Dominated Contract in Team Production

Simin He and Bin Miao*

Oct 2024

Abstract: We experimentally investigate the effect of a dominated contract in team production, one that punishes low output without rewarding high output. We consider three systems of implementing the dominated contract: exogenous, voting, and leadership. We find that teams often voluntarily opt for the dominated contract in the latter two systems. Moreover, once implemented, the dominated contract is equally effective in improving efforts across all three systems. Finally, we identify the incidence of a negative information effect in endogenous institutions: the disclosure of information about others' contract choices may backfire and undermine efficiency.

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

JEL codes: C72, C91, C92

Statements and Declarations: none.

* Simin He: School of Economics, Shanghai University of Finance and Economics, 111 Wuchuan Rd, 200433 Shanghai, China, he.simin@mail.shufe.edu.cn. Bin Miao: School of Economics, Renmin University of China, 59 Zhongguancun Street, 100872 Beijing, China, binmiao11@gmail.com. We are very grateful to Xun Zhu who helped programming the experiments, and Fan Huang and Jialiang Yu who helped running the experiments. This paper benefited from comments by participants of the 2018 ESA World Meeting (Berlin), 2018 Hong Kong University of Science and Technology Workshop on Experimental Economics, 2018 Xiamen University International Workshop on Experimental Economics, and 2020 ESA Global Online Meetings. Simin He acknowledges the National Natural Science Foundation of China (Grant 72473089) for its financial support. Bin Miao acknowledges the National Natural Science Foundation of China (Grant 72394394, 72131003).

1 Introduction

Designing incentive contracts based on team output has become increasingly important in firms and organizations (Nyberg et al., 2018). Yet, it is challenging to design effective team contracts. 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]

Existing studies have relied on the role of a principal in designing and imposing optimal incentive schemes for the teams. In the absence of a principal, self-managing teams, such as shareholders or coauthors, may desire to establish rules to motivate themselves. Interestingly, some of these rules exhibit a "budget-breaking" feature. For example, a group of salesmen may jointly decide to forgo their bonus should they underperform; coauthors may opt to submit their paper to a conference at an early stage, even before there is a complete draft. The "contracts" in these examples are dominated: the salesmen always earn more without the contract, and coauthors can choose to submit their paper after its completion. However, these contracts are endogenously chosen by the teams because the "budget-breaking" feature of 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 can by itself 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 initially form teams of two and play a team production game under the conventional revenue-sharing incentive for fifteen rounds, in which there is a unique equilibrium with the two players free-riding each other. In the subsequent stage, subjects are provided with the opportunity to switch to a strictly dominated incentive scheme and play the production game for fifteen more rounds. In contrast

[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).

to the revenue-sharing scheme, this dominated scheme imposes an additional uniform cost on each team member if the efficient output level is not attained. The dominated scheme inherits the key feature of budget breaking proposed by Holmstrom (1982), generating payoff discontinuity around the efficient output level. This discontinuity gives rise to a new symmetric equilibrium in which each team member exerts the same effort to produce an efficient output, in addition to the original free-riding equilibrium.

In our experiment, we explore three systems to implement the dominated incentive scheme using a between-subject design. The first system involves exogenous imposition, while the other two can endogenously implement the dominated incentive scheme through majority vote and random leadership. In the majority vote system, both team members first vote between the revenue-sharing scheme and the dominated scheme. Then, the voting outcome is revealed, and whichever scheme receives majority vote will be implemented. In the event of a tie, the random tie-breaking rule determines the scheme to be implemented. In the random leadership system, both team members also vote for their preferred scheme initially. However, only the choice of a subsequently 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. Firstly, both subjects' efforts and payoffs increase under the dominated scheme, whether exogenously imposed or endogenously chosen, compared to the baseline revenue-sharing contract. Notably, the free-riding problem is almost entirely resolved under the dominated scheme as the total output approaches the efficient level. Secondly, despite its effectiveness, the dominated scheme is not always implemented by the team in the two endogenous systems. The individual voting rate for the dominated scheme exhibits an increasing trend over time and stabilizes at approximately 70 percent under majority voting and 80 percent under random leadership, with the average voting rates significantly higher under random leadership. Third, our findings reveal an asymmetric effect of voting information when the dominated scheme is endogenously implemented. Specifically, compared to remaining uninformed about the other team member's vote under random leadership, knowing that the other votes against the dominated scheme under majority voting significantly reduces one's effort, whereas knowing the other also votes for the dominated scheme does not significantly increase effort. This indicates a potential negative effect of voting information under majority voting. Conversely, not knowing the other member's voting information under random leadership seems to mitigate such negative impacts.

Our study adds to the existing literature on team incentives by considering endogenous implementation systems. Existing laboratory and field studies have documented the positive effects of various exogenous team incentives (see Charness and Kuhn, 2011 for a review), with a few considering non-linear team contracts (Nalbantian and Schotter, 1997; Spraggon, 2002; Friebel et al., 2017). However, there is a lack of studies exploring endogenous implementation of team contracts.[3] In addressing this gap, our study introduces different implementation systems into team production and finds that teams can endogenously implement a dominated contract, which eventually eliminates the moral hazard problem and enhances team productivity. Notably, the dominated contract also works well when exogenously imposed in our setting, in contrast to the findings in Nalbantian and Schotter (1997). Potential explanations for these differences may lie in the distinctions in contract specifications (see Section 1.1 for details) or the cultural differences between the subjects (Kocher et al., 2016; Vollan et al., 2017).

Our incorporation of different implementation systems contributes to a deeper understanding of how endogenous choice influences team production. The existing literature on endogenous institutions has predominately focuses on the system of voting, identifying three main channels that may lead to the 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). To this end, our findings not only reveal a significant effect of information but also demonstrate that the information effect may, at times, backfire, indicating that it is not always optimal to provide all team members with complete 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 Related Literature

[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.

Several studies have investigated the effect of target-based non-linear contracts in team production in laboratory and field settings, and the evidence is mixed. Nalbantian and Schotter (1997) conduct a systematic investigation of different team incentive schemes in laboratory settings. One such scheme, named target-based forcing contract, features a non-linear aspect by paying team members a flat wage of zero if they fail to meet a certain target. They find a temporary increase in team performance after switching to the forcing contract from the baseline revenue-sharing contract. 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. In the field, Hossain and List (2012) and Friebel et al. (2017) exogenously implement target-based reward or punishment incentives and find overall positive effects on team productivity. In contrast, Freeman et al. (2022) find that a group target has no effect on overall productivity in a real-effort experiment.

In our setting, the dominated contact consistently sustains the efficient outcome, even when exogenously imposed. Two possible factors could have contributed for the effectiveness of our contract. First, our dominated contract imposes a uniform cost and does not change the marginal incentives if the team fails to reach the target, thereby preserving the original inefficient equilibrium. In contrast, other non-linear contracts in existing studies often change the marginal incentives, making the original inefficient equilibrium no longer an equilibrium under the new non-linear contract. Second, our experimental setup does not involve uncertainty in the final output, a feature present in Nalbantian and Schotter (1997). Both factors could make the efficient equilibrium in our setting less risky and more sustainable.[4]

Dannenberg and Gallier (2020) conduct a comprehensive review of the experimental literature examining the role of endogenous institution in promoting cooperation. In prisoner's dilemma games, public good games and common-pool resource games, it is frequently observed that players voluntarily choose schemes involving (ex post) punishment/reward, or (ex ante) mandated minimum contributions.[5] Moreover, compared with exogenous imposition,

[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).

[5] See Bohnet and Kübler (2005), Dal Bo, Foster and Putterman (2010), Dal Bo, Dal Bo and Eyster (2018) for studies on endogenous institutions in prisoner's dilemma game; Sutter and Weck-Hannemann (2003, 2004), 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),

endogenous institutions often have a positive impact on cooperation and efficiency, and the effects depend on institution features such as enforceability, deterrability, entry cost, as well as on the collective-choice rules.[6] To decompose the effects of endogenous institution, Dal Bo, Foster and Putterman (2010) develop a randomization technique and identify a significant democracy premium. Compared to the effect of democracy, the magnitudes of selection effect and information effect are relatively smaller. Gallier (2020) adopts a similar procedure and finds a relatively larger but insignificant democracy effect while the selection and information effects appear negligible. In relation to the literature on endogenous institution, our study introduces different collective-choice rules in team production and provides a detailed characterization of the equilibrium under different rules (see Section 2.3 for details). Moreover, our findings on the differentiated effects from the two collective-choice rules point to a potential negative effect of information in institutions that may be worth future exploration.

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 effort levels 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	$u_i = 10\,(e_1 + e_2) - e_i^2, \quad if\ \ 20(e_1 + e_2) \geq 400$ $u_i = 10\,(e_1 + e_2) - e_i^2 - 35, \ \ if\ 20(e_1 + e_2) < 400$

Gallier (2020) for studies in public good game; and Ostrom, Walker and Gardner (1992) for study in common-pool resource game.

[6] See for example, Kosfeld, Okada and Riedl (2009), Markussen, Putterman and Tyran (2014), Fan, Kwasnica and Thomas (2018), Gallier, Langbein and Vance (2018), Liu and van der Heijden (2019). Another relevant topic on endogenous institution is the flexibility of partnership. It has been shown in different settings that flexible partnership, where people can choose to dissolve relationship with their partners, can promote team cooperation and performance (Honhon and Hyndman, 2020; Hyndman and Honhon, 2020).

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 of six 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 another 15 periods (periods 16–30) of the experiment. In this part, subjects remain in the same matching group as that in Part I, and are randomly matched into pairs in each of the 15 periods. There are three treatments in this part: the Baseline treatment, the Voting treatment, and the Leader treatment. The three treatments differ in how contracts are implemented. In the Baseline treatment, the contract implemented in each period is fixed as Contract B.[7] In both Voting and Leader treatments, at the beginning of each period, the two team members have to endogenously decide which contract, A or B, should be implemented in the subsequent production stage.[8] In the Voting treatment, the two team members vote for the contract. The voting rule is majority, 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. In all treatments, similar to part I of the experiment, subjects learn the total output as well as their own payoffs at the end of that period. Details of the different treatments are summarized in Table 2.

[7] We do not have a treatment in which the contract implemented in each period is fixed as Contract A. The reason is that we are interested in investigating behavior differences in exogenously implemented contract B, and endogenously implemented contract B (or A), once subjects are already made familiar with contract A in the part I of the experiment. So it is not of our interest how people behave if they only engage in contract A throughout the experiment.

[8] Note that in each period, subjects within a matching group are randomly matched in a pair. Therefore, at the beginning of each period, we let the randomly matched pair of subjects choose the contract they would like to play in that period. The goal of this design is to test how contract choice behavior involve over time.

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

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 a large public Chinese university in 2019. The subjects were recruited from the subject pool through Weikeyan (a platform for social sciences experiments in China). 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.[9] 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

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

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.

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 pure strategy subgame perfect 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. An additional symmetric equilibrium $(10, 10)$ arises 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 fifty percent chance in case the two members vote differently. If the efficient output can be achieved under such a scenario, then we argue that efficient output should also occur if both members vote for Contract B. Therefore, we apply the following equilibrium selection criteria in subsequent analyses: if a team member chooses

$e_i = 10$ when she votes for A while B is finally implemented, then she must also choose $e_i = 10$ when 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 the voting outcomes of stage 1 as well as the actually implemented contract. If both members can successfully coordinate at the more efficient output level whenever 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. On the other hand, if the two members fail to coordinate at the efficient output level if Contract B is implemented, they should both vote for Contract A at stage 1. Lastly, if the two members coordinate at the more efficient output level only when both vote for B, then stage 1 voting again becomes a coordination game in that the two members can either both vote for A or both vote for B in equilibrium. This is because voting differently would result in an inefficient output level under Contract B in stage 2 with a probability of 0.5, which is a strictly worse outcome compared with both voting for A or both voting for B.[10]

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 in stage 1, the other team member should always coordinate with the leader in stage 2. Note that this renders the private information of the other team member valueless. Thus, it suffices to characterize the equilibrium according to how the two members exert efforts in stage 2, conditional on the contract selected by the leader. If the two members successfully coordinate at the efficient output level whenever B is selected by the leader, both will vote for B at stage 1 because it is the dominant strategy. If the team members fail to coordinate at the efficient output level 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.[11]

[10] Two members voting differently and coordinating at the efficient output level if Contract B is eventually selected can also be supported as an equilibrium outcome, if both members voting for Contract B ends up generating the inefficient output. However, such an equilibrium does not satisfy our selection criteria.

[11] 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. In such an equilibrium, it is optimal for the other member to choose A in stage 1, since the team will fail to coordinate at the efficient output if her B gets 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, whereas she reduces her effort provision when both vote for B.

2.4 Hypotheses

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

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. Note that in all the equilibria in voting and leader treatments, the two members always choose the same contract in stage 1. Moreover, once both members choose Contract B in stage 1, they always coordinate at the efficient output level in stage 2. In contrast, when Contract B is exogenously implemented, we are not sure about which output level shall the team members coordinate on in stage 2. Hence, we expect the following endogeneity effect.

Hypothesis 2*. Effort levels are higher when Contract B is selected endogenously, compared to when Contract B is imposed exogenously.*

Lastly, we compare the two endogenous institutions. In voting treatment, it is a dominant strategy for team members to vote for A (B) if they believe that they will fail to (successfully) coordinate on the efficient output level whenever Contract B is implemented. However, if the two members believe that they may fail to achieve efficiency in the case that their votes differ and Contract B gets implemented, they need to coordinate again in the voting stage. In contrast, depending on whether the two members can successfully coordinate under Contract B, choosing either A or B in stage 1 is always a dominant strategy for the two members in leader treatment. It suggests that the absence of votes information in leader treatment helps 'eliminate' the strategic uncertainty in stage 1. Hence, we postulate that subjects in leader treatment are more likely to choose Contract B compared with those in voting treatment, leading to the following hypothesis.

Hypothesis 3. *In the leader treatment, Contract B is implemented more often than in 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.[12] *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.

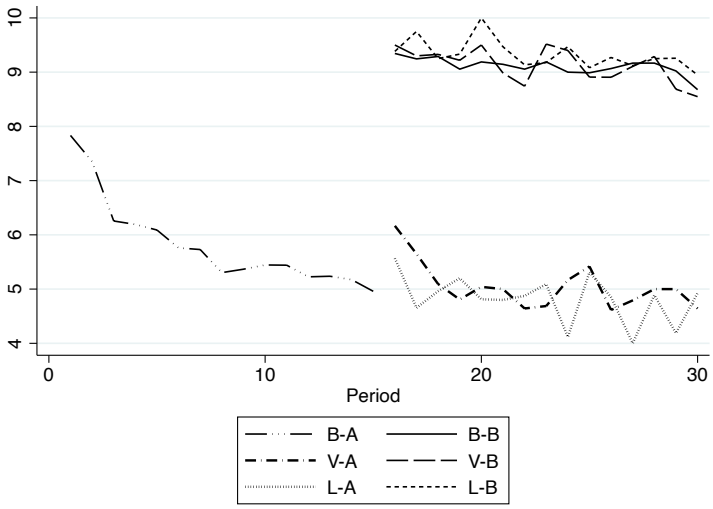


Figure 1 shows the average effort level over time for each condition. The effort levels under Contract A in the first 15 periods gradually decline and converge to an equilibrium level of 5. In the last 15 periods, the effort levels differ across different conditions. For those conditions

[12] 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.

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

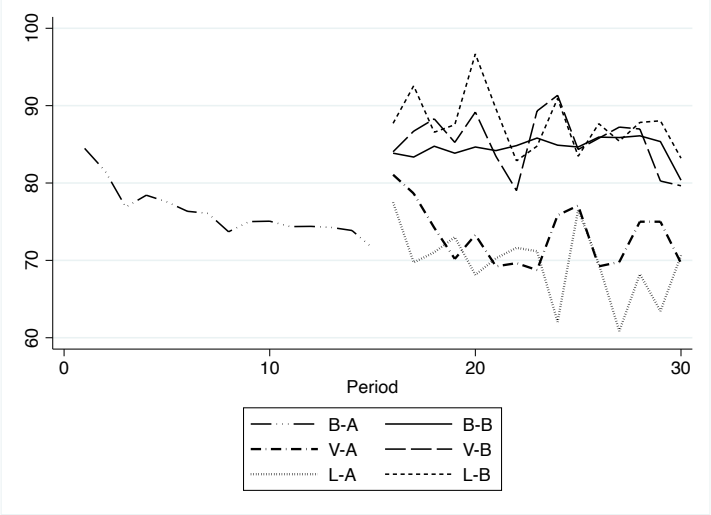
Condition	B-A	V-A	L-A	B-B	V-B	L-B
Effort levels	5.82	5.30	4.73	9.11	8.87	9.25
Test equal to B-A				(<0.001)	(<0.001)	(<0.001)
Test equal to V-A				(<0.001)	(<0.001)	(<0.001)
Test equal to L-A				(<0.001)	(<0.001)	(<0.001)

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).

Table 3 presents the average effort level in each condition, and the Mann–Whitney tests between conditions under Contract A and 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)

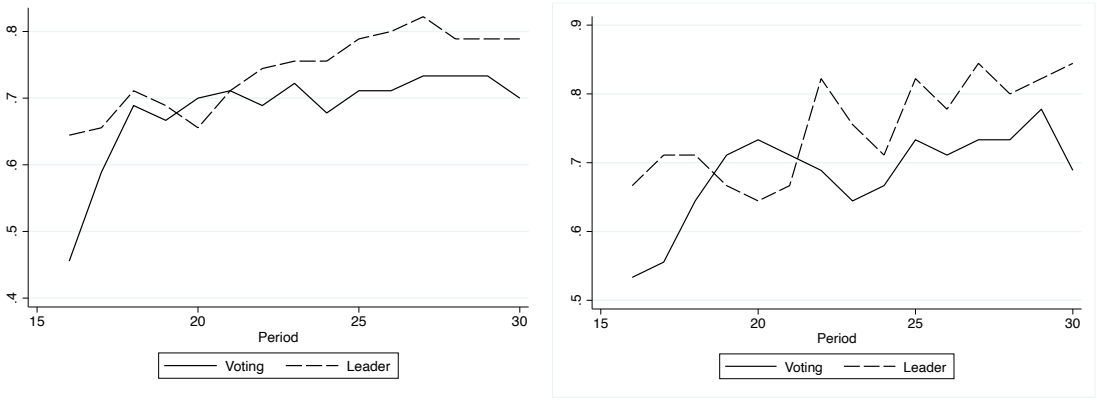
Notes: Statistical tests report p-values of two-sided Mann–Whitney tests. Observations are at matching group level (n = 15 in all treatments).

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 ($p = 0.6113$).[13] 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.*

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

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 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, and on designing incentive contracts to improve workers' performance based on collective outcomes. 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.

Charness, G., & Kuhn, P. (2011). Lab labor: What can labor economists learn from the lab? *Handbook of Labor Economics*, 4, 229-330.

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.

Fan, J., Kwasnica, A.M., & Thomas, D.J. (2018). Paying for teamwork: Supplier coordination with endogenously selected groups. *Production and Operations Management*, 27(6), 1089–1101.

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

Freeman, R. B., Pan, X., Yang, X., & Ye, M. (2022). Team Incentives and Lower Ability Workers: An Experimental Study on Real-Effort Tasks (No. w30427). *National Bureau of Economic Research.*

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.

Gallier, C., Langbein, J., & Vance, C. (2018). Non-binding Restrictions, Cooperation, and Coral Reef Protection: Experimental Evidence from Indonesian Fishing Communities. *Ecological Economics*, 150, 62-71.

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.

Honhon, D., & Hyndman, K. (2020). Flexibility and reputation in repeated prisoner's dilemma games. *Management Science*, *66*(11), 4998-5014.

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

Hyndman, K., & Honhon, D. (2020). Flexibility in long-term relationships: An experimental study. *Manufacturing & Service Operations Management*, *22*(2), 273-291.

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.

Liu, M., & van der Heijden, E. (2019). Majority rule or dictatorship? The role of collective-choice rules in resolving social dilemmas with endogenous institutions. *Working Paper*.

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.

Nyberg, A. J., Maltarich, M. A., Abdulsalam, D. D., Essman, S. M., & Cragun, O. (2018). Collective pay for performance: A cross-disciplinary review and meta-analysis. *Journal of Management*, *44*(6), 2433-2472.

Ostrom, E., Walker, J., & Gardner, R. (1992). Covenants with and without a sword: Self-governance is possible. *American Political Science Review*, 86, 404-417.

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.

Sutter, M., & Weck-Hannemann, H. (2003). On the effects of asymmetric and endogenous taxation in experimental public goods games. *Economics Letters*, 79, 59-67.

Sutter, M., & Weck-Hannemann, H. (2004). An experimental test of the public goods crowding out hypothesis when taxation is endogenous. *FinanzArchiv/Public Finance Analysis*, 94-110.

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.

Online Appendices

Appendix 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 are 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 are 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 are 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.

Appendix 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)

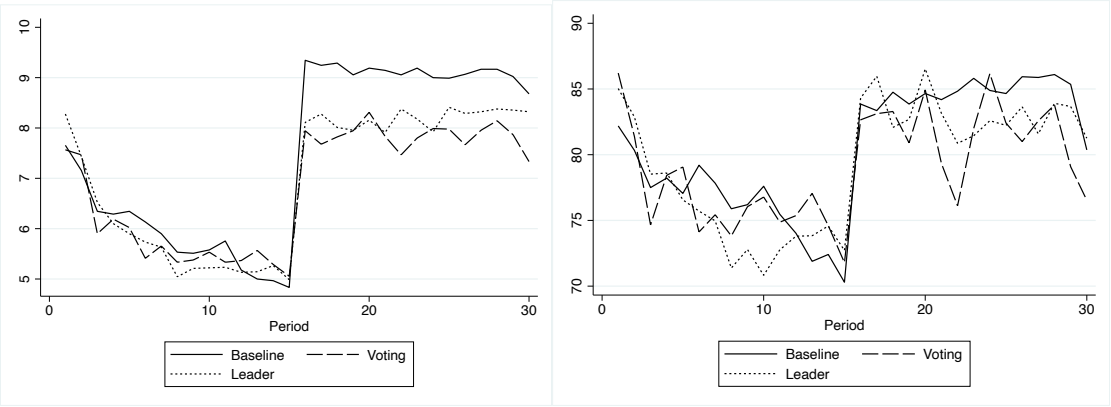


Table B1. Average effort and payoff level (Contract A and Contract B combined).

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.