Quinn & Jones, 1995; Shankman, 1999). The second reason relates to property rights: A firm's assets are not only physical but also the skills of its workers (Kay, 1997). Specifically, workers' property represents their

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investments in firm specific ‘human capital’ (Blair & Stout, 1999). Furthermore, property rights should be assigned to all risk takers in the firm: If a risky investment fails, shareholders are not the only ones bearing the risk; workers are often more exposed to such a risk because, unlike shareholders, they cannot hedge their risk by investing in other businesses. Hence, human respect requires involving workers in risky decision-making (Jansson, 2005). The third reason is related to principal-agent relationships: Shareholders (principals) delegate decision rights to management (agent) who may be better informed about the firm. But modern businesses rely much more on knowledge and skills of their workers (Prahalad, 1997), so that, from this viewpoint, it is reasonable to assign decision rights and responsibilities to workers.

To explore the possibility of shared control between shareholders and workers, we propose a procedurally fair institution that grants workers the power to veto an investment. Because of the threat of workers’ veto, managers are incentivized to claim a ‘fair’ share of an investment surplus. While a manager may be just opportunistically motivated and claim ‘as if’ fairly, workers’ veto against an unfair claim is motivated not by opportunism but by some ‘ethics’ because the veto requires workers to sacrifice their own shares of surplus. Hence, a fair claim implies the enforcement of workers’ ‘pro-social’ preferences on the manager’s decision (see van Damme et al., 2014, Sect. 10).

When the manager’s claim is fair so that vetoing is unnecessary, workers can affect investment decisions via a procedurally fair bidding rule, similar to Güth’s (2011) axiomatically derived rule. This rigorously justifies the principle of *respect for persons* (Kant, 1797): Workers state their willingness to satisfy the manager’s claim and thereby supports an efficiency-enhancing investment via monetary and publicly observable ‘bids.’ This is similar to the principle of cooperation requiring sacrifice or restriction of liberty by Phillips (1997), an operationalization of Rawls’s (1971) theory of justice. According to this principle, workers sacrifice their individual liberty by agreeing to sell the product of their labor to the employer. In our institutional setup, workers sacrifice investment value to satisfy managerial claims by accepting and supporting an investment project.

The procedurally fair bidding rule has ethically desirable properties. If all workers bid truthfully, due to its ‘equal net gain’ property all workers receive the same remuneration from an investment. Its ‘voluntariness’ property guarantees that workers never sacrifice more than their own bids. Finally, its ‘overbidding proof’ property renders overbidding own value weakly dominated. Truthful bidding of all workers is ethically desirable by producing efficiency and equality among workers: Whenever the sum of workers’ bids equals the sum of workers’ investment evaluations, workers approve only investments which are truly efficiency-enhancing and guarantee equal net gains to workers even when their investment values are different. Truthful bidding is, however, theoretically questionable due to individual underbidding incentives. For a worker it is best to underbid as long as the bid sum exceeds the manager’s claim.

After outlining the desirable properties of the procedurally fair bidding rule, we describe the laboratory experiment to assess whether our procedurally fair institution is encouraging managers and workers to behave ethically, especially the extent of fair claim and truthful bidding. The laboratory experiment allows us to test if claims are fair and bids are truthful because investment evaluations are controlled by us, the experimenters.

The experimental setup involves two roles, manager and worker, with one manager and three workers who collectively decide on the implementation of two investment opportunities. We distinguish between two hierarchical levels, manager and workers, which seems to be the closest departure from the shareholder model in which only the manager has decision rights. Specifically, the setup lets the manager first state a claim for each investment’s surplus and finally decide which of the investment opportunities accepted by workers (if any) to implement. There are three decision stages:

1. The manager states a claim for the surplus from each investment, whose efficiency is experimentally induced by the sum of workers’ investment values;
2. Workers observe the manager’s claim and react via bidding for the investments;
3. The manager decides which acceptable investment (if any) to implement, where acceptability requires that the sum of workers’ bids is at least as large as the managerial claim; if no investment is implemented, all parties earn nothing.

Similar to ultimatum bargaining (see Güth & Kocher, 2014), our procedurally fair mechanism may induce managers to claim fairly in order to avoid the risk that workers veto an investment. If a manager claims fairly, the procedurally fair bidding rule lets us infer how much of the surplus workers are willing to sacrifice to satisfy the manager’s claim. For this, truthful bidding is desirable behavior. However, workers may want to gain more by lowering their bids, which questions the implementation of efficient investments. This motivates our main research questions:

Question 1 Do managers claim fairly?

Question 2 Do workers bid truthfully?

Both questions ask to test the fundamental assumption of self-interest in neoclassical economics. In view of considerable experimental evidence of unselfish behavior in experiments (see e.g., Camerer, 2003), we expect to see at least some departure from selfish behavior toward fair claims and truthful bidding by managers and workers, respectively. Workers could underbid less in response to fair managerial claims, and try to achieve more equal gains. In addition, truthful bidding reveals what is efficient, and prevents workers from accepting claims which would let them lose.

In addition to answering the main research questions, we test the robustness of our findings by manipulating the distribution of investment values and the information about them. The former manipulation is motivated by Hansmann's (1989) claim that heterogeneity of workers reduces the efficiency of collective decisions. The latter relates to principal-agent relationships in which workers are better informed about the true efficiency of an investment than the manager, and even compared to other workers since information asymmetries are likely "in large firms with substantial hierarchy and division of labor between management and the rest of the labor force" (see Hansmann, 1989, p. 1766). We test how heterogeneous investment values and asymmetric information about investment values affect managerial claims and workers' bids.

In summary:

1. We propose a procedurally fair bidding mechanism for co-determining investment decisions and their surplus division among managers and workers. The mechanism is fair by granting workers veto power which may induce managers to claim only a fair surplus share and by guaranteeing that workers are treated equally according to an objective criterion, i.e., their bids. However, strategic underbidding is dominant for opportunistic workers (as long as workers can gain).
2. We explore, via a controlled laboratory experiment, whether procedurally fair co-determination crowds-in ethical behavior of managers and workers in the form of fair surplus claims and truthful bidding, respectively. Additionally, we test the robustness of our findings by varying investment values and information about them, which captures worker heterogeneity and asymmetric information about the profitability of investments. Altogether, this seems like the first experiment which tests an institution granting decision rights to both, managers and workers.

The paper contributes to the theory and management of corporate governance by proposing and experimentally testing a procedurally fair institution that gives decision rights to workers, along with managers (on behalf of shareholders). Hong and Plott (1982) conducted a laboratory experiment to explore the potential consequences of proposed policy changes in the transportation market of inland waterways. Since then, the experimental approach has been used to provide advice with scientific evidence on questions of policy (see Roth, 1995, Sect. 2). This also includes the designing and testing of institutions with desirable properties.

Our proposed institution resembles the model of 'enlightened corporate governance' by Brink (2010), in which workers are residual claimants due to bearing a residual risk of specific investments. Unlike Brink's model, in our mechanism workers' bids do not represent claims but rather concessions to satisfy managerial claims: Workers' bids express their willingness to support investments which are truly efficiency-enhancing.

The paper proceeds as follows. The "Co-determination via procedurally fair bidding" section describes the procedurally fair bidding mechanism and its properties in detail. "The experiment" section explains the experimental implementation of the mechanism. The "Results" section presents the experimental results. The "Conclusions" section discusses and concludes.

Co-determination via Procedurally Fair Bidding

The Game

The experimental setup involves a manager and three workers who must collectively decide between two investment options—one safe and one risky—each of which could substitute the status quo of no investment. The motivation of implementing the risky investment is related to property rights, one of the justification of co-determination (Jansson, 2005): Property rights are assigned to all risk takers of the firm, including workers, hence they should be involved in risky decision-making.

The procedurally fair bidding mechanism asks the manager to state a surplus claim for each investment; after announcing the claims, each worker independently submits monetary bids for both investments. Co-determination via bidding allows the three workers to render an investment acceptable (or unacceptable). A manager can implement any acceptable investment but is not obliged by acceptance, that is, they may decide against an investment even if it is acceptable.

In the following we denote by:

- M the only manager-participant, and
- 1, 2 and 3, or non-Ms, the three worker (non-manager) participants.

All four members collectively represent a firm which can:

- maintain its status quo with neither gains nor losses for its M and non-Ms or engage in:

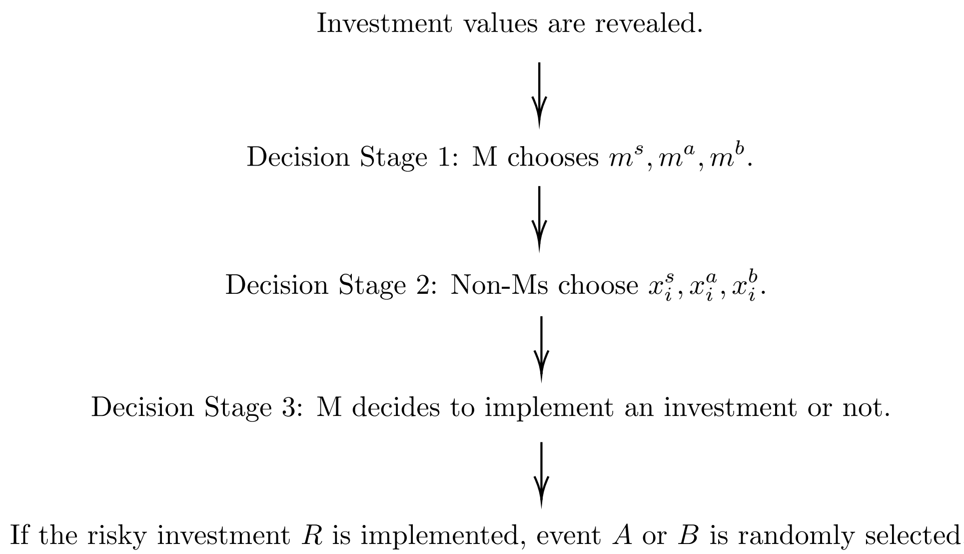

Fig. 1 Timeline of the decision process

- a safe investment S with worker investment values v_1^s, v_2^s and v_3^s, for participants 1, 2, and 3, respectively, or alternatively
- a risky investment R whose worker investment values are
  - v_1^a, v_2^a and v_3^a in case of random event A and
  - v_1^b, v_2^b and v_3^b in case of random event B

where the values $v_i^\#$ for $\# = s, a, b$ and $i = 1, 2, 3$ can be positive or negative. Regarding random events A and B, we may think of 'boom' and 'doom', respectively, since v_i^a-values are, on average, substantially larger than v_i^b-values. Although the mechanism does not require this, we experimentally induced 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.

Figure 1 shows the timeline of the game. There are three decision stages:

Decision Stage 1 M states claims for the safe investment S, denoted by m^s, and for each of two random events, A and B, in case of the risky investment R, denoted by m^a and m^b;

Decision Stage 2 Knowing M's claims m^s, m^a and m^b, non-Ms state (positive or negative) bids x_i^s, x_i^a and x_i^b where $i = 1, 2, 3$; investments S and R are only acceptable when the sum of the corresponding bids, $X^\# = \sum_i^3 x_i^\#$ for $\# = s, a, b$, respectively, guarantees M's claim. So:

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

Decision Stage 3 If S or R, or both investments are acceptable, M can implement one acceptable investment alternative or not; if neither S nor R is acceptable or if M does not implement any acceptable investment, the status quo is maintained.

These decisions imply the following earnings:

- if the status quo is maintained, both M and non-Ms earn nothing;
- if the safe investment S is acceptable and implemented by M,
  - M earns the claim m^s and
  - non-M participant $i = 1, 2, 3$ earns $v_i^s - x_i^s + \frac{X^s - m^s}{3}$;
- if the risky investment R is accepted and implemented by M, then earnings depend on the random event A or B:
  - M earns the claim $m^\#$ and
  - non-M participant $i = 1, 2, 3$ earns $v_i^\# - x_i^\# + \frac{X^\# - m^\#}{3}$,

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

The minimal earning by non-M participant $i = 1, 2, 3$ is

$$g_i^\# = v_i^\# - x_i^\# \quad \text{for} \quad \# = s, a, b,$$

since participant i earns at least $g_i^\#$ when the investment is implemented and $X^\# \geq m^\#$ holds.

Properties

The bidding rule has three desirable properties:

Property 1 *Voluntariness*. Since investing requires acceptability, one always has $X^\# - m^\# \geq 0$ for $\# = s, a, b$, which guarantees:

$$x_i^\# - \frac{X^\# - m^\#}{3} \leq x_i^\#,$$

that is, non-M participant i never pays more than the own bid $x_i^\#$ for $\# = s, a, b$.

Property 2 *Equal net gains with respect to bids* in case of common truthful bidding of all workers. If $v_i^\# = x_i^\#$ for $\# = s, a, b$ and $i = 1, 2, 3$, all non-Ms earn the same, namely:

$$v_i^\# - x_i^\# + \frac{\sum_j^3 x_j^\# - m^\#}{3} = \frac{\sum_j^3 v_j^\# - m^\#}{3}$$

when investment S or R is implemented, or nothing when the status quo is maintained.

The procedurally fair bidding rule disregards the values that workers attach to investments and treats them equally according to their bids, which guarantees actual equality when all workers bid truthfully.

Property 3 *Overbidding proofness*. Any bidding strategy with bid $x_i^\#$ exceeding i's value $v_i^\#$ for $\# = s, a, b$ 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 worker can even block an investment by bidding low enough.

Altogether the mechanism is procedurally fair by allowing non-Ms to bid sufficiently low to veto any unfair claims by M. While M always receives the claim $m^\#$, non-M's bid $x_i^\#$ is the maximum amounts they are willing to forego.

Predictions

Assuming worker's opportunism (own profit maximization) implies:

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

$$x_i^\# < v_i^\# \quad \Leftrightarrow \quad g_i^\# > 0$$

for $i = 1, 2, 3$ and $\# = s, a, b$.

This is because bidding equal to or above own value is weakly dominated by underbidding the own value by 1 unit.

When anticipating worker opportunism, and being aware of their values, M exploits the first-mover advantage by claiming almost the entire surplus, that is non-Ms value sum minus 3 Each worker should expect this and underbid by 1 and accept M's claim, like in ultimatum games.

Conjecture 2 M will claim the aggregated value of all non-Ms, $V^\# = \sum_i^3 v_i^\#$ for $\# = s, a, b$, minus 3,

$$m^\# = V^\# - 3, \tag{1}$$

expecting that each non-M bids own value minus 1:

$$x_i^\# = v_i^\# - 1 \quad \Leftrightarrow \quad g_i^\# = 1$$

when the total value is larger than 3, $V^\# > 3$, as in our experiment.

To answer Question 1: If M claims fairly, this would reject Conjecture 2. While claiming $V^\# - 3$ is the best strategy when assuming opportunistic non-Ms, it might be behaviorally unappealing because ethical non-Ms might find such a claim unfair and unacceptable even though they would lose by rejecting at least 1 unit each. We do not exclude the possibility of an ethical M, who is intrinsically motivated to equally share the surplus. Our experiment will test if M claims $V^\# - 3$ or significantly less.

Regarding Question 2, whether non-Ms bid truthfully, let us examine Conjecture 1. Opportunistic non-Ms would underbid till their total bid equals M's claim:

$$X^\# = m^\# \quad \text{if} \quad m^\# \leq V^\# - 3. \tag{2}$$

When $m^\# < V^\# - 3$, non-Ms face a difficult coordination problem due to the many combinations of bids $(x_1^\#, x_2^\#, x_3^\#)$ which satisfy exactly $X^\# = m^\#$. Even when M claims a fair share, non-Ms may not render the investment acceptable due to coordination failures. Hence, we ask whether non-Ms prefer truthful bidding,

$$x_i^\# = v_i^\# \quad \Leftrightarrow \quad g_i^\# = 0, \tag{3}$$

more than strategic underbidding. Common truthful bidding has two advantages, efficiency and equality. This is behaviorally simple and avoiding the coordination problem via non-Ms accepting an investment only when $V^\# \geq m^\#$. Furthermore, non-Ms earn the same regardless of how values $(v_1^\#, v_2^\#, v_3^\#)$ are distributed (see Characteristic 2 of procedurally fair bidding). Our experiment will test if these advantages induce non-Ms to bid truthfully.

The Experiment

Treatments

The laboratory experiment distinguishes treatments which vary the investment values of workers and information about them from public to private. We adopt a within-subjects design by letting all participants experience all treatments.

Table 1 Order of the 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

Therefore, socio-demographic characteristics are constant across treatments.

All participants go through nine decision rounds. Each round proceeds in the three stages of the decision process, described in "The game" section (see also Fig. 1). At the beginning of the experiment, participants are randomly split up into groups of four and then randomly assigned to roles, either M or one of the three non-Ms. Group matching and roles are maintained throughout the experiment.

Information Conditions

The nine decision rounds are divided in three phases with three rounds each (see Table 1). Phases 1, 2 and 3 differ in their information conditions: public (*Pub*), semi-private (*SemiPri*), and private (*Pri*) (see Table 2). The three phases are preceded by a practice phase of three rounds with information condition *Pub*. 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, that is, participants are not monetarily rewarded.

In all information conditions, non-Ms always know their own values for the safe investment as well as for the two realizations of the risky investment.

In *Pub*, both M and non-M participants know the investment values of each non-M, and the total value for each investment and random state.

In *SemiPri*, non-M participants are only informed about their own values, while participant M is only informed about the total value for each investment and random state. This allows to explore whether not knowing about other non-Ms' values renders it more difficult for workers to collectively accept an investment, and whether M, aware of this difficulty faced by workers, will claim less, even though M knows the total investment values.

Finally, *Pri* is like *SemiPri* for non-M participants, but does not inform M about the total investment value. We test whether non-M participants are better off by not having their investment values revealed to the manager. *Pri* is a particularly relevant scenario given that in the field managers often do not know an investment value as well as workers. Without knowing $V^{\#}$, the manager's claim may be less than $V^{\#} - 3$, Conjecture 2's prediction. Behaviorally, one could expect that M in *Pri* infers from previous tasks the range of non-Ms' total value because the investment values are approximately the same across phases. By the end of Phase 2, M has observed the total values for nine rounds (including the practice phase). Our expectation is that M cautiously demands less than the expected total value.

The *Pub* treatment confronts participants with more parameters, compared to *SemiPri* and *Pri* treatments. The latter treatments challenge participants instead with substantial uncertainty and ambiguity. We consider the latter difficulty as more challenging, and have implemented the three information conditions only in the above order of increasing cognitive difficulty.

Investment Valuations

The three rounds in each phase vary the investment values. Specifically, in Round 1, all non-M values are (approximately) equal for all investment options; in Round 2, one non-M has the highest values for all investment options while another non-M has the lowest (negative) values; in Round 3, any non-M can have the highest or lowest (negative) value depending on the implemented investment (see Table 3). In each round, non-M participants receive randomly assigned monetary values of Set 1, 2 and 3. To avoid confronting participants with already experienced investment values, each value is perturbed by noise via a randomly determined error term $\epsilon_i^{\#}$ from the set $\{-40, -30, -20, -10, 0, 10, 20, 30, 40\}$. Although participants know that the investment values are randomly assigned, they are unaware of random assignment, of the three sets of values, and of the distribution of error terms $\epsilon_i^{\#}$.

We were particularly interested in the effects of asymmetric investment values among non-Ms (Rounds 2 and 3) and on how non-Ms' bids interact with M's claims, reckoned that non-Ms may struggle more to accept M's claim in Rounds 2 and 3 than in Round 1 in which non-Ms' expected values are symmetric. So, in Phase 1 (*Pub*), when M knows each non-M's value, M might be willing to claim less in Rounds 2 and 3 when fearing that non-Ms' struggle more. For this reason, it seems difficult to predict the effects of asymmetric investment values for the probability of acceptance.

Table 2 Information conditions in the experiment

Information condition	M's information	Non-M i's information
Pub	$v_j^{\#}$ for all #, $j = 1, 2, 3$	$v_j^{\#}$ for all #, $j = 1, 2, 3$
SemiPri	$V^{\#}$ for all #	$v_i^{\#}$ for all #
Pri	No information	$v_i^{\#}$ for all #

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	$1500 + \sum_i^3 \epsilon_i^s$	$3000 + \sum_i^3 \epsilon_i^a$	$750 + \sum_i^3 \epsilon_i^b$

Procedures

Each participant was paid the sum of earnings in three randomly selected rounds in addition to a €5 show-up fee. Specifically, one round was randomly selected in each of the three phases for payment. The conversion rate was 100 experimental currency units (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 could not overbid by more than 166 ECU: $x_i^\# - v_i^\# \leq 166$ for $\# = s, a, b$ and $i = 1, 2, 3$.

Participants were students of various scientific disciplines at the Friedrich Schiller University in Jena (Germany), recruited by using ORSEE (Greiner, 2015). Due to the relative complexity of the experimental tasks, we decided to limit participation to students of STEM disciplines. Since each participant faced all treatments, we did not control for demographic characteristics. The experiment was computerized using z-Tree (Fischbacher, 2007). Upon arrival, each participant was randomly allocated to a cubicle and seated in front of a computer. Participants received written instructions (see the translated instructions in Appendix A), which were also read aloud to make them commonly known. After reading the instructions, some extra time enabled participants to read the instructions at their own pace. After everyone finished reading the instructions, participants had to answer eight control questions (see Online Appendix B) before being randomly assigned to groups (firms) of 4 and roles (either M or non-M). 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 ethical priming by alerting participants to the desirable properties of the procedurally fair bidding rule (see the "Properties" section), whose implications could be seen as experimenter demand effects (see Zizzo, 2010). Participants just learned about the procedurally fair mechanism via reading the instructions, answering the related control questions, and experiencing three practice rounds before confronting the incentivized decision tasks. In four sessions, we added a paragraph to the instructions (see the paragraph in section "What are the payoffs?" of Online Appendix A), which specifically assumes negative monetary values (which might increase the cognitive challenge for participants) and illustrates possible losses when overbidding a negative value which can be avoided by not overbidding. We refer to these sessions as 'nudging sessions', since the amended instructions discourage overbidding in case of lowest and negative values. However, there were no significant effects of adding this paragraph to the instructions (Online Appendix C.3 reports the regression analysis).

Results

Main Findings

Regarding Question 1, whether M claims fairly, we consider M's claim ratio, that is, M's claimed share of the total investment value. From Eq. (1) of Conjecture 2, the share of the value claimed by an opportunistic manager is

$$m^\# / V^\# = 1 - 3/V^\#.$$

Figure 2 plots the claim ratio against non-Ms' total values of safe and risky investments (its two random realizations *A* and *B*) in each round of the three information conditions (*Pub*, *SemiPri*, and *Pri*). In all information conditions, almost all data points lie well below the curve of $1 - 3/V^\#$, showing that M participants claimed systematically less. The average claim ratio is 29.5%. A paired-sample *t*-test rejects Eq. (1), that is, M's claims were significantly smaller than predicted (see the first column of Table 4).

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

Result 1 reveals the usual fairness concerns as robustly confirmed by the even more stylized ultimatum experiments with just one responder (see Güth and Kocher, 2014).

We now turn to Question 2, whether non-M participants bid truthfully. Figure 3 is a scatter plot diagram of non-M's bids against their values. Most bids are below the 45-degree line representing truthful bidding. A paired-sample *t*-test

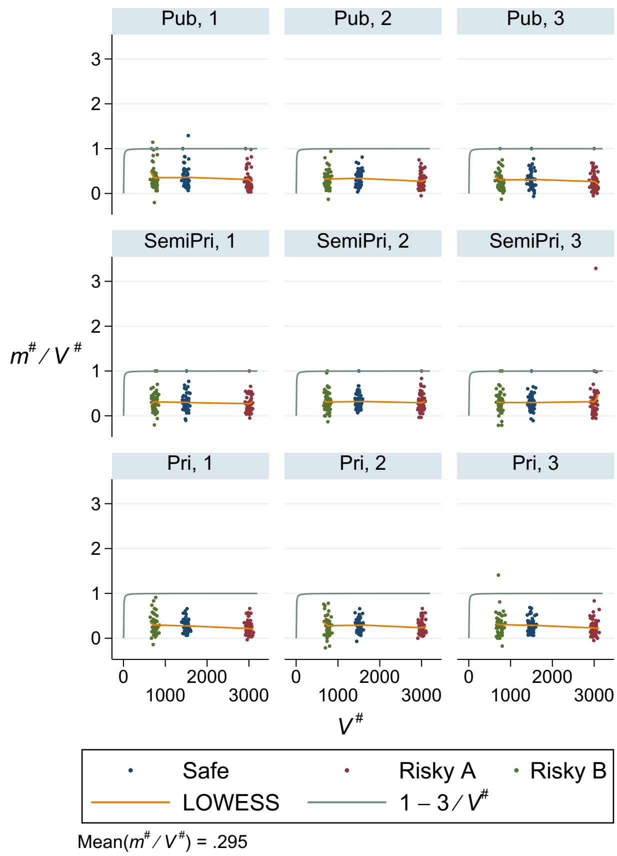

Fig. 2 M's claimed share of the total value $m^\# / V^\#$

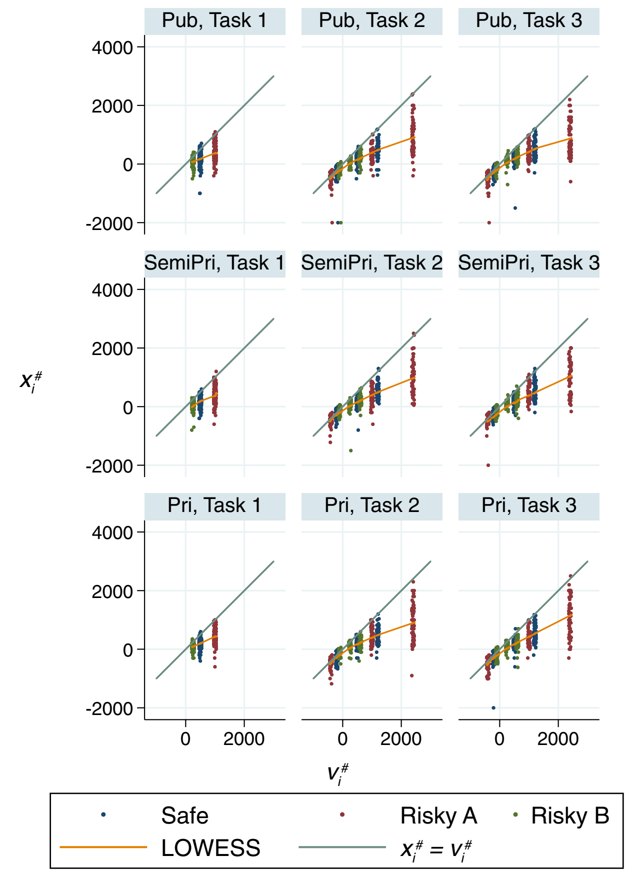

Fig. 3 Non-M's bid $x_i^\#$ against own investment value $v_i^\#$. *Notes:* In addition, there are four bids equal to −9999 (the smallest number a non-M player was allowed to input) and one bid equal to −4000. We do not plot these observations to avoid extremely vertically long diagrams

Table 4 Block bootstrap of paired-sample *t*-test on Eqs. (1), (2) and (3)

Null hypothesis	$m^\# = V^\# - 3$	$X^\# = m^\#$	$x_i^\# = v_i^\#$
Equation	(1)	(2)	(3)
t-value	− 49.51***	2.509	− 55.47***
	(2.846)	(2.533)	(6.534)
Observations	1,134	1,679	6,804

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 to solve the dependency problem: Since M and three non-Ms in each group are interacting throughout the experiment, their decisions are not independent from each other. 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. (2) uses the observations that satisfy $m^\# \leq V^\# - 3$

rejects the null hypothesis of truthful bidding, $x_i^\# = v_i^\#$ (Eq. 3), hence strategic underbidding is statistically significant (see the third column of Table 4). Non-Ms seem to be aware of their opportunistic underbidding incentives.

Result 2 Bids are significantly lower than values. Non-Ms do not bid truthfully.

As non-M participants underbid their investment values, we explore whether they try to maximize their individual profits by aiming at equilibria with $X^\# = m^\#$ (Eq. 2). We plot the ratio of the excess total bid $X^\# - m^\#$ to the total value $V^\#$ in Fig. 4. On average, the excess total bid does not appear to differ significantly from the equilibrium level of zero. This is confirmed by the paired-sample *t*-test in Table 4 (see the second column). We cannot reject the null hypothesis of M's equilibrium behavior.

However, there is substantial variance in the excess total bid around the zero benchmark in Fig. 4 that results in non-Ms vetoing 43.3% of M's claims. This does not support Conjecture 2 that in equilibrium non-Ms always accept M's claims as long as $m^\# \leq V^\# - 3$. Figure 5 shows the histograms of M's claimed share of non-Ms' total value when M's claim is accepted and vetoed. As the vetoed claims tend to be larger than the accepted claims, we statistically test if

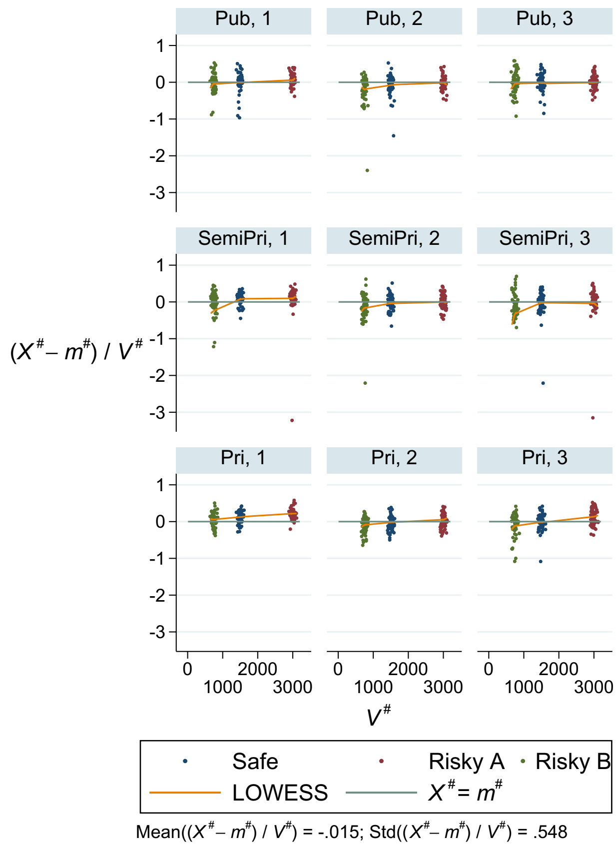

Fig. 4 Ratio of the excess total bid to non-Ms' total value $(X^\# - m^\#)/V^\#$. *Notes:* The graphs report only observations satisfying $m^\# \leq V^\# - 3$

M's claim and the chance of acceptance are negatively correlated. Since the dependent variable is binary ('Accepted' or 'Not accepted'), we adopt a probit model.[1] The estimated coefficient of M's claim ratio is significantly negative (see Regression (1) of Table 5). Using the probit estimation, we draw the predicted acceptance probability in Fig. 6. The downward-sloping curve, colored blue, demonstrates that the larger the share of investment value which M claims, the less likely non-Ms accept them.

The negative effect of M's claim on the acceptance probability implies non-M's ethical behavior: They veto when they view M's claim as unfairly large, similar to unfairly low offers being rejected by responders in ultimatum experiments (see Güth & Kocher, 2014). But the negative effect is possible even when non-Ms are opportunistic: The attempt of non-Ms to collectively bid exactly M's claim tends to fail more often as M's claim increases, similar to threshold public goods experiments, whose contributors are less likely to coordinate in reaching exactly the provision point when the threshold is high (see Croson & Marks, 2000).

We cannot exclude the latter reason because many non-acceptances are observed when M claims less than a quarter of the total value, an equal split among M and the three non-Ms (see the bottom histogram of Fig. 5). More specifically, Regression (1) predicts that 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. In fact, our statistical analysis indicates that non-M's decisions are

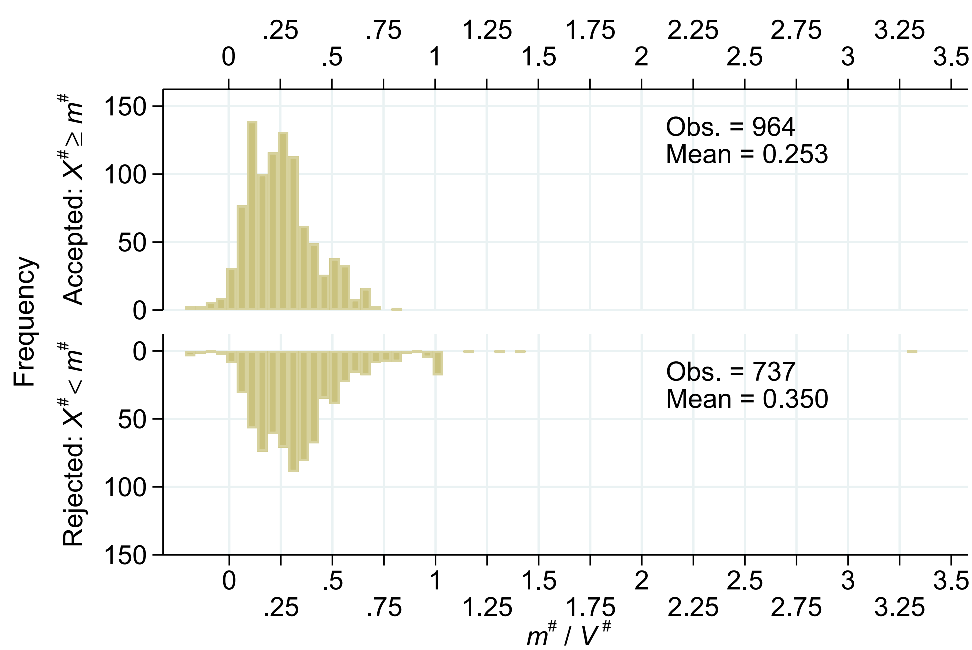

Fig. 5 Histogram of M's claimed share of the total value $m^\#/V^\#$

[1] The probit model fits better than the logit model according to the Akaike's information criterion.

Table 5 Probit models of the acceptability of M's claim

Regressions	(1)	(2)	(3)
Variables	Accept	Accept	Accept
M's claim ratio $m^{\#}/V^{\#}$	− 2.478***	− 2.483***	− 2.468***
	(0.268)	(0.272)	(0.273)
Total value $V^{\#}$		0.000229***	0.000231***
		(3.62e-05)	(3.62e-05)
Phase 2 (*SemiPri*)		0.0267	0.154
		(0.0806)	(0.148)
Phase 3 (*Pri*)		0.207**	0.424***
		(0.0820)	(0.156)
Round 2		− 0.943***	− 0.798***
		(0.0847)	(0.141)
Round 3		− 0.743***	− 0.584***
		(0.0844)	(0.140)
Phase 2 (*SemiPri*) × Round 2			− 0.166
			(0.201)
Phase 2 (*SemiPri*) × Round 3			− 0.196
			(0.200)
Phase 3 (*Pri*) × Round 2			− 0.293
			(0.207)
Phase 3 (*Pri*) × Round 3			− 0.307
			(0.206)
Constant	0.902***	1.020***	0.906***
	(0.0963)	(0.145)	(0.162)
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: $X^{\#} \geq m^{\#}$, otherwise 0. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Random effect models clustered at group level

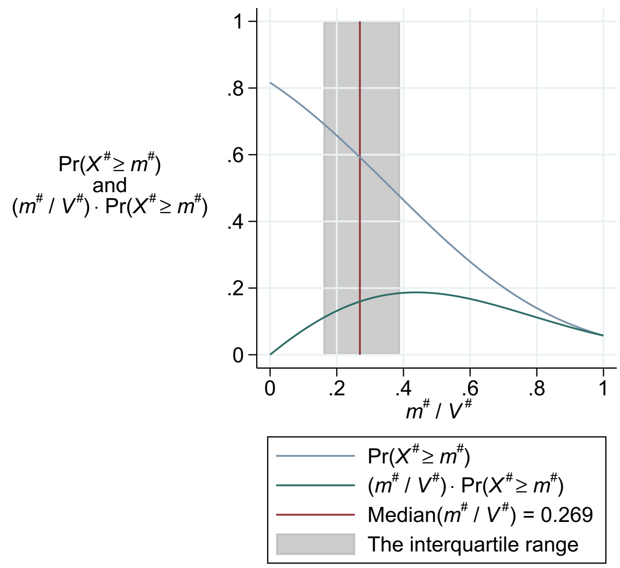

Fig. 6 Predictions of the acceptance probability of M's claim and the ratio of M's expected payoff to the total value based on the probit model (Regression 1), and the median and interquartile range of M's actual claim ratio

affected by the outcome of previous play. After non-Ms failing to accept M's claim, they tend to raise their bids in the following round and vice versa, while controlling for M's claim in the regression (for details, see Online Appendix C.1). If non-Ms are only concerned with equality, their bids should not change as long as M claims the same. This is another evidence supporting the second reason.

Facing the threat of very likely non-Ms' vetoing, we examine whether M claims the profit maximizing level or not. We derive the ratio of M's expected profit to the total investment value, i.e., the claim ratio multiplied by the acceptance probability. The inverse U-shape function in Fig. 6 has an apparent peak of the expected profit where M claims about 45% of the total value, and the interquartile range of the actual claim ratios is below. Possible reasons why M claims less than the estimated profit maximizing level include M's fairness concern and M's risk aversion. Another reason could be M's pessimistic belief regarding the likelihood of non-M's acceptance. This is similar to the proposer's pessimistic belief on responder's acceptance probability in Ultimatum game experiments (see Henrich et al., 2001; Costa-Gomes & Zauner, 2001).

We conclude this section by summarizing our answers to Questions 1 and 2. On average, M claims only 29.5% of the total value, and much fairer than the claim predicted by opportunistic non-Ms (Conjecture 2). Even when M's claim is fair, non-M participants do not bid truthfully, and instead engage in bid shading, as described by Conjecture 1. We do not find evidence that non-Ms' total bids differ from their equilibrium level but confirm substantial heterogeneity resulting in frequent nonacceptance.

Additional Findings on Treatment Effects

This section analyzes how information conditions and asymmetric investment values influence M's claim and non-Ms' bids. We begin with the likelihood of accepting M's claim and adding treatment variables to our probit model (see Table 5). The implications of Regression (2) are as follows:

- Information condition *Pri* significantly enhances acceptance, whereas *SemiPri*'s effect is insignificant. Hence, the effect depends on whether M knows the total value or not rather than whether M and non-Ms know every individual non-M's value.
- Asymmetry of values in Rounds 2 and 3 negatively affects acceptance across all information conditions (the coefficients of the added interaction variables between

Table 6 Linear regressions of the ratio of M's claim to the total value $m^{\#}/V^{\#}$

Regressions	(4)	(5)
Variables	Claim ratio	Claim ratio
Total value $V^{\#}$	− 1.93e-05***	− 1.93e-05***
	(3.80e-06)	(3.80e-06)
Phase 2 (*SemiPri*)	− 0.0390***	− 0.0463***
	(0.0123)	(0.0151)
Phase 3 (*Pri*)	− 0.0730***	− 0.0790***
	(0.0123)	(0.0151)
Phase 1 (*Pub*) × Round 2	− 0.0293*	− 0.0293*
	(0.0151)	(0.0151)
Phase 1 (*Pub*) × Round 3	− 0.0471***	− 0.0471***
	(0.0151)	(0.0151)
Phase 2 (*SemiPri*) × Round 2		0.0130
		(0.0151)
Phase 2 (*SemiPri*) × Round 3		0.00895
		(0.0151)
Phase 3 (*Pri*) × Round 2		0.00663
		(0.0151)
Phase 3 (*Pri*) × Round 3		0.0114
		(0.0151)
Constant	0.375***	0.375***
	(0.0220)	(0.0220)
Observations	1,701	1,701
Number of groups	63	63

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

information conditions and round number in Regression (3) are all statistically insignificant).

- Additionally, non-Ms more likely accept M's claim when the investment value is large.

Further regressions analyze whether the higher acceptance probability in *Pri* is due to a decrease in M's claim or an increase in non-Ms' bids, and what causes lower acceptance when investment values are asymmetric. Table 6 reports the results of linear regressions on M's claim ratio $m^{\#}/V^{\#}$ which corresponds to Fig. 2. Our findings from Regression (4) are as follows:

- M reduces the claim ratio by 3.90% points in Phase 2 (*SemiPri*), when M is informed about the total values but not of non-M's individual values, compared to the one in Round 1 of Phase 1 (*Pub*). In our view, M claims less to let non-Ms accept more easily, due to possibly assuming that non-Ms might have asymmetric values.
- The reduction in M's claim ratio is larger in Phase 3 (*Pri*): 7.30% points. M appears to claim more modestly when unaware of the total value.
- When M knows the investment values of each non-M participant (Phase 1, *Pub*), the claim ratio is smaller in Round 2 and Round 3 than in Round 1, with the effect being only mildly significant for Round 2. This can be explained by M participants assuming that for non-Ms coordinating how to guarantee M's claim is more difficult in case of asymmetric values. Regression (5) confirms that Rounds 2 and 3 in *SemiPri* and *Pri* have insignificant effects because M does not know whether non-Ms values are asymmetric or not.

Claiming less in Phase 3 (*Pri*) may explain the higher chance of acceptance. So, we focus on non-M's bids to find out why acceptance is less likely in Rounds 2 and 3.

We adopt tobit models because the upper limit of non-M's bid is the value plus 166 ECU (see "Procedures" section about the restriction on overbidding). Both regressions in Table 7 rely on the same models. Regression (6) uses all observed non-M bids. Since its estimated coefficients are strongly influenced by five extremely low bids, between −4000 and −9999, which is only wanting to block the investment, Regression (7) excludes these low bids. We conclude from the latter regression:

- The bid and the value have the following relationship for the reference categories (*Pub*, Round 1, Investment *S*):

$$x_i^s = \begin{cases} -89.3 + 0.412\, v_i^s & \text{if } v_i^s \geq 0 \\ -135.9 + 1.119\, v_i^s & \text{if } v_i^s < 0 \end{cases}, \tag{4}$$

  that is, if the value is positive, the bid increases by only 0.412 when the value increases by 1. However, if the value is negative, the bid decreases by 1.119 when the value decreases by 1. Thus a non-M with the highest positive value bids less than would be necessary to compensate another non-M with the lowest (negative) value. In addition, by comparing the intercepts of Eq. (4), we find that the bid decreases by 46.55 if the value is negative. Hence, total bids are lower in Rounds 2 and 3, compared to Round 1 (with no non-Ms having negative value). This accounts for the lower acceptance probability in Rounds 2 and 3. Furthermore, the difference in the slope coefficients of Eq. (4) suggests that underbidding escalates more when the positive value increases than when the negative value decreases. Fig. 3 also demonstrates that non-Ms with the highest values underbid most. We might have observed less underbidding when all investment values are negative.
- Non-M participants bid more in Phase 2 (*SemiPri*) and even more in Phase 3 (*Pri*) where it is not possible to disentangle between the effect of information condition and the experimentally imposed order.

Table 7 Tobit regressions of non-M's bid $x_i^\#$

Regressions	(6)	(7)
Variables	Bid	Bid
M's claim $m^\#$	0.117***	0.110***
	(0.0240)	(0.0226)
Investment value $v_i^\#$	0.418***	0.412***
	(0.0274)	(0.0263)
Dummy for $v_i^\# < 0$	− 85.19**	− 46.55***
	(34.67)	(13.96)
Investment value $v_i^\# \times$ (Dummy for $v_i^\# < 0$)	0.554***	0.707***
	(0.156)	(0.0677)
Phase 2 (*SemiPri*)	− 7.028	28.12**
	(37.88)	(11.49)
Phase 3 (*Pri*)	49.82***	48.82***
	(13.95)	(13.83)
Phase 1 (*Pub*) × Round 2	10.84	9.032
	(16.20)	(15.99)
Phase 1 (*Pub*) × Round 3	29.02*	27.46*
	(15.28)	(15.19)
Phase 2 (*SemiPri*) × Round 2	32.38	− 3.704
	(41.34)	(15.76)
Phase 2 (*SemiPri*) × Round 3	12.32	16.93
	(13.20)	(11.97)
Phase 3 (*Pri*) × Round 2	− 15.16	− 16.70
	(12.29)	(12.51)
Phase 3 (*Pri*) × Round 3	12.08	10.61
	(10.37)	(10.31)
Risky investment *A*	− 54.32**	− 31.74***
	(26.36)	(10.87)
Risky investment *B*	11.20	14.26
	(13.71)	(10.37)
Constant	− 88.78***	− 89.34***
	(23.65)	(22.28)
Observations	5,103	5,098
Number of groups	63	63

Notes: Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Mixed models clustered at the group level and the subject level. Robust errors are used due to heteroscedasticity. 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 (6) uses all the observations. Regression (7) excludes 5 observations of outliers in *SemiPri*, which are 4 observations of −9999 and 1 observation of −4000

- The effect of asymmetric values in Rounds 2 and 3 on bids is statistically insignificant for Phases 2 (*SemiPri*) and 3 (*Pri*) due to each non-M being unaware of the other non-M values. In Phase 1 (*Pub*), there is mild evidence that Round 3 bids are higher than Round 1 bids.
- The non-Ms increase their total bid only by $0.110 \times 3 = 0.330$ if M's claim increases by 1. Hence, a higher claim ends up with lower acceptance probability as shown in Fig. 6.

To sum up the treatment effects, acceptance of M's claim is more likely in Phase 3 (*Pri*) because M claims less and non-Ms bid more. We observe lower claims and higher bids in Phase 2 (*SemiPri*), however, without sufficiently enhancing acceptance. M's claim is less likely to be accepted in Rounds 2 and 3 when values are asymmetric since the non-M participant with the highest investment value underbids by large amount. Even though M tends to claim less in these rounds of Phase 1 (*Pub*), this does not compensate the underbidding by non-M participants.

Conclusions

We proposed and experimentally tested an institution that gives decision rights to managers (on behalf of shareholders) and workers. We began by (1) describing the desirable properties of the institution, and then (2) tested whether the institution crowds-in ethical behavior of managers and workers via a laboratory experiment. Although worker involvement in corporate governance can be justified in many ways (see e.g., Jansson, 2005), to the best of our knowledge, no previous study has specified and experimentally tested procedurally fair rules of corporate governance.

The proposed institution is procedurally fair in the sense of granting workers the power to veto an unfair surplus claim by the manager. To determine surplus sharing among workers, a bidding rule lets workers state their willingness to sacrifice own surplus in order to satisfy the manager's claim. The properties of voluntariness and overbidding proofness prevent workers from losses even when their investment values are negative and even when all the workers are opportunistic. If workers bid truthfully, the property of equal net gains among workers applies, although opportunistic workers would underbid.

Our findings do not support truthful bidding of workers but confirm ethical behavior of managers in the form of fair surplus claims. Even if managers claim fairly, efficient investments are often not implementable due to strategic underbidding of workers. Failure in coordination by opportunistic workers, who try to collectively bid to just guarantee the manager's claim, reduces the likelihood of accepting efficient investments. This likelihood is even lower when investment values are asymmetric, which is consistent with Hansmann's (1989) claim that collective decision-making among heterogeneous workers is less efficient. Instead, acceptability is more likely when information about the overall investment value is not shared with the manager. So ambiguity of investment values for managers reduces their claims and raises workers' bids. Thus, it seems best for opportunistic workers not to reveal their private information about investment values: Information asymmetry increases acceptance probability and what can be shared among workers.

Plausible explanations for workers' opportunism are the very stylized laboratory environment and that participants were university students whose imported values might considerably differ from those of actual workers or employees who would behave less selfishly due to their corporate identity concerns. Hence, one would likely observe significantly less opportunism when implementing the same protocol with real managers and workers as participants instead of students.[2]

A more controlled laboratory setting involves students whose ethical inclinations could be encouraged by informing them about the mechanism's desirable properties. For example, alerting participants that general truthful bidding leads to equal net gains among workers and guarantees the implementation of an efficient investment.

Future research could also explore the impacts of behavioral factors and institutional features which might induce workers to behave more ethically. Firstly, pre-play communication may induce workers to cooperate and increase the likelihood of truthful bidding. Secondly, competition among firms should make workers more interested in their firms' efficiency and enhance group identity, or corporate identity, increasing solidarity among workers, as well as between them and the management. Thirdly, sanctioning by other workers or the manager may deter or weaken workers' underbidding, although such sanctioning is difficult in case of private information about investment values.[3] Finally, unlike our experiment, a simplified setup without the manager seems suitable for worker-owned partnerships (for example, legal or medical experts with different competences and skills such as those discussed by Hansmann, 1989) whose few partners equally participate in determining major restructuring investments.

Finally, this study provides a foundation for further research on corporate governance, both theoretical and experimental. The proposed institution could be developed into practical institutional rules to regulate the duties of shareholders and workers, and to coordinate their actions.

[2] See Gneezy and Imas (2017) for a discussion of the pros and cons of using 'lab-in-the field' experiments. The main advantage of such experiments is that employing the 'theoretical population', i.e., the population that the model is representing, increases the 'external validity' of the findings.

[3] The interested reader may refer to popular behavioral studies: Balliet (2010) for a meta-analysis of the role of communication in social dilemmas; Chen and Li (2009) for the effect of competition on in-group cooperation; Fehr and Gächter (2000) and Croson and Marks (2001) for coordination in threshold public goods games; and Abbink and Hennig-Schmidt (2006) for using rich vs neutral frames in economic experiments.

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Declarations

Conflict of interest The authors declare that they have no conflict 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.

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