Dominated Contract in Team Production

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Abstract: We experimentally investigate the effect of a dominated contract in team production, which punishes low output but does not reward high output. We consider three systems of implementing the dominated contract: exogenous, voting, and leadership. We find that teams choose the dominated contract in the latter two systems. Moreover, when the dominated contract is implemented, it is equally effective in improving the efforts across the three systems. Finally, we identify the incidence of negative information effect in endogenous institutions: revealing information about others' contract choices may backfire and harm efficiency.

Keywords: dominated contract, cooperation, coordination, endogenous institutions, laboratory experiment.

JEL codes: C72, C91, C92

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1 Introduction

In his seminal work on team incentives, Holmstrom (1982) observes that teamwork, while benefiting from complementarity in production, may suffer from the free-riding problem due to imperfect observability of individual inputs. To overcome this moral hazard problem, Holmstrom (1982) proposes a non-linear "budget-breaking" contract that either punishes or rewards the team contingent on joint output.[1] Similar forms of non-linear contracts have been implemented and proven successful in promoting efficiency (e.g., Spraggon, 2002; Friebel et al., 2017).[2]

These existing studies have relied on the role of a principal in designing and imposing optimal incentive schemes for the team. In the absence of a principal, a self-managing team, for example, shareholders or coauthors, may desire to establish rules to motivate themselves. Interestingly, some of these rules manifest a "budget-breaking" structure. For example, a group of salesmen may jointly decide to forgo their bonus should they underperform; coauthors may submit their paper to a conference at an early stage, even before there is a complete draft. The "contracts" in these examples seem dominated, that is, the salesmen always earn more without the contract or the coauthor can choose to submit whenever they complete the daft. However, these contracts are endogenously chosen by the teams because with a "budget-breaking" structure, these contracts may mitigate the moral hazard problem in teams and eventually improve productivity.

In this study, we experimentally investigate the following question: whether a team itself can implement seemingly dominated incentives that are potentially efficiency-enhancing and, if so, how endogenously implemented incentives affect team productivity differently from exogenously imposed incentives. In our experiment, subjects form teams of two and play team production under the conventional revenue-sharing incentive first. They are then given the chance to switch to a strictly dominated incentive scheme, which, compared with the revenue-sharing scheme, imposes an additional uniform cost on each team member should the efficient output level is not reached. The dominated scheme inherits the key feature of budget breaking, as proposed by Holmstrom (1982), as it generates payoff discontinuity around the efficient

[1] Other solutions for moral hazard in teams include monitoring (Alchian and Demsetz, 1972), competition (Lazear and Rosen, 1981), social norms (Kandel and Lazear, 1992), and long-term interaction (Che and Yoo, 2001).

[2] Monitoring and competition have also been shown effective in the laboratory or field settings (e.g., Grosse, Putterman and Rockenbach, 2011; Bandiera, Barankay and Rasul, 2013). Other studies have also identified factors that affect team productivity, such as framing (Hossain and List, 2012) and feedback (Hamilton, Nickerson and Owan, 2003).

output level. This discontinuity gives rise to a new symmetric equilibrium in which each team member exerts the same effort to generate an efficient output, in addition to the usual free-riding equilibrium. The additional cost can be interpreted as either reward or punishment for reaching/not reaching the target should one take different baseline schemes as the reference point, and we frame it as loss here to make it difficult for the team members to voluntarily choose the dominated scheme even though the scheme itself can sustain efficient output as an equilibrium, while the revenue-sharing scheme cannot.

In addition to exogenous imposition, we consider two systems that may endogenously implement the dominated incentive scheme: unanimous vote and random leadership. In unanimous vote, both members first vote between the revenue-sharing scheme and the dominate scheme, and then the voting outcome is revealed, and whichever scheme receives unanimous vote will be implemented. In case non-unanimity occurs, the random tie breaking rule determines the scheme to be implemented. In random leadership, both members also vote for their preferred scheme first, yet only the (thereafter) randomly selected leader's choice is revealed and implemented. Note that the selected leader in random leadership is unaware of the vote of the other team member.

Our main findings are threefold: First, under the dominated scheme, whether exogenously imposed or endogenously chosen, both subjects' efforts and payoffs increase, compared with that under the baseline revenue-sharing contract. Moreover, the free-riding problem is almost eliminated under the dominated scheme as the total output approaches the efficient level. Second, despite being effective, the dominated scheme is not always implemented by the team when the members can make choices. The individual voting rate for the dominated scheme exhibits an increasing trend over time and stabilizes after a few rounds at approximately 70/80 percent in unanimous voting/random leadership. The slight difference between the two systems may be rooted in the information difference mentioned earlier. Lastly, once the dominated scheme is implemented endogenously, conditional on one member voting for the dominated scheme herself, we observe an asymmetric effect of information about the other member's contract choice. In particular, compared with no information, knowing the other team member does not (does) vote for the same scheme has a significant negative (no significant) effect on one's own effort. This suggests that ignorance of the other member's choice under random leadership becomes a bliss for the team as it removes the potential negative information effect on the leader.

Our study contributes to two strands of the literature. First, existing laboratory and field studies have documented the positive effects of different exogenous team incentives, but only a few have focused on non-linear team contracts (Nalbantian and Schotter, 1997; Spraggon, 2002; Friebel et al., 2017). To the best of our knowledge, even fewer have considered endogenous implementation of team contracts.[3] In relation to this, this study introduces different systems into team production and finds that teams can endogenously implement a dominated contract, which eventually eliminates the moral hazard problem and raises team productivity. Notably, the dominated contract also works well when exogenously imposed in our setting, which is in contrast to the findings of Nalbantian and Schotter (1997), and such differences may be accounted for by the distinctions in contract specifications (see subsection 1.1 for details) or the cultural differences between subjects (Kocher et al., 2016; Vollan et al., 2017).

Second, our design of different systems helps deepen the understanding of how endogenous choice may take effect in team production. The literature on endogenous institutions predominately focuses on the system of voting and has identified three main channels that may lead to an overall outperformance of endogenous institutions: selection effect through sorting, information effect carried in the votes, and democracy effect stemming from the procedure of joint decision itself (by voting). While the selection and democracy effects have usually been found to significantly contribute to the effect of endogenous institutions, the information effect is often negligible and has been under-investigated (Dal Bo, Foster and Puttemann, 2010; Gallier, 2020). In light of this, our findings not only reveal a significant effect of information but also demonstrate that the information effect may at times backfire, and hence, it is not always best to give all team members the exact information.

The remainder of this paper is organized as follows. Section 1.1 discusses related literature. Section 2 presents the experimental design, and discusses the theoretical predictions and hypotheses. Section 3 presents the experimental results. Section 4 concludes.

1.1 Literature Review

[3] Some studies show that endogenous team formation by self-selection can enhance the effects of team incentives (Badiera, Barankay and Rasul, 2013; Cooper, Ioannou and Qi, 2018). The incentives in these studies are not designed to tackle the moral hazard problem.

Nalbantian and Schotter (1997) is among the first to systematically investigate different incentive schemes for teams in laboratory. One of their schemes, target-based forcing contract, is different from the dominated scheme considered here in that the team members are paid a flat wage (0) should they miss the target in their setting. Their forcing contract is also "budget breaking" and can support the efficient output as an equilibrium. Nalbantian and Schotter (1997) find that performance increases after switching to a target-based forcing contract from the baseline revenue-sharing contract. However, this effect vanishes in a few periods, as the team starts to fail the target. In a related study, Spraggon (2002) exogenously imposes a number of non-linear (not necessarily dominated) contracts and finds that only those contracts that result in unique efficient equilibrium eventually work. Comparing with these two studies, the dominated contact in our setting admits two equilibria and works well in sustaining the efficient outcome, even when exogenously imposed. There are two possible reasons for this difference. First, our dominated contract imposes a uniform cost and preserves the original (inefficient) equilibrium under the revenue-sharing contract, while Nalbantian and Schotter's (1997) forcing contract, by offering a flat payment, collapses the inefficient equilibrium output level to zero. Second, our experimental setup does not involve uncertainty in the total output as those in Nalbantian and Schotter (1997) and Spraggon (2002). Both factors contribute to making the efficient equilibrium in our setting less "risky" and more sustainable.[4] Other studies, such as Hossain and List (2012) and Friebel et al. (2017), exogenously implement target-based reward or punishment incentives in the field and find positive effects on team productivity.

Related to endogenous institutions, numerous recent experimental studies examine the role of endogeneity in promoting cooperation and efficiency (see Dannenberg and Gallier, 2020, for an excellent review). In public goods games and prisoner's dilemma games, many studies introduce endogenous choice for schemes involving punishment, reward, or minimum provision levels (e.g., Bohnet and Kübler, 2005; Gürerk, Irlenbusch and Rockenbach, 2006; Tyran and Feld, 2006; Kosfeld, Okada and Riedl, 2009; Sutter, Haigner and Kocher, 2010; Andreoni and Gee, 2012; Markussen, Putterman and Tyran, 2014; Kamei, Putterman and Tyran, 2015; Martinsson and Persson, 2019; Gallier, 2020). Depending on whether the group members can alter the size of reward or punishment at the ex-post stage, the rewarding/punishing

[4] A less relevant topic about dominated contract is threshold mechanism in public goods. In a threshold mechanism, players can enjoy the benefits of the public good if and only if the sum of their contributions exceeds a predetermined threshold. As such, a threshold mechanism seems "dominated" by the conventional non-threshold voluntary contribution mechanism while creating incentives to produce a cooperative and efficient outcome. This latter observation is confirmed by numerous experimental studies (e.g., Suleiman and Rapoport, 1992; Cadsby and Maynes, 1999).

schemes considered in these studies can be either enforceable or non-enforceable. A common finding in these studies is that institutions, once formed endogenously, have positive effects on cooperation and social welfare. Moreover, group members tend to prefer non-enforceable schemes over enforceable schemes (Markussen, Putterman and Tyran, 2014), and endogenously chosen non-enforceable schemes work better in promoting cooperation than the same exogenously implemented institutions (Sutter, Haigner and Kocher, 2010).

In our design, the dominated contract is enforceable. Moreover, our dominated contract converts the original game with a unique free-riding equilibrium into a coordination game in which a new efficient equilibrium arises. In light of this, Dal Bo, Foster and Putterman (2010) is the most closely related study. They consider a prisoner's dilemma game in which the players can vote whether to punish themselves for unilateral defection, so that the game essentially transforms into a coordination game where all players cooperating can be sustained as an efficient equilibrium. They find that endogenously chosen institutions lead to a higher level of cooperation compared with when they are exogenously imposed. Perhaps surprisingly, Dal Bo, Dal Bo and Eyster (2018), in a subsequent study, find that if there is an additional punishment for mutual defection so that cooperation becomes a unique equilibrium, subjects fail to appreciate the equilibrium effect and reject such an institution. In our study, the relatively low implementation rate of the dominated incentive scheme in voting/random leadership may have also been caused by such an underappreciation of the equilibrium effect.

To closely examine the different channels of endogenous institutions, numerous studies adopt the randomization technique developed by Dal Bo, Foster and Putterman (2010). The randomization decision system introduces an outsider that may overrule the voting outcome and randomly selects one institution to implement. By comparing two groups with the same voting outcomes in which one gets to implement the institution for which they have voted, while the other is overruled even though the same institution is randomly selected, Dal Bo, Foster and Putterman (2010) observe a significant democracy effect of endogenous institutions. Gallier (2020) adopt a similar technique in a public goods game with endogenous choice of a sanction scheme and decompose the endogenous institution effect into the information, democracy, and selection effects, in addition to the institution effect itself. A common finding in these studies is that the information effect is usually negligible. In our setting, we observe a significant information effect and demonstrate that information may not always be beneficial in endogenous institutions.

Finally, many laboratory and field studies have examined the effect of team incentives while allowing individuals to self-select into different schemes. Bandiera, Barankay and Rasul (2013) observe heterogeneous effects of rank incentives or tournament incentives among teams, which stem from changes in team composition due to self-selection. Cooper, Ioannou and Qi (2018) examine team production with effort complementarities (weak-link game). In their setting, individuals self-select through a market mechanism into an alternative contract, which, compared with the original contract, offers a lower base payment and a higher bonus payment for each unit increase in output. Note that the alternative incentive contract is not strictly dominated by the original contract, and it generates the same set of equilibria as the original contract. They find that the alternative contract, when implemented through sorting, performs better than when it is exogenously given in terms of shifting the outcome toward a higher coordination level.[5]

2 Experimental design and procedures, hypotheses

2.1 Treatment design

Our experiment adopts a team production environment in groups of two under different contracts. Table 1 summarizes the payoffs for each contract. In short, in a team of two members, each member exerts effort e_i with a quadratic cost e_i^2. The total output equals the sum of the efforts times 20. Contract A is revenue-sharing in that each member splits the total output, and the final payoff of each member equals the revenue shared minus the effort cost incurred. In contrast, Contract B (dominated contract) pays the same as the baseline contract if the total output exceeds 400 (equivalent to total effort exceeds 20) and imposes an additional cost of 35 for each member if the total output falls (strictly) below 400.

Table 1. Game payoffs

Game/Contract	**Payoff function**
Contract A	$u_i = 10\,(e_1 + e_2) - e_i^2$
Contract B	$u_i = 10\,(e_1 + e_2) - e_i^2, \quad if\ 20(e_1 + e_2) \geq 400$ $u_i = 10\,(e_1 + e_2) - e_i^2 - 35, \quad if\ 20(e_1 + e_2) < 400$

[5] With the involvement of time, Fahn and Hakenes (2019) demonstrate that present-biased individuals can choose to join team production to overcome inconsistency problems in a repeated setting. Our study focuses on the atemporal strategic effect of dominated contract on teams, and we would like to leave the question of how the strategic effect and time preference effect may interact in a temporal setting for future investigations.

The detailed experimental setting consists of three parts. At the beginning, the subjects read the instructions and answer some comprehensive questions.

Part I consists of the first 15 periods (periods 1–15) of the experiment. At the beginning of Part I, all subjects are randomly assigned to a matching group of six. In each of the 15 periods, the subjects in the matching group are randomly matched into pairs to play Contract A. The matching is anonymous to avoid the reputation effect. At the end of each period, subjects learn the total output of the team and their own payoffs during that period. This part of the experiment enables all subjects to familiarize themselves with Contract A.

Part II consists of the second 15 periods (periods 16–30) of the experiment. At the beginning of this part, subjects remain in the same matching group as that in Part I, with one-third of the groups randomly assigned to the Baseline treatment, one-third into the Voting treatment, and one-third into the Leader treatment. In all treatments, subjects are randomly matched into pairs in each of the 15 periods and play either Contract A or B and learn the total output as well as their own payoffs at the end of that period. The three treatments differ in the procedure for selecting the contracts.

Table 2. Treatments overview

Treatment	Periods 1–15	Periods 16–30	No. of subjects	No. of groups	No. of sessions
Baseline	Contract A, Exogenous	Contract B, Exogenous	90	15	8
Voting	Contract A, Exogenous	Contract A or B, Endogenous	90	15	8
Leader	Contract A, Exogenous	Contract A or B, Endogenous	90	15	8

In the Baseline treatment, the contract implemented in each period is fixed as Contract B. In the Voting treatment, the team members vote at the beginning of each period to decide which contract, A or B, should be implemented in the subsequent production stage. The voting rule is unanimity, and in case of a draw, Contract A or B is implemented with equal chance. After learning the exact vote shares as well as the chosen contract, the team members proceed to the production stage. In the Leader treatment, the team members first choose between Contracts A and B. Then, one of them is randomly chosen as the team leader, whose previously chosen contract will be implemented. After learning the leader of the team and their chosen contract,

the team members proceed to the production stage. Details of the different treatments are summarized in Table 2.

Part III consists of two individual decision-making tasks that aim to elicit individual risk preference and social preference with real incentives. We elicit subjects' risk attitude using a simple task proposed by Eckel and Grossman (2008), with one additional option to capture risk-seeking behavior. In this method, a subject chooses among six even-chance gambles that vary in expected value and variance. From Gambles 1 to 6, the expected value decreases, as does the variance. A higher choice indicates a higher level of risk aversion. Social preference elicitation follows a similar protocol. A subject chooses among seven allocations, each delivering certain payoffs for themselves and an anonymous person from a different experiment to be conducted by the researcher. The seven allocations vary in the degree of equity and efficiency, with allocation 1 being the most selfish option and allocation 4 the most efficient (see Appendix A for the detailed instructions of both tasks).

2.2 Procedures

The experiment was conducted at Wuhan University in November 2019. The subjects were recruited from the subject pool through Ancademy (a platform for social sciences experiments). We ran eight sessions in total. To minimize the session effect, we ran all three treatments simultaneously in each session. Each session consisted of 30 or 36 participants. A total of 270 Chinese subjects were recruited and equally distributed across the three treatments. The subjects were undergraduate students from various disciplines at Wuhan University. 41% were male. Table 2 presents the number of subjects, number of independent matching groups, and number of sessions in each treatment.

The experiment was computerized using z-Tree (Fischbacher, 2007) and was conducted in Chinese.[6] Upon arrival, subjects were randomly assigned a card indicating their table number and were seated in the corresponding cubicle. All instructions were displayed on their computer screens. Control questions were asked to check their understanding of the instructions. After completing the control questions for Part I (periods 1–15) and Part II (periods 16–30), the subjects were provided handouts of the summarized instructions of the corresponding part. The same experimenters were always present during the experimental sessions.

[6] The English translations are provided in Appendix A.

After finishing the experiment, the subjects received their earnings via WeChat payment privately. The average earnings were CNY 45 (approximately USD 7), including a show-up fee of CNY 15 (approximately USD 2). Each session lasted between 60 and 70 minutes.

2.3 Theoretical predictions

This section analyzes the theoretical predictions of the subjects' behavior in our experimental setting. We focus on symmetric equilibrium in the team production stage under different contracts and consider the notion of perfect Bayesian equilibrium when the selection of contract is endogenous.

Production Stage:

Contract A: Under Contract A, a unique equilibrium $(5,5)$ exists, as $e_i = 5$ is a dominant strategy for each team member. In the unique equilibrium, each member obtains a payoff of 75. Note that the efficient effort provision level is $(10,10)$, yielding a payoff of 100 for both.

Contract B: $(5,5)$ is still one equilibrium because the extra cost of 35 imposed is independent of the effort chosen. Notably, there arises one additional symmetric equilibrium $(10,10)$ because the additional cost of 35 generates payoff discontinuity around $(10,10)$, which makes the marginal gain at $e_i = 10$ sufficiently high to compensate for the marginal cost. Comparing the two equilibria, one can verify that $(5,5)$ is risk-dominant, while $(10,10)$ is payoff-dominant, and it remains undetermined which equilibrium shall arise under this contract.

Next, we analyze voting choices in endogenous institutions. Both the Voting and Leader treatments can implement Contract B with a certain chance in case the two members vote differently. If the efficient equilibrium can be achieved under such a scenario, then we believe that efficient equilibrium should also occur if both members vote for Contract B and Contract B is finally implemented. Therefore, we apply the following equilibrium selection criteria in subsequent analyses: if a team member chooses $e_i = 10$ along a path where she votes for A while B is implemented, then she must also choose $e_i = 10$ along the path where both vote for B.

Voting Treatment - Voting Stage:

In the Voting treatment, the exact distribution of votes is common knowledge, and the equilibrium can be characterized by how the two members exert stage-2 efforts conditional on stage-1 voting outcomes as well as the actually implemented contract. If both members can successfully coordinate at the more efficient equilibrium as long as Contract B is implemented, then voting for Contract B becomes a dominant strategy for both members at stage 1, since unilaterally choosing B can increase the likelihood of Contract B being selected in stage 2 and hence raise the expected payoff for each member. However, if the two members fail to coordinate at the efficient equilibrium whenever Contract B is implemented, they should both vote for Contract A at stage 1. Lastly, if the two members coordinate at the more efficient equilibrium only when both vote for B, then stage-1 voting again becomes a coordination game in the sense that the two members can either both vote for A or both vote for B. This is because voting differently results in an inefficient equilibrium under Contract B with a probability of 0.5, which is a strictly worse outcome compared with either both voting for A or both voting for B.[7]

Leader Treatment - Voting Stage:

In the Leader treatment, the leader does not know the vote of the other team member. Nevertheless, given the leader's chosen contract, the other team member shall always coordinate with the leader in equilibrium, even though they have more information. As a result, it suffices to characterize the equilibrium by how the two members exert stage-2 efforts conditional on which contract is selected by the leader. If the two members successfully coordinate at the more efficient equilibrium whenever B is selected by the leader, both will choose B at stage 1 because it is the dominant strategy. If the team members fail to coordinate at the more efficient equilibrium at stage 2, given Contract B is selected by the leader, both members should vote for A at stage 1 as it is again a dominant strategy.[8]

2.4 Hypotheses

According to the theoretical predictions in Section 2.3, we arrive at the following hypotheses to be tested in the experiment.

[7] Two members voting differently and coordinating at the efficient equilibrium if Contract B is eventually selected can also be supported as an equilibrium, if the outcome is inefficient along the path where both players vote for Contract B. However, such an equilibrium does not satisfy our selection criteria.

[8] There exist asymmetric equilibria in which one leader is favored in that the team exerts the efficient effort level only if B is chosen by this leader and later implemented. In this equilibrium, it is optimal for the other member in stage-1 to choose A, since the team will fail to coordinate at the efficient output if her B is implemented. Note that this equilibrium also violates our selection criteria as the "follower" is willing to exert efficient effort when she votes for A and the leader votes for B, but reduces her effort provision when both vote for B.

First, recall that the unique (symmetric) equilibrium (5, 5) under Contract A survives under Contract B, while the efficient effort level (10, 10) arises as an additional equilibrium under Contract B. As such, when Contract B is implemented, whether exogenously imposed by the experiment or endogenously selected by the team members, we expect the subjects to increase their effort compared with that under Contract A.

Hypothesis 1. *In all treatments, effort levels are higher under Contract B than under Contract A.*

Next, we consider the difference between the exogenous and endogenous institutions when Contract B is implemented. In both voting treatment and leader treatment, all equilibria that can implement Contract B at stage 1 involve both members coordinating at the efficient output level at stage 2. This is the equilibrium selection effect of endogenous institutions; hence, we expect the following endogeneity effect.

Hypothesis 2*. Effort levels are higher if Contract B is selected endogenously, compared with the case where it is exogenously imposed.*

Lastly, we compare the difference between two endogenous institutions. Compared with the voting treatment, the absence of information in leader treatment helps eliminate the strategic uncertainty at stage 1 because the two members in the voting treatment sometimes need to coordinate at stage 1, given that they fail to reach the efficient output level if their votes differ from each other. Such a difference leads us to hypothesize the following information effect between the two endogenous institutions.

Hypothesis 3. *The leader treatment implements Contract B more often than the voting treatment.*

3 Results

3.1 Efforts and payoffs under Contract A and Contract B

We begin by examining how subjects' behavior under dominated Contract B differs from that under conventional revenue-sharing Contract A. In total, there are six different conditions depending on the treatment and contract: *B-A, B-B, V-A, V-B, L-A, and L-B*. The first letter refers to the treatment names (B for Baseline, V for Voting, and L for Leader). The second letter refers to the contract implemented, Contract A or Contract B. *B-A* includes observations

of periods 1–15 in all the three treatments.[9] *B-B* includes observations of periods 16–30 in the Baseline treatment. *V-A* and *V-B* include observations of periods 16–30 in the Voting treatment: it is *V-A (V-B)* if subjects endogenously choose Contract A (B). Similarly, *L-A* and *L-B* include observations of periods 16–30 in the Leader treatment: *L-A (L-B)* means the leader of a pair endogenously chooses Contract A (B).

Figure 1. Effort level over time by contract and treatments.

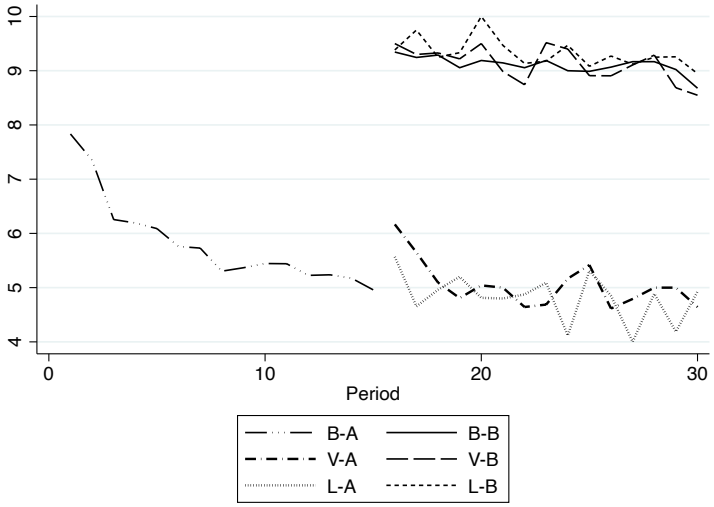


Figure 1 shows the average effort level over time for each condition. The effort levels under Contract A in the first 15 periods gradually decline and converge to an equilibrium level of 5. In the last 15 periods, the effort levels differ across different conditions. For those conditions implementing Contract A (*V-A* and *L-A*), the effort levels are close to the equilibrium level of 5. In contrast, for those conditions implementing Contract B (*B-B*, *V-B*, and *L-B*), effort levels are much higher and almost reach 10, the efficient equilibrium level.

Table 3. Effort levels by conditions

Condition	B-A	V-A	L-A	B-B	V-B	L-B
Effort levels	5.82	5.30	4.73	9.11	8.87	9.25
Test equal to B-A				(<0.001)	(<0.001)	(<0.001)
Test equal to V-A				(<0.001)	(<0.001)	(<0.001)
Test equal to L-A				(<0.001)	(<0.001)	(<0.001)

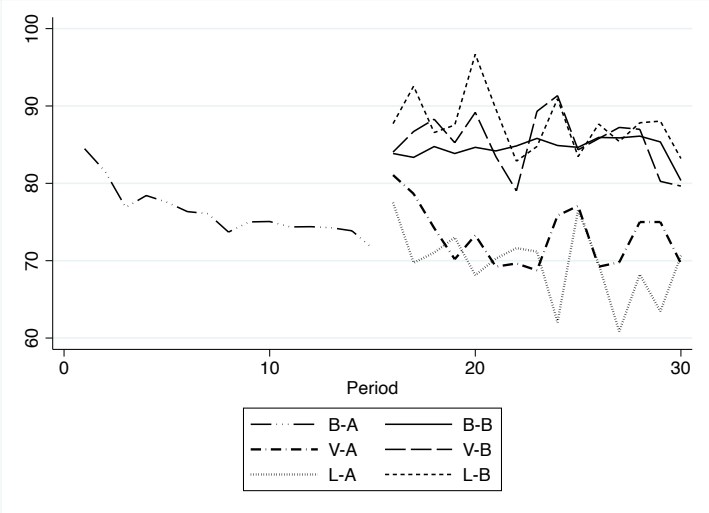
Notes: Statistical tests report p-values of two-sided Mann–Whitney tests. Observations are at the matching group level (matching group n = 45 in B-As, and n = 15 in all other conditions).

[9] Given that there is no ex-ante difference in periods 1–15 across treatments, in *B-A* we pool observations from all the three treatments together (only periods 1–15). This means that *V-A* and *L-A* only include the self-selected Contract A in periods 16–30.

Table 3 presents the average effort level in each condition, and the Mann–Whitney tests between conditions under Contract A and conditions under Contract B. We find that effort levels are always significantly higher under Contract B than under Contract A, regardless of how the contracts are implemented. These results demonstrate that people indeed exert a much higher effort level under Contract B than under Contract A, which is consistent with Hypothesis 1.

Result 1a. *Regardless of how the contract is implemented, the effort levels under Contract B are always higher than those under Contract A.*

Figure 2. Payoff level by treatment conditions



Next, we compare the payoff levels across the six conditions. Figure 2 shows the average payoff levels over time for each condition. In the first 15 periods, the payoff levels decline and converge to an equilibrium level of 75. In the last 15 periods, when Contract A is implemented (*V-A* and *L-A*), payoffs are similar but more volatile compared to those in the first 15 periods and yield a mildly declining pattern. When Contract B is implemented (*B-B*, *V-B*, and *L-B*), payoffs are much higher, lying between 80 and 95.

Table 4. Payoff levels by conditions

Condition	B-A	V-A	L-A	B-B	V-B	L-B
Payoff levels	76.24	74.87	68.68	84.57	80.94	86.33
Test equal to B-A				(0.002)	(0.149)	(<0.001)
Test equal to V-A				(0.007)	(0.191)	(0.003)
Test equal to L-A				(0.004)	(0.049)	(<0.001)

Notes: Statistical tests report p-values of two-sided Mann–Whitney tests. Observations are at the matching group level (matching group n = 45 in B-As, and n = 15 in all other conditions).

Table 4 presents the average payoff level in each condition, and the Mann–Whitney tests between conditions under Contract A and conditions under Contract B. We find that payoff levels are generally higher under Contract B than under Contract A, and the differences are significant in most of the comparisons, except for two (*B-A* vs. *V-B*, *V-A* vs. *V-B*). This is understandable because failure to meet the target under Contract B incurs an additional cost and may result in a strictly lower payoff compared with the equilibrium payoff under Contract A, even though the subjects exert strictly higher effort levels under Contract B.

Result 1b. *Payoff levels are generally higher under Contract B than under Contract A.*

Finally, we compare the subjects' behavior across the three different conditions in which Contract B is implemented. According to Hypothesis 2, subjects should exert higher effort when Contract B is endogenously selected, since in all the equilibria in the Voting and Leader treatments, only those subjects who expect to exert the efficient effort level shall choose B in the first stage. Table 5 shows that the effort levels in the three conditions are not significantly different from each other (Mann–Whitney test), which means that the endogenously implemented Contract B fails to improve effort compared to the exogenously implemented Contract B. This is inconsistent with Hypothesis 2, and we shall further investigate this issue in subsequent analyses.

Table 5. Effort levels under Contract B

Condition	B-B	V-B	L-B
Effort levels	9.11	8.87	9.25
Test equal to Baseline		(0.468)	(0.662)
Test equal to Voting			(0.575)

Notes: Statistical tests report p-values of two-sided Mann–Whitney tests. Observations are at matching group level (n = 15 in all treatments).

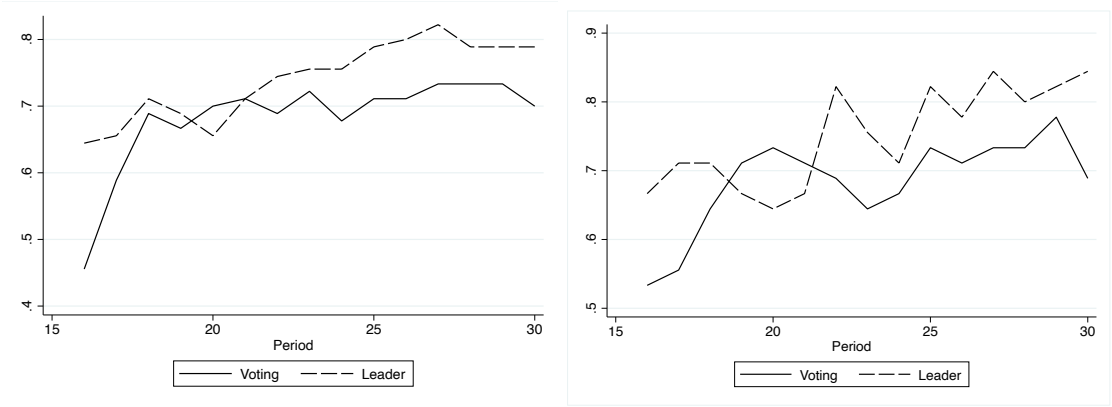
Result 2. *Inconsistent with Hypothesis 2, effort levels under Contract B are not significantly different across the different implementations.*

3.2 Endogenous institutions: Voting vs. Leader

In this subsection, we deepen our analyses of endogenous institutions by closely comparing subjects' behaviors in treatments Voting and Leader. We start by comparing the subjects' contract choice behaviors in these two treatments. Figure 3 shows the individual contract choice rate (left panel) and the implementation rate (right panel) of Contract B over time for these two treatments. We first look at the subjects' choice behavior in period 16, which is

driven purely by the switch from an exogenous system to an endogenous system. We find that subjects in Leader are significantly more likely to choose Contract B than those in Voting (64% vs. 46%, two-sided Mann–Whitney test, $p = 0.016$). When accounting for the 15 periods in total, subjects in Leader still choose Contract B more often compared to subjects in Voting (74% and 68%, two-sided Mann–Whitney test, $p = 0.079$).

Figure 3. Individual voting rate (left panel) and implementation rate (right panel) of Contract B over time.



To further investigate this difference, we perform an OLS regression using the contract choice data in period 16. The dependent variable is the individual contract choice (equals 1 if a subject chooses Contract B, and 0 otherwise). The independent variables include subjects' effort and payoff levels in period 15 and individual characteristics such as risk and social preferences. Table 6 presents factors significantly affecting contract choice behavior. We can see that subjects' effort levels in period 15 significantly affect their contract choice in period 16: the higher the effort level, the less likely it is that one chooses contract B. Moreover, more risk-averse subjects are less likely to choose Contract B, which is intuitive because the efficient equilibrium in Contract B is riskier. Both effort choices and risk attitudes are endogenous factors of the subjects. Table 6 shows that being exogenously assigned to the Leader treatment significantly increases one's chance to choose Contract B at a rate of 0.195. In sum, these results suggest that the higher rate of choosing Contract B in Leader is likely to be driven by the treatment itself, which supports Hypothesis 3.

Table 6. Determinants of voting Contract B in period 16

	Choosing Contract B in period 16
Leader	0.195***
	(0.072)
Effort_p15	−0.057***
	(0.017)
Risk averse	−0.232***
	(0.079)
Observations	180
R-squared	0.149

Notes: OLS estimates. Dependent variable: 1 if a subject chooses Contract B in period 16. "Effort_p15" is the effort level subject choose in the period 15. Robust standard errors in parentheses, fixed effects at individual level. *** p < 0.01, ** p < 0.05, * p < 0.1

Result 3. *Consistent with Hypothesis 3, subjects in Leader are significantly more likely to choose Contract B than subjects in Voting. This pattern persists over time.*

Next, we examine the subjects' effort choices upon the implementation of Contract B in the two endogenous treatments. Recall that subjects in treatment Voting always learn the contract choice of their opponents, while the leaders in treatment Leader are not informed of the other's contract choice. As such, we investigate how subjects' effort levels differ because they receive different information about contract choice. Table 7 presents the average effort levels under contract B in the different treatments from periods 16–30. The first (second) number in each cell represents the effort level of oneself (the other player). Note that two contract choice conditions can both implement Contract B in the two endogenous treatments: in one, both subjects choose B and in the other, one chooses A and the other chooses B.

Table 7. Effort in Voting and Leader under Contract B, by different voting condition

	Treatment		
Contract B	*Baseline*	9.11, 9.11	
		Self B, Other A	Self B, Other B
	Voting	7.63, 7.21	9.69, 9.69
	Leader	9.52, 7.68	9.52, 9.57
	Test V = L	(0.0135, 0.9825)	(0.4622, 0.8034)

Notes: In each cell, the first number represents the choices of the row players (self), and the second number represents the choices of the column players (other). Numbers in parentheses are the *p*-values of two-sided Mann–Whitney tests of Voting and Leader under the same condition (tests are performed at the matching group level).

When Contract B is exogenously imposed (Baseline), the average effort level is 9.11. In treatment Voting, when one subject chooses B and the other chooses A, their corresponding

effort levels are 7.63 and 7.21 and not significantly different from each other (p = 0.6113).[10] When both subjects choose B, the average effort levels are 9.69, which is significantly higher than 7.63 (p = 0.0120) and 7.21 (p = 0.0307). In the Leader treatment, when the leader chooses B and the other chooses A, the average effort level of the leader is higher than that of the other (9.52 vs. 7.68, p = 0.0232). When both subjects choose B, their effort choices are almost identical (9.52 and 9.57, p = 0.4662). Comparing across treatments, we find that subjects who choose B and learn that the other chooses A in Voting exerts a significantly lower effort than the subjects who choose B but are not informed of the other's contract choice in Leader (7.63 vs. 9.52, p = 0.0135).

Overall, these results suggest that when Contract B is implemented endogenously, subjects' effort choices are affected by not only their own contract choices but also the information they receive about the other's contract choice. Two implications follow. First, when the two subjects' choices differ, this information effect results in lower effort levels in both treatments Voting and Leader compared with when Contract B is exogenously implemented, which could weaken the overall effect of endogenous institutions and hence contribute to the observed indifference between exogenous and endogenous institutions in Result 2. Second, note that in the treatment Leader, without information on the other's contract choice, the leader sustains almost efficient effort provision. This is possible if the leader perceives the other to be highly cooperative (which is true in our sample). Through learning, this bliss of ignorance in the treatment Leader may have led to the persisting higher implementation rate of Contract B in Result 3.

Result 4. *In both Voting and Leader, when Contract B is implemented, subjects who choose Contract A exert a lower effort than subjects who choose Contract B. For subjects who choose Contract B, they exert lower effort when learning that the other chooses Contract A, compared to when they learn that the other chooses Contract B, or remain ignorant of the other's contract choice.*

Finally, we use OLS regressions to investigate the factors that affect contract choices and effort choices in periods 16–30. Regarding contract choice (columns1-2 in Table 8), we find that both choosing Contract B and playing Contract B in the previous period significantly increase one's

[10] All the p-values in this paragraph are from two-sided Mann–Whitney tests, and the tests are performed at the matching group level.

likelihood of choosing Contract B in the current period. In addition, if one's team plays Contract B but fails to meet the target level in the previous period, it significantly decreases the likelihood that one chooses Contract B. These results on contract choices suggest that subjects learn to adopt Contract B over time. Moreover, after experiencing Contract B in the previous period, whether they choose Contract B again depends critically on whether they meet the target level previously.

Table 8. Effort choices under Contract B

	(1)	(2)	(3)	(4)	(5)	(6)
	Contract Choice		Effort Choice (A)		Effort Choice (B)	
	Voting	Leader	Voting	Leader	Voting	Leader
Choose Contract B			−0.235	−0.023	−0.092	0.698**
			(0.365)	(0.342)	(0.474)	(0.343)
Self chooses B × Other Chooses B					1.783***	
					(0.371)	
Self Chooses B × Selected Leader						0.048
						(0.101)
Choose Contract B_lag	0.687***	0.692***	−0.204	−0.676*	0.573	0.804***
	(0.042)	(0.031)	(0.291)	(0.357)	(0.357)	(0.283)
Contract B_lag	0.144***	0.093***	−0.384	0.335	0.656**	0.853***
	(0.035)	(0.029)	(0.384)	(0.384)	(0.275)	(0.259)
Fail to meet target_lag	−0.159***	−0.229***	0.642	0.141	−1.746***	−2.053***
	(0.048)	(0.037)	(0.486)	(0.437)	(0.468)	(0.380)
Payoff_lag	0.0006	−0.0011***	0.0069*	0.0091*	−0.0031	0.0009
	(0.001)	(0.000)	(0.004)	(0.005)	(0.006)	(0.005)
Constant	−0.052	0.211	5.136***	3.959***	5.962***	8.096***
	(0.066)	(0.087)	(0.604)	(0.674)	(0.619)	(0.665)
Period	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES
N	1260	1260	384	306	876	954
R-sq	0.413	0.270	0.118	0.189	0.446	0.367

Notes: OLS estimates. Dependent variable: contract choice (1-2), effort choice (3-6). "Choose Contract B" indicates whether a subject chooses Contract B in the current period. Both choose B "Self chooses B × Other Chooses B" indicates whether both players choose Contract B in the current period. "Self Chooses B × Selected Leader" indicates whether a subject chooses B and is selected as the leader in the current period. "Choose Contract B_lag" indicates whether a subject chooses Contract B in the previous period. "Contract B_lag" indicates whether a subject experiences Contract B in the previous period. "Fail to meet target_lag" indicates whether a subject fails to meet the target level if Contract B is implemented. "Payoff_lag" is the payoff a subject receives in the previous period. Observations are from periods 16–30. Robust standard errors in parentheses, fixed effects at individual level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

For effort choice, we differentiate between two cases by the contract eventually implemented. When Contract A is implemented (columns 3-4 in Table 8), one's own contract choice in the

current period has no significant effect on effort choices in both treatments Voting and Leader, which is expected because there exists a unique equilibrium under Contract A. When Contract B is implemented (columns 5-6 in Table 8), we find that choosing Contract B in the current period significantly increases one's effort in the treatment Leader but not in treatment Voting. Moreover, knowing that the other chooses B in treatment Voting significantly increases one's own effort level, while being selected as the leader (getting own contract choice B implemented) has no significant effect on one's effort level in the treatment Leader. These results are aligned with the observations in Table 7, which highlight the effect of information in determining individual effort choices. Finally, choosing Contract B and experiencing Contract B in the previous period both have a positive effect on effort choice in the current period, while playing B but failing to meet the target has a negative effect.

Overall, the above analyses of individual contract choice and effort choice suggest potential learning of playing Contract B through positive feedback, which could lead to the observed increasing choice rate for Contract B in Figure 3. More importantly, the information effect we observed at the aggregate level (Result 4) continues to exist at the individual level.

4 Conclusion

In this study, we experimentally investigate the dominated contract in team production. We find that when the dominated contract is imposed exogenously, it successfully increases the team output to an almost efficient level. When given the opportunity to voluntarily decide whether to implement such a contract, subjects choose it frequently, indicating that they expect this mechanism to be effective *ex ante*. Compared to a voting system, subjects are more likely to choose the dominated contract in a leadership system. When the dominated contract is implemented under the two endogenous systems, teams also manage to increase their efforts, but no more than when the contract is exogenously imposed. Finally, we find that providing subjects with information about their opponents' contract choices may hurt productivity, as team members tend to exert lower effort levels after learning that their opponents do not choose the dominated contract.

Our study adds to the literature on designing mechanisms to foster team cooperation. The dominated contract mechanism is shown to be effective, regardless of how it is implemented. It also adds to the literature on comparisons between exogenous and endogenous institutions.

Our findings suggest that the endogenously selected dominated contract does not necessarily outperform its exogenous counterpart. This is partially because the output level is already high when the dominated contract is exogenously implemented, and a future direction along this line involves investigating the robustness of the dominated contract under circumstances with more uncertainty so that the overall effect of the contract may not be as strong as that observed in this study. Lastly, our findings highlight the importance of information, and it remains an interesting question to explore the optimal provision of information when forming endogenous institutions.

References

Alchian, A. A., & Demsetz, H. (1972). Production, information costs, and economic organization. *American Economic Review*, *62*(5), 777-795.

Andreoni, J., & Gee, L. K. (2012). Gun for hire: Delegated enforcement and peer punishment in public goods provision. *Journal of Public Economics*, *96*(11-12), 1036-1046.

Bandiera, O., Barankay, I., & Rasul, I. (2013). Team incentives: Evidence from a firm level experiment. *Journal of the European Economic Association*, *11*(5), 1079-1114.

Bohnet, I., & Kübler, D. (2005). Compensating the cooperators: is sorting in the prisoner's dilemma possible?. *Journal of Economic Behavior & Organization*, *56*(1), 61-76.

Cadsby, C. B., & Maynes, E. (1999). Voluntary provision of threshold public goods with continuous contributions: experimental evidence. *Journal of Public Economics*, *71*(1), 53-73.

Che, Y. K., & Yoo, S. W. (2001). Optimal incentives for teams. *American Economic Review*, *91*(3), 525-541.

Cooper, D. J., Ioannou, C. A., & Qi, S. (2018). Endogenous incentive contracts and efficient coordination. *Games and Economic Behavior*, *112*, 78-97.

Dal Bó, E., Dal Bó, P., & Eyster, E. (2018). The demand for bad policy when voters underappreciate equilibrium effects. *The Review of Economic Studies*, *85*(2), 964-998.

Dal Bó, P., Foster, A., & Putterman, L. (2010). Institutions and behavior: Experimental evidence on the effects of democracy. *American Economic Review*, *100*(5), 2205-29.

Dannenberg, A., & Gallier, C. (2020). The choice of institutions to solve cooperation problems: a survey of experimental research. *Experimental Economics*, 1-34.

Eckel, C. C., & Grossman, P. J. (2008). Forecasting risk attitudes: An experimental study using actual and forecast gamble choices. *Journal of Economic Behavior & Organization*, *68*(1), 1-17.

Fahn, M., & Hakenes, H. (2019). Teamwork as a self-disciplining device. *American Economic Journal: Microeconomics*, *11*(4), 1-32.

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

Friebel, G., Heinz, M., Krueger, M., & Zubanov, N. (2017). Team incentives and performance: Evidence from a retail chain. *American Economic Review*, *107*(8), 2168-2203.

Gallier, C. (2020). Democracy and compliance in public goods games. *European Economic Review*, *121*, 103346.

Grosse, S., Putterman, L., & Rockenbach, B. (2011). Monitoring in teams: Using laboratory experiments to study a theory of the firm. *Journal of the European Economic Association*, *9*(4), 785-816.

Gürerk, Ö., Irlenbusch, B., & Rockenbach, B. (2006). The competitive advantage of sanctioning institutions. *Science*, *312*(5770), 108-111.

Hamilton, B. H., Nickerson, J. A., & Owan, H. (2003). Team incentives and worker heterogeneity: An empirical analysis of the impact of teams on productivity and participation. *Journal of Political Economy*, *111*(3), 465-497.

Holmstrom, B. (1982). Moral hazard in teams. *The Bell Journal of Economics*, 324-340.

Hossain, T., & List, J. A. (2012). The behavioralist visits the factory: Increasing productivity using simple framing manipulations. *Management Science*, *58*(12), 2151-2167.

Kamei, K., Putterman, L., & Tyran, J. R. (2015). State or nature? Endogenous formal versus informal sanctions in the voluntary provision of public goods. *Experimental economics*, *18*(1), 38-65.

Kandel, E., & Lazear, E. P. (1992). Peer pressure and partnerships. *Journal of Political Economy*, *100*(4), 801-817.

Kocher, M. G., Martinsson, P., Persson, E., & Wang, X. (2016). Is there a hidden cost of imposing a minimum contribution level for public good contributions?. *Journal of Economic Psychology*, *56*, 74-84.

Kosfeld, M., Okada, A., & Riedl, A. (2009). Institution formation in public goods games. *American Economic Review*, *99*(4), 1335-55.

Lazear, E. P., & Rosen, S. (1981). Rank-order tournaments as optimum labor contracts. *Journal of Political Economy*, *89*(5), 841-864.

Markussen, T., Putterman, L., & Tyran, J. R. (2014). Self-organization for collective action: An experimental study of voting on sanction regimes. *Review of Economic Studies*, *81*(1), 301-324.

Martinsson, P., & Persson, E. (2019). Public Goods and Minimum Provision Levels: Does the institutional formation affect cooperation?. *The Scandinavian Journal of Economics*, *121*(4), 1473-1499.

Nalbantian, H. R., & Schotter, A. (1997). Productivity under group incentives: An experimental study. *American Economic Review*, 314-341.

Spraggon, J. (2002). Exogenous targeting instruments as a solution to group moral hazards. *Journal of Public Economics*, *84*(3), 427-456.

Suleiman, R., & Rapoport, A. (1992). Provision of step-level public goods with continuous contribution. *Journal of Behavioral Decision Making*, *5*, 133–153.

Sutter, M., Haigner, S., & Kocher, M. G. (2010). Choosing the carrot or the stick? Endogenous institutional choice in social dilemma situations. *The Review of Economic Studies*, *77*(4), 1540-1566.

Tyran, J. R., & Feld, L. P. (2006). Achieving compliance when legal sanctions are non-deterrent. *The Scandinavian Journal of Economics*, *108*(1), 135-156.

Vollan, B., Landmann, A., Zhou, Y., Hu, B., & Herrmann-Pillath, C. (2017). Cooperation and authoritarian values: An experimental study in China. *European Economic Review*, *93*, 90-105.

Appendices

A Experimental Instructions

[All treatments]

Welcome to this experiment on decision-making. Please read the following instructions carefully.

During the experiment, please stay quiet and do not communicate with other participants in any means. If you have any question at any time, please raise your hand, and an experimenter will come and assist you privately. The experiment will last for about one hour.

This experiment is divided into three parts. In Part I and II, you are going to take part in an experiment in this room together with other participants. Each participant seat behind a private computer, and no one can ever know the identity of another. In Part III, you are going to conduct your decision-making independently with other participants. All decisions are made on the computer screen.

It is an anonymous experiment. Experimenters and other participants cannot link your name to your desk number, and thus will not know the identity of you or of other participants who made the specific decisions.

During the experiment, your earnings are denoted in points. Your earnings depend on your own choices and the choices of other participants. At the end of the experiment, your earnings will be converted to RMB at the rate: 12 points = ¥ 1.

In addition, you receive 15 RMB show-up fee. Your total earnings will be paid to you in cash privately.

[Part 1]

In this part of the experiment, you will be allocated to a fixed group of six participants. In each round, the six participants will be randomly matched in pairs to conduct production activity. This production activity is going to repeat for 15 rounds. In each round, you will be re-matched to one of the other participants in your group, and the probability of matching each of them is identical. You will not be able to identify the partner you are matched with.

You will receive earnings in this production activity, and your earnings are determined as follows.

Output: The output of the production is determined by the input of you and your partner. You can choose an input number ranging from 0 to 20 (integers); a higher number is a higher input. You and your partner will choose the input simultaneously. You do not know the input of your partner when you choose your input; likewise, your partner does not know your input choice when he or she makes a choice. The final output is determined by both of your input:

Output = 20 × (your input + your partner's input)

Cost: During the production process, your cost of production is determined by your own input level. The higher your input level, the higher the cost. Your cost of production is determined as follows:

Your cost = your input^2

Your partner will face the same cost function. That is, when his or her input level is X, his or her cost is X^2.

Earnings: Your earnings are determined by the production output and your cost. You and your partner will share the output equally, and then deducted by the cost incurred. That is, your earnings in each production equals to half of the output minus your cost.

Your earnings = $\frac{1}{2}$ × output – your cost

Your partner's earnings is determined in the same way, that is:

Your partner's earnings = $\frac{1}{2}$ × output – your partner's cost

When deciding your input level, a calculator will be available on your computer screen. You can input any (hypothetical) input level of you and your partner, and then the calculator will show you the corresponding output and your earnings.

Table of input and earnings: The table below shows the relationship between your earnings and your input, your partner's input. The vertical line is your input level, the horizontal line is your partner's input level, and the corresponding cell shows your earnings under these input levels.

	0	5	10	15	20
0	0	50	100	150	200
5	25	75	125	175	225
10	0	50	100	150	200
15	-75	-25	25	75	125
20	-200	-150	-100	-50	0

In this part, the production activity will be repeated for 15 rounds, and two rounds will be randomly selected for payment. The probability that each round is selected is identical. For example, suppose the computer randomly selected round 4 and round 9 for payment, then your payment from this part is the sum of your earnings in round 4 and round 9 (negative earnings will be counted as well).

[Part 1 Baseline]

Now Part I is ended, and you are about to start Part II. In this part of the experiment, you are still allocated to the same group of six participants as in Part I. In each round, the six participants will be randomly matched in pairs to conduct production activity. This production activity is also going to repeat for 15 rounds. In each round, you will be re-matched to one of

the other participants in your group, and the probability of matching each of them is identical. You will not be able to identify the partner you are matched with.

You will receive earnings in this production activity, and your earnings are determined in a different way compared to Part I. The production function in Part II is called Contract B, and the production function in Part I is called Contract A.

Compared to Contract A, Contract B works as follows: when the output produced by you and your partner is lower than 400, your earnings equals to half of the output minus your cost, and deducted by an extra 35.

The detailed function of Contract B is presented below:

If your output is equal or above 400, your earnings equal to half of the output minus your cost.

If your output is lower than 400, your earnings equal to half of the output minus your cost, and deducted by 35.

$$\text{Your earnings} = \begin{cases} \frac{1}{2} \times \text{output} - \text{your cost}, & output \geq 400 \\ \frac{1}{2} \times \text{output} - \text{your cost} - 35, & output < 400 \end{cases}$$

Your partner's earnings is determined in the same way, except that the cost is his or her own cost.

Note that, in this new contract, output and cost is determined the same way as Part I.

At the end of each period, you will learn the output and your earnings in that period.

When deciding your input level, a calculator will be available on your computer screen. You can input any (hypothetical) input level of you and your partner, and then the calculator will show you the corresponding output and your earnings.

Table of input and earnings: The table below shows the relationship between your earnings and your input, your partner's input. The vertical line is your input level, the horizontal line is your partner's input level, and the corresponding cell shows your earnings under these input levels.

	0	5	10	15	20
0	-35	15	65	115	200
5	-10	40	90	175	225
10	-35	15	100	150	200
15	-110	-25	25	75	125
20	-200	-150	-100	-50	0

In this part, the production activity will be repeated for 15 rounds, and two rounds will be randomly selected for payment. The probability that each round is selected is identical. For example, suppose the computer randomly selected round 4 and round 9 for payment, then your payment from this part is the sum of your earnings in round 4 and round 9 (negative earnings will be counted as well).

[Part II Voting/Leader]

Now Part I is ended, and you are about to start Part II. In this part of the experiment, you are still allocated to the same group of six participants as in Part I. In each round, the six participants will be randomly matched in pairs to conduct production activity. This production activity is also going to repeat for 15 rounds. In each round, you will be re-matched to one of the other participants in your group, and the probability of matching each of them is identical. You will not be able to identify the partner you are matched with.

In this part, you and your partner can choose between two different production contracts. Contract A is exactly the same as in Part I. Contract B is different compared to contract A, and it differ as follows: when the output produced by you and your partner is lower than 400, your earnings equals to half of the output minus your cost, and deducted by an extra 35.

The detailed functions of Contract A and B are presented below:

Contract A:

$$\text{Your earnings} = \frac{1}{2} \times \text{output} - \text{your cost}$$

Contract B:

If your output is equal or above 400, your earnings equal to half of the output minus your cost.

If your output is lower than 400, your earnings equal to half of the output minus your cost, and deducted by 35.

$$\text{Your earnings} = \begin{cases} \frac{1}{2} \times \text{output} - \text{your cost}, & output \geq 400 \\ \frac{1}{2} \times \text{output} - \text{your cost} - 35, & output < 400 \end{cases}$$

Your partner's earnings is determined in the same way, except that the cost is his or her own cost.

Note that, in this new contract, output and cost is determined the same way as Part I.

Table of input and earnings: The two tables below shows the relationship between your earnings and your input, your partner's input, under each contract, respectively. The vertical line is your input level, the horizontal line is your partner's input level, and the corresponding cell shows your earnings under these input levels.

Contract A

	0	5	10	15	20
0	0	50	100	150	200
5	25	75	125	175	225
10	0	50	100	150	200
15	-75	-25	25	75	125
20	-200	-150	-100	-50	0

Contract B

	0	5	10	15	20
0	-35	15	65	115	200
5	-10	40	90	175	225
10	-35	15	100	150	200
15	-110	-25	25	75	125
20	-200	-150	-100	-50	0

[Voting]
In each period, once you are randomly matched into pairs, you and your partner will choose a contract by voting. You do not know the vote of your partner when you cast your vote; likewise, your partner does not know your vote when he or she casts a vote.

Once you both finish voting, the voting results will determine which contract will be implemented in this period.

- If both you and your partner vote for contract A, contract A will be implemented.
- If both you and your partner vote for contract B, contract B will be implemented.
- If you and your partner vote differently, the computer will randomly pick a contract. That is, the probability of implementing contract A or contract B is 50% each.

Once you and your partner finish voting, both of you will be informed of the voting results and the contract implemented in this period. Your earnings will be determined by the contract implemented. In the next period, you and your partner in the next period will vote again, and the contract in the next period is determined by the voting results in that period.

At the end of each period, you will learn the output and your earnings in that period.

[Leader]
In each period, once you are randomly matched into pairs, you or your partner will be randomly selected as the leader in this period, each of you has a probability of 50% to be selected as the leader. The leader can choose the contract (contract A or contract B) by herself or himself.

The procedure takes the following steps:

- At the beginning of each period and after random re-matching, each participant indicates his or her intended contract choice (contract A or contract B), if he will be selected as the leader in his or her group.
- Computer randomly selects (with a probability of 50%) one participant in a pair as the leader.
- The previous contract choice of the leader will be implemented directly for this pair.
- Before conducing the production activity, both players in a pair will be informed of who is the leader, and the contract choice of the leader.
- In the next period, you and your partner in that period will indicate the contract choice again, and the leader will be randomly selected again. That is, the contract may be different in the next period.

At the end of each period, you will learn the output and your earnings in that period.

[Part III]

Now you are about to start Part III. In this part, you will make two decisions. You will receive earnings from both of these decisions. Please select your favorite option according to your preferences.

Part III Question 1
Your earnings will depend on the outcome of a fair coin toss. Every option shows the amount in points you earn in case a head shows up or a tail shows up. The probability of head or tail equals to 50%, respectively. After you make a decision, the computer will randomly decides the outcome of the coin toss.

Your earnings in this part are denoted in points. Your earnings will be converted to RMB at the rate: 12 points = ¥ 1.

Option 1：Head：51 Tail：0
Option 2：Head：45 Tail：9
Option 3：Head：39 Tail：12
Option 4：Head：33 Tail：15
Option 5：Head：24 Tail：18
Option 6：Head：21 Tail：21

Please indicate which one of the six options above you prefer:

Part III Question 2
You can select one of the following seven options to determine your earnings. A refers to yourself, and B refers to a randomly matched participant in this room. In each option, “Amount A” refers to your own earnings, and “Amount B” refers to the earnings of the other participant matched with you. Note that, the participant matched with you in this part will not be anyone you have been matched with in Part I or Part II.

At the meantime, the participant matched with you will make the same decision as you do. In the end, only one of your decisions will be randomly selected to determine both of your earnings. If your decision is selected, then "Amount A" in your decision will be your earnings, and "Amount B" in your decision will be the other's earnings. If the decision of the other is selected, then "Amount A" in his/her decision will be his/her earnings, and "Amount B" in his/her decision will be your earnings.

Your earnings in this part are denoted in points. Your earnings will be converted to RMB at the rate: 12 points = ¥ 1.

Option 1：Amount A：30 Amount B：0
Option 2：Amount A：29 Amount B：8
Option 3：Amount A：26 Amount B：15
Option 4：Amount A：21 Amount B：21
Option 5：Amount A：15 Amount B：26
Option 6：Amount A： 8 Amount B：29
Option 7：Amount A： 0 Amount B：30

Please indicate which one of the seven options above you prefer:

[Questionnaire]

Finally, please take your time to answer the following questions.
Birth year and month:
Gender (Male/Female):
Major of study:
Grade:
Are you a member of the Communist Youth League?
Are you a member of the Communist Party?
If not, do you plan to be a member of the Communist Party?

What is your strategy in Part 1? Please describe briefly.

[Baseline] What is your strategy in Part 2? Please describe briefly.
[Voting or Leader] What is your strategy in contract choice and effort choice? Please describe briefly.

B Supplemental figures and tables

Figure B1. Average effort level (left panel) and payoff level (right panel) over time by treatments (Contract A and Contract B combined)

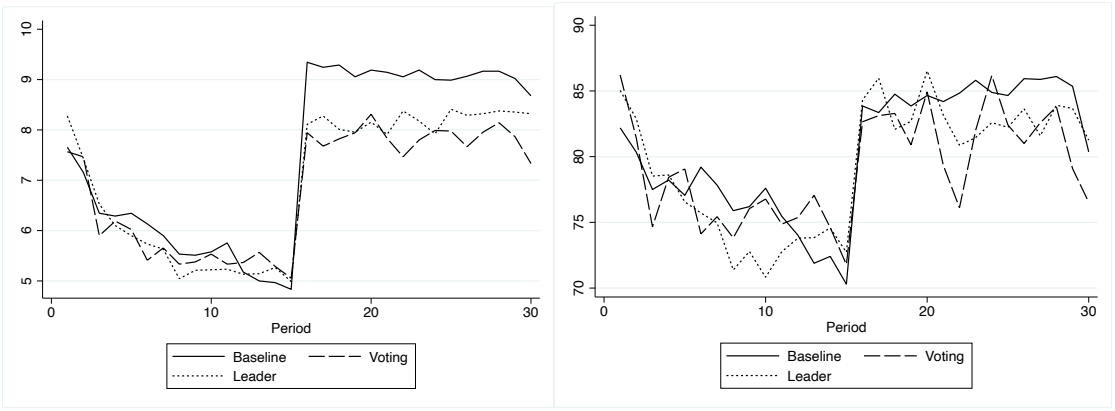


Table B1. Average effort and payoff level (Contract A and Contract B combined).

Condition	Periods	Baseline	Voting	Leader
Effort	1-15	5.88	5.80	5.79
		(0.59)	(0.51)	(0.82)
	16-30	9.11	7.85	8.20
		(1.39)	(1.52)	(1.18)
Payoff	1-15	76.41	76.64	75.67
		(4.63)	(3.55)	(6.61)
	16-30	84.57	81.60	83.06
		(19.32)	(13.57)	(12.85)

Notes: The average effort and payoff levels are calculated at the matching group level. Standard deviations are in parentheses.