The Dictatorial Public Goods Game*

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Abstract

We propose a novel game, the *Dictatorial Public Goods Game*, to study the interplay between collective resource generation and centralized allocation of public goods. After making choices in a standard Voluntary Contribution Mechanism (VCM), one player is selected from the group to administrate the contributions: either invest them in a public good or expropriate them for personal gain. We find that such dictatorial addition pushes efficiency below a standard VCM. Administrators' choices and, hence, efficiency, are also affected by framing—public good provision vs. resource expropriation. Moreover, the probability of expropriation declines in the contribution level. Thus, pro-social choices in the contribution and in the provision stages act as complements, reflecting the generation of social capital in the group. An insight is that when few are entrusted to make decisions on behalf of the collective, inefficiencies will arise unless the tension between administrators' self-interest and advancing the collective good can be reconciled.

Keywords: group decision-making, public goods, repeated games, institutions.
JEL codes: C92, H41

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1. Introduction

Human prosperity relies on cooperation. To thrive, societies must overcome the inherent collective action problem underlying cooperation (Olson, 1974). Humans evolved to be "supercooperators," often willing to incur a personal cost to promote the greater good, a trait that has contributed to our success as a species (Nowak and Highfield, 2011). However, evolved psychological mechanisms are in themselves insufficient to sustain large-scale cooperation (Hardin, 1968). Societies must also develop robust institutions that facilitate cooperation and efficient provision of public goods (Acemoglu, Johnson, and Robinson, 2005). Tullock (1971) argued that centralized mechanisms, such as governments, are an imperfect solution for the collective action problem, as political decision making regarding the allocation of public goods constitutes a public good in itself. Decision makers—such as politicians, judges, or bureaucrats—benefit personally from the public good, but do not internalize the full social implications of their choices. As a result, even weak self-interest can override the collective interest. In this paper, we introduce the *Dictatorial Public Goods (DPG) Game*, an experimental paradigm designed to study the interplay of collective resource generation and centralized allocation of public goods.

The DPG is composed of two stages. First, society generates a common resource via the Voluntary Contribution Mechanism (VCM). In the second stage, one individual—the administrator—makes a dictatorial decision whether to expropriate the common resource or use it to generate a public good benefiting the whole society. This institution brings into sharp focus the inherent social dilemmas existing at the two stages of resource generation and public good allocation. It provides a workhorse to explore issues surrounding the appointment of the centralized administrator, the effect of centralized institutions on decentralized cooperation, and the effect of social capital on public good provision.

In the experiment reported in this paper, we provide initial results on the effects of adding an allocation stage to the standard linear public goods game and explore the effects of the statutory default. Our results indicate that the provision of public goods in both stages of the game is sensitive to whether the administrator's choice is framed as public good provision or resource expropriation. Furthermore, the administrators in our experiment respond negatively to the incentives created by contribution decisions, as they are *less* likely to expropriate larger amounts. Thus, pro-social choices in the contribution and in the provision stages act as complements, reflecting the generation of social capital in the group.

While the DPG is a stylized game with binary administrator choices, it captures the essence of many real-world situations. Consider, for example, administrators in nonprofit organizations deciding how to allocate charitable contributions. Directing

funds to administrative costs that benefit them personally may be socially inefficient. empirical evidence shows that donors are less willing to donate to organizations perceived as allocating a high percentage of their budget on overhead costs (Gneezy, Keenan, and Gneezy, 2014; Tinkelman and Mankaney, 2007). Startup firms formed by a group of contributors provide an additional example. A startup manager faces a key decision: how much of the pooled funds to invest into the project for collective benefit, and how much to divert to personal use. This ethical dilemma is especially pronounced in initial coin offerings (ICOs), where projects raise funds publicly with the promise of generating future returns. Unfortunately, it's not uncommon for the project leaders to betray this trust and abscond with the funds (Aliyev, Allahverdiyeva, and Putniņš, 2023; Howell, Niessner, and Yermack, 2020; Hu, Parlour, and Rajan, 2019). At a broader level, the DPG also captures the core features of representative democracies highlighted by Tullock (1971). Citizens contribute to society through taxes and voluntary civic engagement, with a small group—or even a single individual—entrusted to make decisions on behalf of the collective. These representatives, like the administrators in the DPG, must reconcile the tension between self-interest and advancing the collective good.

Our results reveal a significant framing effect. Consistent with previous results in public goods games, we find a counter-default effect on Administrator decisions. Administrators are more likely to provide the public good when expropriation is the default, although these differences diminish with repetition. As a result, the institution that frames contributions as providing the means for the central administration to provide public goods is more efficient than the institution where contributions are made to the public good, but can be "misused" by the central administration.

Higher contributions increase the temptation to expropriate the collected resources. In contrast, we find that Administrators are more likely to provide the public good as the contributions by the other group members increase. Contributions, in turn, respond positively to provision decisions by the Administrator in the previous period. This highlights the role of social capital in our mini-society, as positive reciprocity builds trust between the public and the administrator.

Thus, this paper introduces a new paradigm to study the mutual dependencies between collective resource collection and public goods provision. We provide initial results on behavior in this environment, restricted to the special case where the Administrator is randomly assigned from the group members and focusing on the statutory role of this administrator. Taken together, the novel paradigm and results set the stage for future research on improving public goods provision under the realistic assumption that provision requires centralized decisions.

The remainder of the paper is organized as follows. We review related experimental literature in Section 2. Section 3 introduces the Dictatorial Public Goods Game.

Section 4 describes the experiment, followed by the operational research questions in Section 5. Section 6 presents the experimental results, and Section 7 concludes.

2. Experimental literature

The DPG combines features of three standard experimental games: public goods games, dictator games, and trust games. Considered separately, the first stage of the DPG is a linear public goods game (Chaudhuri, 2011; Ledyard, 1995; Zelmer, 2003) while the second stage is a Dictator Game with multiple recipients and efficiency gain from giving (Engel, 2011; Forsythe et al., 1994; Kahneman, Knetsch, and Thaler, 1986). With both stages considered together, the DPG extends the Trust Game to a game with many trustors and one trustee (Berg, Dickhaut, and McCabe, 1995; Johnson and Mislin, 2011).

Public goods games. Participants in linear public goods experiments contribute to the public good substantially more than the theoretical Nash equilibrium prediction of zero contribution (Chaudhuri, 2011; Isaac, Walker, and Thomas, 1984; Ledyard, 1995). Contributions decrease with repetition, but increase again when the game is restarted, even if the restart is known in advance (Andreoni, 1988; Cookson, 2000; Croson, 1996). The DPG deviates from the standard game by including a second-stage centralized provision mechanism. The two centralized mechanisms in public good provision most studied in the experimental literature are taxation (Andreoni, 1993; Gronberg et al., 2012) and centralized sanctioning of free riders (Kamei, Putterman, and Tyran, 2015; Markussen, Putterman, and Tyran, 2014). Closer to the DPG are experiments on democratically elected leaders. In Markussen and Tyran (2017), a single player (the "leader") receives the full endowment and makes a contribution decision. In Hamman, Weber, and Woon (2011), the "allocator" determines a contribution level for each member in a group of nine. The DPG differs from these lines of research by combining decentralized voluntary contributions with a centralized allocation decision within the same institution.

Our experiment varies whether the administrator's decision is framed as provision or expropriation. Previous studies examined similar framing manipulations of the *contribution* decision. Andreoni (1995) found that contributions are higher when presenting the social effects of contributions as a positive externality of investments in the group account compared to a negative externality of investments in the personal account. Park (2000) found that this effect is driven by contributions by individualists rather than by cooperators. Gächter, Kölle, and Quercia (2017) compared provision vs. maintenance of public goods. They replicate the result that contributions

are higher in the provision treatment, where individual actions carry positive externalities, and show that the framing of the decision affects preferences, as the provision framing leads more participants to become conditional cooperators (see also Böhm and Theelen, 2016; Cox, 2015; Cox and Stoddard, 2015; Dufwenberg, Gächter, and Hennig-Schmidt, 2011; Fosgaard, Hansen, and Wengström, 2014; Gächter, Kölle, and Quercia, 2022; Khadjavi and Lange, 2015).

In contrast, Cox et al. (2013) did not find a difference between provision and maintenance of public goods, possibly due to the smaller sample size. Their design included a two-stage version of the game, similar to the DPG. One player (the "king") chooses a contribution level after observing the contributions of the other players. This player can not only contribute, but can also appropriate any existing funds from the public account. Unlike the DPG, the king has to make a continuous choice between contributing and appropriating. The framing manipulation confounds the framing of the provision decision and the appropriation decision, whereas our design fixes the positive framing of the contributions and only manipulates the statutory default for the administrator. Consistent with our findings, Cox et al. (2013) find that contributions are lowest and appropriations are highest in the negative framing.

Dictator games. The administrator's decision in the DPG resembles a dictator game with multiple recipients. However, unlike the DPG, most prior studies permitted dictators to discriminate among the multiple recipients (Büchner, Coricelli, and Greiner, 2007; Erkal, Gangadharan, and Nikiforakis, 2011; Greiner, Güth, and Zultan, 2012; Selten and Ockenfels, 1998). For example, Erkal, Gangadharan, and Nikiforakis (2011) found that transfers are sensitive to both the level of endowments and to whether these endowments were earned. Greiner, Güth, and Zultan (2012) found that dictators respond to idiosyncratic impressions formed through one-way communication. In the "solidarity game", where the numbers of dictators and recipients vary, dictators tend to give a fixed amount, such that when there are two recipients, each receives roughly half the amount given to a single recipient (Büchner, Coricelli, and Greiner, 2007; Selten and Ockenfels, 1998). In contrast, studies that did not allow for discrimination found that larger recipient groups elicit larger total contributions (Andreoni, 2007; Chiang and Hsu, 2019). Importantly, in all these studies, the dictator allocates a fixed pie, whereas giving in the DPG generates a public good, thereby increasing the total surplus. Stahl and Haruvy (2006) studied dictator games that varied both in the number of recipients and in the efficiency of giving. They found that dictators are more generous when giving is more efficient—either because there are more recipients or because each recipient receives a larger return.

Although framed differently, the L-treatment in the stealing experiment by Falk and Fischbacher (2002) is a dictator game with multiple recipients and efficiency

gain for giving (or efficiency loss for "stealing"), as is the second stage of the DPG. In this experiment, players could condition their choice on the stealing behavior of others. In the DPG, in comparison, the administrator conditions on the resources contributed to the common pool.

As with public goods games, dictator decisions can be framed as giving or taking. Krupka and Weber (2013) found evidence that taking is perceived as more socially unacceptable than not giving, with choices following the normative judgment. Other studies, however, did not find an effect for framing in the dictator game (Dreber et al., 2013; Grossman and Eckel, 2015), with possible heterogeneous effects by gender (Chowdhury, Jeon, and Saha, 2017; Kettner and Ceccato, 2014).

Trust games. The DPG can be viewed as an extension of the trust game (Berg, Dickhaut, and McCabe, 1995). In the standard trust game, one trustor chooses an amount to send to a trustee. The amount sent is augmented by the experimenter, typically by a factor of 3, after which the trustee chooses an amount to send back to the trustor. The DPG deviates from this design in two crucial features. First, there are multiple trustors. Second, the efficiency gain is determined by the second mover's choice rather than in the first stage. Prior studies with two trustors studied the dynamic effects and responsiveness of one trustor to the other trustor's choices in a repeated game (Buskens, Raub, and van der Veer, 2010; Cassar and Rigdon, 2011; Van Miltenburg, Buskens, and Raub, 2012).

Bohnet and Meier (2012) tested the effect of framing in the first-stage decision. In their *Distrust Game*, the trustor's decision is how much to take from the trustor, hence reflecting distrust rather than trust. This framing leads to more trust/less distrust, despite lower trustworthiness on the part of the trustees. In comparison, we find that a negative framing of the second-stage action also reduces trustworthiness, but does not appear to affect anticipatory trust.

Coordination games. The DPG is also closely related to the multi-player coordination game in Camera, Charness, and Chemaya (2024). It is a novel two-stage game, where, in the first stage players can communicate using a chat box and then independently choose to either trade at a small cost, or not. A large pot of money can be created only if at least two players coordinate on trade. By default, this money is entirely allocated to a randomly selected trader. In the second stage, this default allocation can be vetoed, in which case half of the money is destroyed and the rest is redistributed. In one treatment, veto can only occur through a majority vote, in which case the leftover money is equally distributed to majority voters. In another treatment, one player has veto power, in which case she collects the entire leftover money. The experiment shows that this concentration of decision-making authority

tends to lower the quality of decisions, even if decision-making powers rotate from player to player over time. It also dilutes the effectiveness of communication as a means to promote socially-efficient decisions.

3. The Dictatorial Public Goods Game

The DPG involves a set N of n players. At the first stage of the game, each player i chooses an amount c_i out of an initial endowment e to contribute to the public account. Next, nature chooses one of the players to be the "Administrator" with all players equally likely to be selected. The Administrator a learns the sum of contributions in the group and chooses between *Provision*—using the public account to provide the public good—and *Expropriation* of the public account for her personal use. If the the Administrator provides the public good, each player, including the administrator, earns the sum of collected contributions multiplied by a marginal per-capita return factor m. The payoff for the Administrator is thus:

$$\pi_a = \begin{cases} e - c_a + \sum_{j \in N} c_j. & \text{if } a \text{ expropriates,} \\ e - c_a + m \sum_{j \in N} c_j. & \text{if } a \text{ provides,} \end{cases}$$

and the payoff for player $i \neq a$ is:

$$\pi_i = \begin{cases} e - c_i. & \text{if } a \text{ expropriates,} \\ e - c_i + m \sum_{j \in N} c_j. & \text{if } a \text{ provides.} \end{cases}$$

In our control treatment (see below), there is no administrator discretion, and the public good is always provided, reducing the game to the standard voluntary contribution mechanism (VCM). It is easy to confirm that for self-interested rational players, the sub-game perfect equilibrium of the game dictates zero contributions in the first stage and expropriation in the second stage. This also holds when the game is finitely repeated and in the control VCM.

4. Experimental Design and procedure

We implemented the DPG with the following parameters: $n = 4, e = 10, m = 0.5$. The experiment included four parts, as detailed below. Participants were randomly matched in groups of four that remained fixed throughout the session. The initial

instructions indicated that instructions for each part of the experiment will be provided at the beginning of the part, and that decisions made in any one part will not influence any other part. Feedback on the first three parts was withheld until the end of the experiment.

4.1. Treatments

Each group participated in one of three treatments: Control, Take, and Share, with 15 groups in each treatment for a total of 180 participants. The Control treatment implemented the standard Voluntary Contribution Mechanism (VCM). The game is equivalent to the DPG without Administrator discretion, i.e., the administrator is forced to provide the public good. The Take and Share implementations of the DPG differ only in the labels assigned to the Administrator's choice. In the Share frame, Expropriation is labeled as the default plan and Provision is labeled as sharing the contributions. In the Take frame, Provision is labeled as the default plan and Expropriation is labeled as taking the contributions.

4.2. Timeline of the experiment

Part 1: VCM In Part 1 of the experiment, participants played a one-shot VCM without feedback. This part provides an individual measure of willingness to cooperate, allowing us to account for individual heterogeneity in preferences in our anaylses.

Part 2: DPG In the control treatment, participants repeated the one-shot VCM. In the Take and Share treatments, participants played a one-shot DPG in the corresponding frame. All participants provided an Administrator decision contingent on their being selected as Administrator. Thus, participants first chose their contribution, as in Part 1. In the Control treatment, this marked the end of Part 2. In the Take and Share treatments, once all participants made their choice, they proceeded to the next stage. All participants received information on the total sum of contributions in their group and chose between Provision and Expropriation. See Table 1 for the alternatives as presented to participants in the experiment.

Thus, in the Take and Share treatments, participants learned the sum of contributions before making their Administrator decision. For comparability, we also informed participants in the Control treatment of the sum of contributions at this stage. Additional feedback was deferred to the end of the experiment. At the time, each participant learned the sum of contributions in the group, whether she was selected to be the Administrator, the Administrator's choice, and her resulting individual payoff in the part.

Table 1: Administrator choice.

	Treatment	
	Take	Share
Provision:	Go with the DEFAULT PLAN	INVEST the sum of all contributions and SHARE the project's yield with everyone else
Expropriation:	TAKE the sum of all contributions for yourself and DO NOT INVEST it	Go with the DEFAULT PLAN

Part 3: Social norms In Part 3 we elicited social norms using the Krupka and Weber (2013) method. Participants rated the social acceptability of different choices on a 4-point Likert scale.[1] All participants rated choices of contributing 0 points and contributing all 10 points. Participants in the Take and Share treatments additionally rated Provision and Expropriation, presented as in Table 1. Participants received a bonus of $0.50 if their answer matched the modal answer (including a 3-way tie) among the other three members in their group. As with the previous parts, participants learned the number of "correct" answers and the resulting bonus only at the end of the experiment.

Part 4: Repeated games In Part 4, participants played the same game as in Part 2 (VCM, DPG in Take frame, or DPG in Share frame) repeatedly for 15 periods. The feedback provided at the end of each period was similar to that provided at the end of the experiment for Part 2, and included the sum of contributions in the group, whether the participant was selected to be the Administrator, the Administrator's choice, and the individual period payoff.

4.3. Procedures

We recruited a total of 180 undergraduate student subjects (25% males) through announcements at Chapman University. The experiment was conducted in the Economic Science Institute's laboratory in March 2025. Participants had no previous experience with this type of game, and were arranged in private computer terminals, without the possibility to communicate or have eye contact with other participants.

[1]The options were very socially appropriate, somewhat socially appropriate, somewhat socially inappropriate, and very socially inappropriate.

Instructions were distributed and publicly read at the beginning of each part. A non-incentivized comprehension quiz was administered after reading the instructions for Part 2 (see Supplementary Material); after collecting the participants' answers the experimenter publicly provided the correct answers with a detailed explanation for each answer.

The experiment was programmed and conducted using z-Tree (Fischbacher, 2007). Each session included 20 participants, and lasted for about 45 minutes on average. At the conclusion of a session, participants were given feedback about each part and informed about their total salient earnings in the session. The conversion rates for salient earnings were \$0.25 per point in Part 1 and 2, \$0.50 per correct answer in Part 3, and \$0.05 per point in Part 4[2] In addition, participants received a \$7 fixed payment.

5. Research questions

Our experimental design allows us to explore several issues surrounding the interplay of collective action and centralized provision of public goods. The comparison of the DPG and the baseline VCM highlights the implications of having a discretionary agency when commitment to produce centralized public goods is unfeasible. The relationship between contributions at the first stage and the second stage reveals whether these decisions act as complements or substitutes. The repeated game in Part 4 allows us to explore the dynamics associated with these issues, while the different framing treatments shed light on the effects of the statutory role of the administrator.

We start by testing the treatment effects on efficiency. Efficiency in our game is minimized at an aggregate payoff of $ne = 40$ if no player contributes or if the Administrator chooses to expropriates. It is maximized at the aggregate payoff of $n^2me = 80$ obtained when all players fully contribute and the Administrator chooses to provide. Efficiency is thus given by $\left(mn\sum_{i\in N}(c_i) - ne\right) / \left(n^2me - ne\right)$ if the Administrator provides. Writing C for the sum of contributions and plugging in the experimental parameters, this simplifies to $\frac{C-20}{20}$. Expropriation, on the other hand leads to zero efficiency. Our first research question relates to treatment comparisons vis-à-vis efficiency.

Research question 1. *Does efficiency differ between the treatments, in the one-shot game of Part 2 and in the repeated game of Part 4?*

Any loss of efficiency in the different treatments may result from differences in contribution levels, from expropriation by the Administrator, or from both. We test

[2]We adjusted the conversion rate in part 4 from \$0.07 per point after the first two sessions.

the relative impact of these two channels by shutting each down separately. First, we compare the counterfactual efficiency if the Administrator always provides—which is equivalent to the proportion of endowments contributed—to full efficiency. The difference reflects the loss of efficiency due to reluctance to contribute. Next, we consider the counterfactual efficiency under full contributions, assuming that the probability of provision is that predicted under full contributions based on a logistic model. Our next research question addresses this issue.

Research question 2. *To what degree do treatment differences in efficiency result from differences in contributions or from differences in Administrator decisions?*

Our next research question extends the analysis to the dynamics in the repeated game.

Research question 3. *Do time trends in contributions and in Administrator decisions differ across the three treatments?*

The incentive to expropriate increases with the contributions, whereas the incentive to contribute decreases the more likely the Administrator is to expropriate. This potentially creates a negative-feedback cycle that unravels cooperation in the DPG. On the other hand, both contributions and provision reflect social capital in our mini-society. Viewed as complements in producing social welfare or as reciprocal actions between society and the central Administrator, however, contributions and provision should reinforce each other. If Administrators reciprocate contributions by providing, the feedback cycle becomes positive, and cooperation may be sustained. Furthermore, the framing of the Administrators' decision may impact their perceptions and behavior. Our next research question aims to test this.

Research question 4. *Are Administrators more likely to provide when contributions are higher or lower, depending on the framing of the decision?*

Our final research question looks at the social norms elicited in Part 3 of the experiment.

Research question 5. *Are social norms affected by the possibility of expropriation and by the framing of the Administrator decision?*

6. Results

6.1. Descriptive statistics

Table 2 presents the aggregate contributions, Administrator decisions, and resulting expected efficiency across the experiment. Efficiency is lowest in the Take treatment

Table 2: Descriptive statistics.

		Control	Share	Take
Part 1	Contribution	4.80	5.68	5.18
(VCM)		(1.86)	(1.72)	(2.01)
	Efficiency	0.48	0.57	0.52
		(0.19)	(0.17)	(0.20)
Part 2	Contribution	3.87	4.67	3.95
(One-shot)		(1.86)	(1.59)	(1.96)
	Provision	–	0.63	0.47
		–	(0.23)	(0.25)
	Efficiency	0.39	0.31	0.22
		(0.19)	(0.25)	(0.26)
Part 4	Contribution	4.29	4.26	3.63
(Repeated)		(1.87)	(2.08)	(1.72)
	Provision	–	0.74	0.60
		–	(0.13)	(0.21)
	Efficiency	0.43	0.34	0.26
		(0.19)	(0.22)	(0.20)

Notes: Average contributions, Share of Administrators providing, and expected efficiency (across the four Administrator decisions) by part and treatment.

in the one-shot game and in the repeated game. This may be due to the lower contributions in this treatment and to the lower provision rates. Recall that provision rates may respond to the contribution levels and, in the repeated game, contribution levels may respond to provision decisions realized in previous rounds. We explore these issues systematically in the following.

6.2. Efficiency, contributions, and provision

We start by comparing *expected* efficiency across treatments. Recall that efficiency is defined as the realized gains from public goods provision compared to the potential gains. Thus, expected efficiency is defined at the group level to be the share of endowments contributed in the group multiplied by the share of players who chose to provide as Administrators. We calculated the mean expected efficiency in the one-shot and repeated games for each group to obtain 15 independent observations per treatment at each part of the experiment. Table 3 presents the results of pairwise Mann-Whitney tests for comparing efficiency levels between treatments. Unsurprisingly, there are no significant treatment effects in Part 1 of the experiment, before the treatment manipulation kicks in. In both the one-shot games of Part 2 and the

Table 3: Exact Mann–Whitney test for expected efficiency ($N = 15$ per treatment).

Part 1 (VCM)		
	z-value	**p-value**
Share vs Take	0.81	.429
Control vs Take	−0.50	.630
Control vs Share	−1.45	.151
Part 2 (One-shot)		
	z-value	**p-value**
Share vs Take	1.60	.113
Control vs Take	2.47	.012
Control vs Share	1.10	.281
Part 4 (Repeated)		
	z-value	**p-value**
Share vs Take	1.56	.124
Control vs Take	2.26	.023
Control vs Share	1.31	.202

repeated games of Part 4, efficiency is significantly lower in the Take treatment compared to the Control. Efficiency is not significantly harmed by the option to expropriate under the Share framing. However, the differences between the Share and Take treatments do not reach statistical significance.

The Tobit regressions reported in Table 4 confirm and strengthen these results. Behavior is qualitatively and quantitatively similar in the one-shot and in the repeated game. Introducing expropriation in the Share treatment reduces efficiency by roughly 8 percentage points compared to the control, although this difference is not statistically significant in the baseline models reported in Columns (1) and (3). This gap increases to 13–14 percentage points and becomes significant when controlling for the cooperation tendencies in the group—as captured by the efficiency (or contributions as share of the endowment) in the VCM of Part 1—in Columns (2) and (4). Efficiency in the Take treatment is significantly lower than in the Control in all specifications, with a mean difference of roughly 17–20 percentage points, depending on the game and model. The difference between the Share and Take difference is not statistically significant, even with the control ($\Delta = -0.063, z = -1.11, p = .272$ in the one-shot game; $\Delta = -0.059, z = -1.09, p = .277$ in the repeated game).

Result 1. *Efficiency is significantly reduced if a central administrator can expropriate the public good. Efficiency levels are lower in the Take frame compared to the Share*

Table 4: Tobit regressions on efficiency.

	(1) One shot	(2) One shot	(3) Repeated	(4) Repeated
Share	−0.077	−0.126**	−0.088***	−0.147***
	(−1.16)	(−2.19)	(−1.28)	(−2.85)
Take	−0.168**	−0.189***	−0.181***	−0.206***
	(−2.51)	(−3.34)	(−2.57)	(−3.53)
Period			−0.013***	−0.013***
			(−6.63)	(−6.60)
VCM		0.547***		0.667***
		(4.29)		(5.54)
Constant	0.387***	0.124*	0.534***	0.213***
	(8.18)	(1.70)	(11.19)	(3.65)
Observations	45	45	675	675

Notes: Dependent variable: realized efficiency (1 obs = 1 group in a Part). Robust standard errors clustered on groups in Column (2). *VCM* is the efficiency in part 1 of the experiment. t-values in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

frame, although this difference is not statistically significant.

The two conditions required to reach maximal efficiency are full contributions and no expropriation. How much of efficiency loss is due to low contributions and how much due to expropriation? Figure 1 presents the breakdown of efficiency loss across treatments, in the one-shot and repeated games. The "loss due to free riding" is the relative gap between the maximal obtained group payoff of 80 and the payoff that would have been obtained with the actual level of contributions and all four group members choosing to provide as Administrators. The "loss due to expropriation" is the gap between the expected efficiency and what would have been obtained if all four group members chose to provide.

The figure shows that, by far, the larger drop in efficiency is due to low contributions. However, compared to the Control, loss of efficiency in the two versions of the DPG game is largely due to expropriation rather than differences in contributions. The exception is the repeated play under the Take frame, where we see both a reduction in contributions and expropriation. We explore these issues further by analyzing the treatment differences in contributions and in Administrator choices.[3]

The Tobit regressions reported in Table 5 reveal no significant treatment effects in contributions, either in the one-shot or in the repeated game. In contrast, the logistic

[3]The Administrator choice is moot if all four group members contributed zero. This occurred in one period each of five groups; one in the Control, one in the Share, and three in the Take treatment. These observations are omited from any analysis that involves the Administrator choice.

Figure 1: Efficiency loss.

regressions reported in Table 6 uncover systematic framing effects on Administrator choice. Participants in the Take treatment were, on average, 16.1 percentage points less likely to provide compared to the Share treatment in the one-shot game ($z = -1.92, p = .055$). The average effect in the repeated game was comparable, with the likelihood of provision dropping by 12.5 percentage points in Take compared to Share ($z = -2.28, p = .023$).

Result 2. *Contribution levels are similar in the VCM and in the DPG under both framings. Differences in efficiency result from expropriation rates, which are significantly higher under the Take frame.*

6.3. Dynamics

Figure 2 plots contributions and provision rates across the 15 periods of the repeated game. Contributions follow a downward trend typical of repeated public goods games. We see that both contributions and provision rates are consistently lower in the Take treatment compared to the other treatments in all periods. Column (3) in Table 5 allows for differential time trends in the different treatments. The coefficient for Period is negative and significant ($p = .002$), while the interactions with the treatment are negligible and non-significant, indicating similar time trends across treatments. Similarly, Column (4) in Table 6 allows for differential time trends in the Share and Take treatments for Administrator decisions. The results confirm a negative trend in the Share treatment, whereas provision rates are stable in the Take treatment ($\beta = -0.015, z = -1.107, p = .285$).

Table 5: Regressions on contributions.

	(1) One shot	(2) Repeated	(3) Repeated	(4) Repeated
Share	0.277	−0.338	−0.298	
	(0.56)	(−0.59)	(−0.53)	
Take	−0.144	−0.790	−1.018*	0.060
	(−0.27)	(−1.47)	(−1.82)	(0.13)
Period			−0.145***	−0.072**
			(−3.16)	(−2.44)
Share × Period			−0.005	
			(−0.09)	
Take × Period			0.029	−0.005
			(0.59)	(−0.16)
Lagged contributions				0.371***
				(4.02)
Lagged provision				1.207***
				(5.03)
VCM	0.592***	0.354***	0.354***	0.330***
	(9.03)	(5.83)	(5.83)	(5.12)
Constant	1.026***	2.588***	3.751***	0.311
	(2.65)	(5.48)	(7.49)	(0.48)
N	180	2700	2700	1668

Notes: Dependent variable: contribution (1 obs = 1 subject in a Part). Robust standard errors clustered on groups. *Lagged contribution* is the mean contribution of the other three group members in the previous period. *Lagged provision* is the Administrator decision implemented in the previous period. *VCM* is the contribution in part 1 of the experiment. t-values in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6: Logistic regressions on Administrator provision.

	(1) One shot	(2) One shot	(3) Repeated	(4) Repeated	(5) Repeated
Take	−0.661*	−0.559*	−0.591**	−1.109***	−0.979***
	(−1.89)	(−1.78)	(−2.31)	(−2.86)	(−2.69)
Period				−0.077**	−0.048
				(−2.42)	(−1.44)
Take × Period				0.062*	0.055
				(1.77)	(1.54)
Contribution		0.169**			0.204***
		(2.04)			(3.95)
VCM	0.044	0.040	0.119***	0.120***	0.103***
	(0.84)	(0.76)	(3.47)	(3.47)	(2.90)
Constant	0.298	−0.456	0.410*	1.045***	0.029
	(0.78)	(−0.95)	(1.72)	(2.94)	(0.08)
Observations	120	120	1784	1784	1784

Notes: Dependent variable =1 if subject provides the public good as an Administrator (1 obs = 1 subject in a round). Robust standard errors clustered on groups. *Contribution* is the mean contribution of the other three group members in the current period. *VCM* is the contribution in part 1 of the experiment. t-values in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

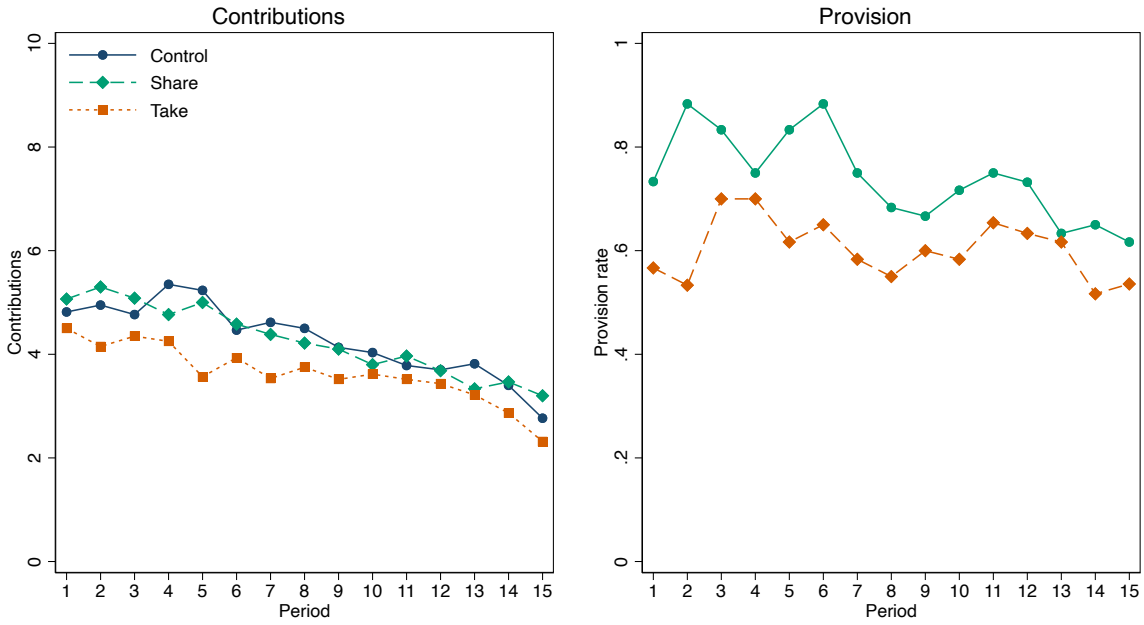

Figure 2: Dynamics in the repeated game.

Result 3. *Contributions decrease across periods at a similar rate across treatments. Provision rates start higher under the Share framing compared to the Take framing, but decrease to similar levels in later periods. Provisions rates under the Take framing are stable.*

We proceed to look at the mutual relations of contributions and provision. Players have a stronger incentive to contribute the more likely they believe the Administrator to provide. We should, therefore, expect higher contributions following periods in which the designated Administrator chose to provide. Indeed, average contributions increase from 2.89 following expropriation to 4.66 following provision in the Share treatment, and from 2.48 to 4.57 in the Take treatment. Column (4) in Table 5 shows that contributions respond positively to the implemented Administrator decision as well as to the amount contributed by the other three players in the previous round.

How Administrators respond to the collected contributions is less straight forward, as posited in our Research question 4. Although Administrators may reciprocate to high contributions by providing the public good, higher contributions increase the personal gain from expropriating. Figure 3 reveals a positive association between provision rates and average contributions of the other three group members. This association is naturally weaker in the one-shot game, where some data points are based on just one or two observations. The regression in Column (5) of Table 6 confirms the significance of this observation. An additional token contributed, on average, by other group members is associated with an average increase of 3.9

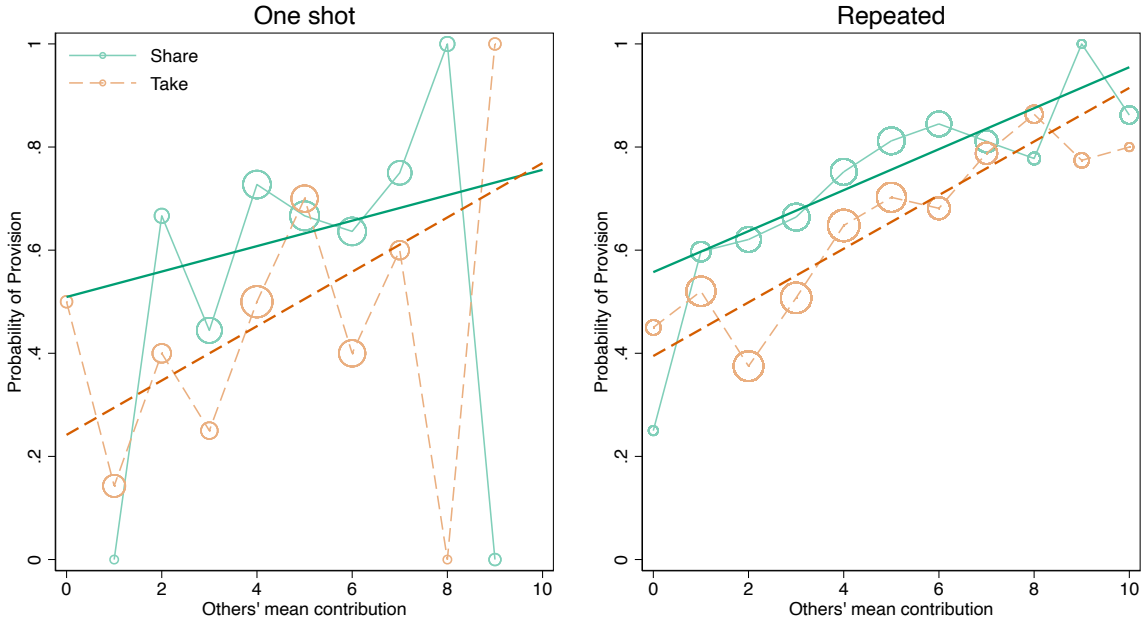

Figure 3: Provision by collected contributions.

Notes: Provision rates by the average contribution of the other three group members (rounded up). The size of the bubble reflect the frequency with which the level of contribution occurred. The lines plot the linear fit.

(one shot) and 4.0 (repeated) percentage points in the likelihood of provision ($z = 2.18, p = .030$ for the one-shot game $z = 4.28, p < .001$ for the repeated game).

Result 4. *Contributions in the repeated game are higher following a period in which the designated Administrator chose to provide. In both the one-shot and the repeated game, Administrators are more likely to provide the public good if the other group members contributed more, contrary to the monetary incentive to expropriate induced by contributions.*

6.4. Social norms

Figure 4 presents the mean elicited social norms. As can be expected, the prosocial actions, contributing the full endowment (mean rating 3.47, $SE = 0.045$) and providing as Administrator (mean rating 2.57, $SE = 0.022$) are rated as more socially acceptable than contributing nothing (mean rating 1.83, $SE = 0.050$) and expropriating (mean rating 1.08, $SE = 0.052$) in all treatments.[4]

[4]The standard errors and tests reported in this section are based on OLS regressions of the norm ratings on treatment dummies. We cluster robust standard errors on groups as a conservative measure to account for potential dependencies due to the information about the sum of contributions in the group provided to participants before making Administrator decisions in Part 2 of the Share and Take treatments.

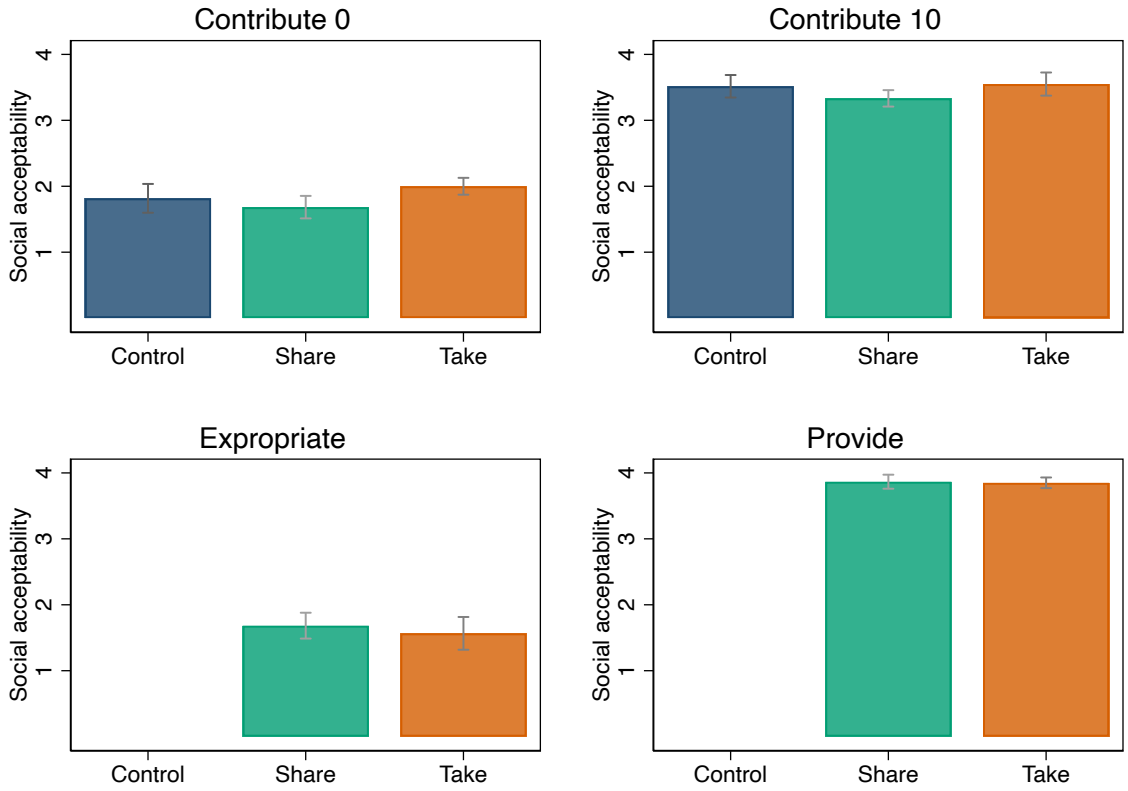

Figure 4: Social norms.

Notes: Ratings ranges from 1 (very socially inappropriate) to 4 (very socially acceptable). 95% confidence intervals based on OLS regressions with robust standard errors clustered on groups.

The norm ratings for Provision and Expropriation are similar in the Share and Take treatments, despite the differences in actual decisions documented above. This lack of normative differences may result from the fact that the norm elicitation was for actions rather than strategies. It is possible that norms diverge for, e.g., expropriation following high contributions by the other group members even if they do not differ for the unconditional elicitation used in the experiment. A follow-up study can explore this possibility.

Strong free riding (contributing nothing) is considered to be less socially unacceptable in the Take frame compared to the Share frame (mean rating of 2.00 vs. 1.68, $t = 2.99, p = .005$). This is consistent with the notion that keeping resources is acceptable if contributed resources may be "stolen". However, full contributions are also deemed to be more socially acceptable under the Take compared to the Share framing (mean rating of 3.55 vs. 3.33, $t = 2.03, p = .049$). Therefore, this result should be taken with caution.

Result 5. *The framing of the game does not affect the normative perceptions of Pro-*

vision and Expropriation. Both free riding and fully contributing are perceived more favorably in the Take treatment compared to the Share treatment.

7. Conclusion

We proposed a novel game, the *Dictatorial Public Goods Game*, to study how a centralized allocation of public goods may affect the group's contributions. Our setup adds a second stage to the standard Voluntary Contribution Mechanism. In this additional stage, one group member is given the administrative power to redirect the contributions generated in the VCM away from the public good and to her own personal account.

The main finding is that, with this addition, efficiency significantly drops below that attained in a standard VCM. This holds independent of how we framed the administrator's choice, either as choosing to reject a "resource expropriation" default action, or choosing to reject a "public goods provision" default action. We do see that the frequency of expropriation is inversely related to contributions, but this complementarity did not encourage contributions over and above the levels attained in a standard VCM setting. In other words, the experiment suggests that contributions are inelastic to the institutional setting—automatic or discretionary investment into the public good. The implication is that, when a few individuals in a society are in charge of administering collective contributions to a public good, this additional decision-making layer can only add further obstacles to advancing the collective good, due to expropriation. How can we cure this problem?

Our new paradigm provides a workhorse to explore several possibilities. Here, we mention three. A first possible way to reduce the frequency of expropriation is to select administrators among the more cooperative players in the group—instead of relying on a random selection process. This could, in principle, be done by imposing a selection mechanism that is contingent on histories of past contributions. Such a selection could be externally imposed or could be endogenous. For example, consider a voting process whereby every group member participates in the administrator's selection in every round. This could be implemented by making individual histories of contributions public. Although doing so is reasonable in a laboratory with few subjects, it is arguably impractical in a field setting, as it would requires continuous monitoring actions of a large number of individuals.

A second possibility is to allow administrators to pre-commit to a contingent plan, whereby investment of resources in the public good is automatic whenever contributions reach a pre-specified threshold. Below that threshold, investment can remain discretionary. Given rapid technological development this contingent planning sce-

nario is not that unreasonable for field settings; for instance, nowadays it could be implemented using smart contracts, which could take the investment decision off administrators' hands under certain selected contingencies.

A third possibility is to introduce a compensation-plus-tenure mechanism for administrators. In this scenario, everyone could try out as an administrator, on a rotating basis perhaps, and then a selection process could take place. Those selected as administrators would be subject to a recurrent process of confirmation in the job, based on their past administrative performance. They could be motivated to hold onto the job—and to avoid expropriation—through a modicum of compensation, which could be deducted from the collective level of contributions. This mechanism also seems of possible implementation in a field setting, as it requires monitoring of a very small subset of individuals in society.

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A. Instructions

The instructions presented below are for the Share treatment. The other instructions can be found in the supplementary materials of the paper. The instructions are similar in Parts 1 and 4 across all treatments. The Take treatment uses the same instructions as the Share treatment, with one key difference: the default decision for the administrator is to invest the sum of all contributions in the project and share its yield equally among all group members.[5] Participants in the Control treatment play in Parts 2 and 4 the same game as in Part 1. In addition, they only answer the first two questions in Part 3 (regarding contributions), and do not answer Questions 3 and 4, which are only relevant for the DPG.

A.1. Share:

In this session you will play a game in a group of 4 people. You will earn points depending on your choices and the choices of others **in your group**. Points will be converted into dollars in a manner that we explain later. Different participants may earn different amounts.

Overview

The session is divided into 4 separate **parts**:

Part 1 **Part 2** **Part 3** **Part 4**

Choices and outcomes in one part do not affect outcomes in other parts.
Before each part begins, we will explain how it works.

Part 1

Everyone starts with 10 points. Each point is worth 15 cents (10 points = $1.50).
Your task—as well as everyone else's—is to choose how many of your 10 points you wish to contribute to a fund. The rest, you keep for yourself. The computer will calculate the sum of all contributions in your group.
The sum of all contributions will be invested in a project that yields twice the amount invested. This yield is then equally shared among all 4 group members, independently of their contributions.
The expression below shows how your earnings are calculated:

[5] Therefore, deviating from the default means to "Take."

$$(10 - \text{your contribution}) + \frac{2 \times \text{Sum of all contributions}}{4}$$

Whatever you don't contribute, you keep. You also receive an equal share of the project's yield. So, your contribution raises the earnings of all other group members, and their contributions raise your earnings.

After everyone makes their choice, we will move on to Part 2.

You will receive feedback about outcomes, contributions, and payoff **at the end of this session**.

Part 2

In this part, you will play a version of the game described in Part 1.
First, you will make choices about your contribution, as in Part 1. Then, you will see the sum of all contributions.
At this point, you must make an additional decision as an **administrator**: you decide what to do with this sum.
The **default plan** is to give this sum to the administrator, without investing any.
As an administrator, you have the power to scrap the default plan and follow what was done in Part 1: invest the sum of all contributions in the project and share its yield equally among all group members.
You will be asked: What do you wish to do as an administrator?

- ○ Go with the DEFAULT PLAN.
- ○ INVEST the sum of all contributions and SHARE the project's yield with everyone else.

Everyone must make a choice as an administrator. **At the end of the session**, one person in your group will be randomly selected to be the administrator. Everyone has an equal chance of being selected. The expressions below show how your earnings will be calculated:

- **If the administrator chooses the DEFAULT PLAN** your payoff is:
  (10 − your contribution) if you **are not** the administrator.
  (10 − your contribution) + Sum of all contributions if you **are** the administrator.

  Here no one receives anything from the project—since it is scrapped—so your contribution to the project can only raise the administrator's earnings (if you are not the

administrator).

- **If the administrator chooses INVEST & SHARE** your payoff is as in Part 1, which is:

$$(10 - \text{your contribution}) + \frac{2 \times \text{Sum of all contributions}}{4}$$

After everyone makes their choice, we will move on to Part 3.
You will receive feedback about the outcome and payoff in Part 2 **at the end of this session**.

Self-Test

You must answer all questions correctly before proceeding.

Hypothetical Scenario 1: You contribute 2 points, the other three people contribute 0, 4, and 1 points. The administrator chooses 'INVEST & SHARE.' Please choose one of the following:

(a) The total contribution is 7 points.
(b) If I am the administrator, I will earn $10 - 2 + \frac{2\times 7}{4}$ points.
(c) If I am not the administrator, I will earn $10 - 2 + \frac{2\times 7}{4}$ points.
(d) All of the above

Hypothetical Scenario 2: You contribute 2 points, the other three people contribute 0, 4, and 1 points. The administrator chooses 'DEFAULT PLAN.' Please choose one of the following:

(a) The total contribution is 7 points.
(b) If I am the administrator, I will earn $10 - 2 + 7$ points.
(c) If I am not the administrator, I will earn $10 - 2$ points.
(d) All of the above

Hypothetical Scenario 3: You contribute 10 points, the other three people contribute nothing. Please choose one of the following:

(a) If I am not the administrator and the administrator chooses 'DEFAULT PLAN,' I will earn 5.
(b) If I am not the administrator and the administrator chooses 'INVEST & SHARE,' I will earn 5.
(c) If I am the administrator and choose 'INVEST & SHARE,' I will earn 5.
(d) Both (b) and (c)

Hypothetical Scenario 4: You contribute 0 points, the other three people contribute 30 in total. Please choose one of the following:

(a) If I am not the administrator and the administrator chooses 'DEFAULT PLAN,' I will earn 40.
(b) If I am not the administrator and the administrator chooses 'INVEST & SHARE,' I will earn 40.
(c) If I am the administrator and choose 'DEFAULT PLAN,' I will earn 40.
(d) Both (b) and (c)

Hypothetical Scenario 5: You contribute 5 points, the other three people contribute 7, 8, and 10 points. The administrator chooses 'INVEST & SHARE.' Please choose one of the following:

(a) You will earn 15, and the player who contributes 10 will earn 15.
(b) You will earn 20, and the player who contributes 10 will earn 15.
(c) You will earn 20, and the player who contributes 10 will earn 20.
(d) You will earn 15, and the player who contributes 10 will earn 20.

Part 3

In thinking about the game in Part 2 please answer a few questions. Your answers will not be revealed to others.
You will receive feedback about the outcome and payoff in Part 3 **at the end of this session**. At that point, the computer will identify the **most popular answer** among the **other three** members of your group.
For each question, you will receive $0.50 if your answer matches the most popular answer, and nothing otherwise. If two or more answers are equally popular, you will receive $0.50 as long as your answer matches one of the equally popular answers.
After everyone makes their choice, we will move on to Part 4.

Questions

1. How socially appropriate is it to contribute 0 points?

   (a) very socially inappropriate
   (b) somewhat socially inappropriate
   (c) somewhat socially appropriate
   (d) very socially appropriate

2. How socially appropriate is it to contribute all 10 points?

   (a) very socially inappropriate
   (b) somewhat socially inappropriate
   (c) somewhat socially appropriate
   (d) very socially appropriate

3. How socially appropriate is it to choose *INVEST & SHARE* as an administrator?

   (a) very socially inappropriate
   (b) somewhat socially inappropriate
   (c) somewhat socially appropriate
   (d) very socially appropriate

4. How socially appropriate is choosing the *DEFAULT PLAN* as an administrator?

   (a) very socially inappropriate
   (b) somewhat socially inappropriate
   (c) somewhat socially appropriate
   (d) very socially appropriate

Part 4

In this part, you will play the same game as in Part 2for 15 consecutive periods.
At the beginning of each period, everyone will start with 10 points. Each point is now worth 5 cents (10 points = $0.50).
In each period, you will proceed as described in Part 2.
At the end of each period, you will see the contributions in your group and the outcome. You will always remain anonymous.
Your final payoff from Part 4 is determined by the sum of all points you earn over the 15 periods.