DELEGATION AND COORDINATION WITH MULTIPLE THRESHOLD PUBLIC GOODS: EXPERIMENTAL EVIDENCE

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Abstract

When multiple charities, social programs and community projects simultaneously vie for funding, donors risk miscoordinating their contributions leading to an inefficient distribution of funding across projects. Community chests and other intermediary organizations facilitate coordination among donors and reduce such risks. To study this, we extend a threshold public goods framework to allow donors to contribute through an intermediary rather than directly to the public goods. Through a series of experiments, we show that the presence of an intermediary increases public good success and subjects' earnings only when the intermediary is formally committed to direct donations to socially beneficial goods. Without such a restriction, the presence of an intermediary has a negative impact, complicating the donation environment, decreasing contributions and public good success.

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1. Introduction

In threshold public good games, players choose how much (money, time or effort) to contribute towards a public good that will provide benefits only if total contributions exceed a minimum level. Such games can be used to model strategic contribution decisions involving crowdfunding projects, social movements, and charitable giving. In the games, individuals choose how much to contribute to a common cause, while recognizing that their contribution may have a meaningful impact only if the cause also receives enough support from others to be viable. For example, philanthropists who wish to support the construction of a new community arts center recognize that their contribution will only have its intended effect if total contributions from all donors are high enough for the project to move forward. Except in the case of very large donors who can unilaterally ensure the success of a project, donors prefer to contribute to projects that receive enough funding from others to be viable, but not so much funding from others that the marginal impact of their own contribution is low.

Further complicating the donor decision is the fact that, in many settings, multiple projects or opportunities simultaneously vie for donor funding. Donors must choose not only how much to contribute, but also to which projects or charities to contribute. In these settings, donors are exposed to the additional risk that they inefficiently spread contributions too thinly across projects. Corazzini et al. (2015) (henceforth CCV) extend the threshold public good environment to allow for multiple public goods simultaneously vying for funding, and show how increasing the number of public goods can discourage giving, decrease total contributions and increase the probability that all public goods fail.

The present paper extends the multiple threshold public good environment from CCV to allow for strategic delegation.[1] Here, donors may provide their contributions to an intermediary, which then chooses how to allocate total contributions across potential uses. The presence of an intermediary has the potential to simplify donor strategies and reduce coordination problems. No longer must one choose how to allocate contributions across alternative projects. One must simply choose *how much* to contribute, leaving the decision about *where* to contribute in the hands of the intermediary. The use of delegation strategies may avoid situations where contributions are spread inefficiently across projects. The presence of an intermediary could therefore encourage contributions and increase the probability that public goods successfully reach their funding thresholds.

Intermediaries are common in real world philanthropic environments (Chlass et al., 2015; Coffman, 2017; Giving.USA.Foundation, 2018). Americans gave more than 410 billion to charity in 2017 (2.1% of the GDP). Voluntary contributions represented 70% of total giving of which only 2% did not flow through organizations and intermediaries (Giving.USA.Foundation, 2018). Many large non-profits are involved with a variety of projects and choose how to allocate contributions they receive across alternative uses. Furthermore, some prominent organizations exist with the specific mission of encouraging and coordinating philanthropic efforts for their causes or within their communities.

At the cause level, for example, the Susan G. Komen Foundation raised approximately $400 million to reduce cancer deaths during the 2009-2010 fiscal year. The organization then choose how to allocate its funds across related activities such as funding various research projects (21%), education campaigns (39%), providing cancer screening and treatment (19%), and fundraising and administration (21%) (Susan G. Komen Foundation, 2010). At the community level, community chest organizations such as the United Way operate in many locations to encourage and coordinate local donor efforts. In 2016, United Way pooled funds from more than 9 million individual donors and $60,000$ corporate partners for a total of $4.7 billion raised. It also managed a network of $1,200$ local offices in 40 different countries and coordinated the volunteer efforts of 2.9 million individuals. The funding activities and the volunteer efforts supported projects in $1,800 communities$, serving more than 60 million people (UnitedWay, 2016; Economist, 2017).

Typically, individuals choose how much to contribute to their preferred cause's foundation or a local United Way. Then the organization decides how to allocate the sum of its contributions across many viable projects and organizations in order to maximize the social impact of the donations. By contributing through the United Way or related organizations, individuals do not need to strategize about whether their own donations are optimal given the allocation decisions of others. They simply choose how much to give and defer to the intermediary organization to allocate their contributions across projects in the optimal way.

[1] The literature review discusses several recent papers that extend CCV in other directions.

After incorporating an intermediary organization into a repeated multiple threshold public good game, we show experimentally that the effectiveness of such organizations depends heavily on the formal restrictions placed on its use of donor funds.

First, we consider an environment in which the intermediary is under no obligation to allocate donor funds to a use that is valued by the donors. This need not be interpreted as illegal theft or embezzlement of funds, but, rather, it captures the possibility that an organization may be able to direct contributions towards increasing its staff size or salaries, or towards projects that are unrelated to the projects donors hoped to fund. However, just because an intermediary can expropriate funding doesn't mean that it will do so. Intermediaries may feel obligated to use funding in accordance with donor expectations, especially in dynamic environments where fund use today may affect future donations.

Second, we consider an alternative version of the environment in which a "destination rule" formally requires that the intermediary pass along the entire value of the donors' delegated contributions to public goods. Redirecting all or part of the delegated contributions for private benefit is no longer possible. Such a destination rule is consistent with non-profit sector regulations or public commitments made by NGOs that generally improve transparency regarding the use of funds and limit the share of contributions that can be directed to overhead or administrative costs.[2]

In both environments, the presence of an intermediary may reduce the risk of donors contributing to projects that do not receive enough support from others to be viable. In doing so, the presence of an intermediary may potentially encourage contributions and increase public good success and payoffs. In the unrestricted delegation environment, however, donors face a dimension of risk that is not present with a destination rule: they face uncertainty about whether the intermediary will work in the public interest, and risk that their contributions will not be passed along to a public good. Regardless of whether the intermediary intends to behave outside of the public interest, donors face the possibility that it might.

The relative risk associated with contributing is lower in the delegation game with a destination rule than it is in either the game without delegation or the game with unrestricted delegation. We therefore expect delegation to increase contributions and public good success when intermediaries face restrictions on their use of funds. It is less clear, however, whether the presence of an intermediary will increase contributions and public good success when there is no destination rule. Unrestricted delegation reduces the risk of mis-coordination among donors, while simultaneously introducing the risk of intermediary expropriation. Which dimension of risk is more effective at discouraging contributions is an empirical question, which we consider experimentally.

In the laboratory experiment, we show that the presence of an intermediary increases success of public goods and overall welfare only in the setting with a destination rule. With a destination rule, the ability to delegate donations has a significant positive impact on public good funding, including coordination, success rates and payoffs. When the intermediary does not face formal restrictions on the use of funds, however, donors contribute even less than in the case without an intermediary. Without a destination rule, the presence of an intermediary does not help increase contributions or improve public good success, leading to worse outcomes for groups and less success for the public goods they are trying to support.

Together, these results suggest that an intermediary organization can help facilitate coordination among donors and successful funding of public goods. For this to be the case, however, donors must have reason to believe that the intermediary will use their donations effectively. Without this confidence, the presence of an intermediary can decrease contributions and public good success.

Our findings highlight the potential for community chest organizations and other intermediaries, and the benefits from such organizations restricting how they are able to use donations ahead of any funding drive. They also illustrate a channel through which regulations and oversight of charitable organizations, such as rules governing the portion of donations that may be directed to administration, may facilitate donations and lead to more successful charitable giving.

[2]It is also related to donors adding conditions to their contributions that require funding to be spent in certain ways. Large donors often add restrictions to an organization's use of their funds. There is not only a moral obligation for non-profits to honor donor's wishes, but they are also required by law to do so (Brody, 1998; Bac, 2002; Goodwin, 2005; Atkinson, 2008). Under destination rules, NGOs must be careful in choosing how to use donations as, in case they do not comply with the initial intent, donors can take legal action, resulting in substantial monetary and reputation costs for the intermediary.

2. Literature review

There is a substantial and growing literature using laboratory experiments to consider the decisions of individuals to contribute to public goods. Within this literature, our analysis is most related to the papers that consider the allocation of contributions across multiple goods (e.g. Blackwell and McKee, 2003; Moir, 2006; Bernasconi et al., 2009) and the papers which focus on threshold public goods (Bagnoli and Lipman, 1989; Andreoni and Gee, 2015), which is sometimes used to model donor contributions to charitable organizations and fundraising projects (Andreoni 1989, 1998).

Several recent papers, beginning with CCV (first discussed in the introduction), consider environments in which donors allocate contributions across several different threshold public goods. Such a framework is a stylized representation of an environment in which multiple charities or fundraising projects simultaneously vie for donations. CCV show how increasing the number of public goods in such an environment can make coordination among donors more difficult to achieve, which discourages donations and makes it less likely that any public good succeeds. Several recent papers consider related extensions of this framework. Ansink et al. (2017) considers the impact of seed money on contributions and extends the framework to allow for giving in continuous time. Cason and Zubrickas (2018) and Liu et al. (2016) considers the impact of rebates when a public good fails to achieve its threshold on contributions in a multiple good setting.[3] These papers consider various aspects of how inefficiencies arise as multiple projects vie for funding. Our paper contributes to this literature by exploring the role of donation intermediaries.

The idea that delegation can improve coordination has been well studied in a variety of other strategic environments. Theoretical analysis of the topic focuses mainly on principle-agent settings (e.g. Aghion and Tirole, 1997; van den Steen, 2006; Hammon et al., 2010) and the theory of firm (e.g. Vickers, 1985). Empirical research on delegation has devoted attention to contexts such as corporate governance (e.g. Alfoldi et al., 2012), management (e.g Sengul et al., 2012) and labour relations (e.g. Charness and Sutter, 2012). Our focus on delegation in charitable giving represents a novel focus of research. Furthermore, our evidence shows how delegation can decrease outcome efficiency when preferences donor and intermediary preferences are not fully aligned. This is related to the work on trust-related concerns between principals and the delegated entities. Opportunistic behavior, essentially related to free-riding (e.g. Gur and Bjørnskov, 2017; Herz et al., 2016; Löschel and Rübbelke, 2014; Brown et al., 2012) leads to delegation failures and sub-optimal outcomes. Hidden costs of the intermediation such as inefficient administration and embezzlement (e.g. Chlass et al., 2015; Di Falco et al., 2016), as well as explicit prices like overhead fees (e.g. Gneezy et al., 2014; Butera and Houser, 2018) represent further aspects that negatively affect intermediation, especially in charitable giving contexts. In our experiments, we compare outcomes in a setting in which a delegate is unable to act outside of the interests of the others players and a setting in which delegate behavior is unrestricted (and trust-related concerns are relevant). This allows us to identify the degree to which such concerns affect donor behavior and outcomes in our environment.

Related to our paper, a recent strand of experimental research has confirmed the positive effects generated by delegation-based mechanisms in voluntary contribution settings. In this literature, the discretionary power on financing a public good is given to intermediaries, either endogenously elected by the group members (e.g. Hamman et al., 2011; Bernard et al., 2013; Kocher et al., 2018) or exogenously appointed (e.g. Oxoby, 2013; Makowsky et al., 2014; Hauge and Rogeberg, 2015). Bolle and Vogel (2011) examine the effect of using either an endogenous or an exogenous procedure to appoint the intermediary, finding that both delegation schemes stimulate the provision of public goods in the short run. Taking another approach, Kocher et al. (2018) study the effect of delegation when a global public good benefits multiple groups of agents and investigate whether welfare increases when groups delegate the contribution decision to a single (delegated) player. Results show that electoral delegation substantially increases inter-group cooperation, and that re-election incentives prevent representatives from excessive exploitation of their constituents. Bernard et al. (2013), Stoddard et al. (2014), and Stoddard et al. (2019) consider a similar problem devising a tragedy-of-the-commons game in which players choose how much to extract from a common pool of resources. They provide further supporting evidence on the general conclusion that delegation can lead to higher payoffs, in this case reducing the severity of tragedy of the commons. None of these papers focus on delegation in a multiple public good or threshold public good environment.

[3] See also Bouma et al. (2018).

A connected stream of literature looks at the role of leadership on voluntary provision of public goods. Leaders are defined as the first movers in choosing contributions to a public good. A leader's contribution is observed by other group members before they choose their own individual contributions. It is found that leaders, by setting a virtuous example, can positively influence followers' contributions both in public good (Levati et al., 2007; Rivas and Sutter, 2011; Jack and Recalde, 2015; Drouvelis et al., 2017) and common pool settings (Buchholz and Sandler, 2017). Delegation, as we consider in our experiment, represents an alternative means of improving contributions.

3. Experimental design

Our experimental design extends the multiple threshold public good setting of CCV to include treatments in which subjects can delegate their contributions to one group member (the "intermediary") who then decides how to allocate the delegated contributions across different public goods.

We present results from three distinct treatments with multiple public goods, using a between-subject design:

- *No delegation (NoDel)* - Benchmark treatment with multiple public goods and no delegation based on the setting in CCV.
- *Delegation without restriction (Del)* - Treatment with multiple public goods and the option to delegate contribution to an intermediary but with no destination rule.
- *Delegation with destination rule (DelRule)* - Treatment with multiple public goods, the option to delegate contributions to an intermediary and a destination rule restricting her behavior.

In the last part of the data analysis, we also report results from three additional and analogous treatments in which there is only one available public good, $NoDel[1]$, $Del[1]$, $DelRule[1]$, that are intended to disentangle the role played by multiplicity of public goods in mediating the effects of delegation.

72 subjects participated in each treatment, for a total of 432 participants in the experiment. In each of the treatments, 18 groups of four participants were formed. These groups were kept constant throughout the experiment. Each group participated in a repeated threshold public good contribution game with 12 rounds of repetition. Subjects received feedback about the results at the end of each round. We describe the treatments in detail below.

No delegation treatments. In every period of *NoDel*, each participant is endowed with 55 tokens. Participants independently and simultaneously choose how to divide their endowment between a "private account" and twelve "collective accounts", indexed by n. For each token put into his own private account, a subject receives a return of two points. Each token put into a collective account n returns a benefit of B_n to all players. The benefit associated with a collective account depends on total contributions to that account from all players, denoted C_n, with

$$B_n(C_n) = \begin{cases} 0 & \text{when } C_n < 132 \\ C_n + b_n & \text{when } C_n \geq 132, \end{cases} \tag{1}$$

where $b_n \in \{20, 30\}$ denotes the bonus associated with that good. When total contributions to n do not achieve the threshold of 132 tokens, the contributions to that good are forfeited. When they reach or exceed the threshold, all players benefit equally. The threshold is set at 60% of the total endowment, assuring that at most one public good can be effectively funded.[4] Four of the collective accounts offer bonuses $b_n = 30$ and eight offer $b_n = 20$. Otherwise, the goods are identical.

In the single public good environment with no delegation, $NoDel[1]$, the collective account has a threshold of 132 and offers a bonus of 30 in case of successful contribution.

Delegation treatments. We extend the multiple threshold public good environment to allow for delegation in two ways. Treatments *Del* and *DelRule* add an initial stage to the *NoDel* treatment in which group members can make transfers to an intermediary player. There are still four group members, each endowed with 55 tokens, and three of the group members can transfer any number of tokens between 0 and 55 to the fourth group member. In the second stage, players contribute to public goods in the same way

[4]The marginal per capita return to the collective account equals 0.5 meaning that the marginal return to a subject from successfully contributing to a collective account (namely, once the threshold is reached) is half the return from the private account.

that they did under *NoDel* except that their updated endowments reflect the first stage transfers. The only difference between *Del* and *DelRule* concerns restrictions placed on the intermediary's use of the transferred funds in the second stage. In *Del*, there are no restrictions in how the intermediary may allocate the transfers received between public goods and her private account. In *DelRule*, the intermediary cannot direct transfers received from other players to her own private account; she must direct transfers to a public good.

In the two treatments with a single collective account, *Del*[1] and *DelRule*[1], delegation is based on the same experimental features used in *Del* and *DelRule*.

3.1. **Procedures.** Upon their arrival to the lab, subjects were randomly assigned to a computer terminal. At the beginning of the experiment, instructions were distributed and read aloud (see the online Supplementary Material for the instructions used in *DelRule*). Before the first period started, subjects were asked to answer control questions at their terminal to ascertain their understanding of the procedure and instructions. Subjects' questions about procedures and instructions were answered privately.

In each period of *Del* and *DelRule* (and later *Del*[1] and *DelRule*[1]), subjects participated in two consecutive phases: a delegation phase and a contribution phase. At the beginning of the delegation phase, the computer randomly chose one of the group members to serve as an intermediary, and subjects were privately informed about their role.[5] Non-intermediary group members simultaneously chose how much of the initial endowment to transfer to the intermediary. The intermediary did not make any choice in the delegation phase. At the end of the delegation phase, subjects received feedback on the overall amount transferred to the intermediary, and their own updated endowment that they would have access to in the contribution phase. For the non-intermediaries, this equaled 55 minus any transfer they made in the first stage. For the intermediary, this equaled 55 plus the sum of transfers from others.

At the beginning of the contribution phase, each subject was presented with a number of bins (on the terminal screen) equal to the total number of private and collective accounts (thirteen in *NoDel*, *Del*, and *DelRule*; two in *NoDel*[1], *Del*[1], and *DelRule*[1]).[6] Each of the twelve boxes of the collective accounts showed the threshold and the size of the corresponding bonus.

The twelve collective accounts were divided into two groups. Four were efficient, assigning a bonus of 30 points in case the group contributed more than the threshold, and eight were inefficient, with a respective bonus of 20 points. The four efficient public goods were randomly selected in periods 1, 5, and 9, and were kept unchanged for four consecutive periods. The random reshuffle of the efficient public goods every four periods was motivated by two important considerations. First, it allows us to investigate the effects of delegation in settings characterized by mis-coordination, still preserving the possibility that, in subsequent periods, subjects could develop coordination over multiple alternatives even without delegating resources. For instance, subjects could simply use contributions to signal to the other group members the alternative to opt for in the next period.[7] Second, we believe that reshuffling the public goods captures an important feature of the real world. As much as social needs continuously emerge overtime (consider for instance intervening after earthquakes and other natural disasters, supporting schools, communities, sick people), also charitable options are strongly volatile and change overtime. In these situations, donors

[5]More precisely, in every period, the probability of a group member to be assigned to the role of delegate was kept equal to 25% and independent across repetitions.

[6]In order to minimize frame effects associated with letter or number labels, the twelve collective accounts in *NoDel*, *Del*, and *DelRule* were labeled using colors: white, yellow, green, red, light blue, blue, gray, violet, brown, pink, black, and orange. Also, subjects in these treatments were told that the order of (but not the label associated with) the boxes of the collective accounts on their screen was randomly determined by the computer in every period.

[7]At the same time, we did not want to reshuffle every period in order to preserve the possibility that subjects could effectively use past experience (instead of delegation) to guide their contribution decisions after achieving coordination. Our experimental design was chosen to allow for several high-likelihood-of-mis-coordination periods and other more-stable periods in the same setting.

do not have enough experience and information to successfully coordinate their actions on the same option.[8]

At the end of every period, each subject was informed about the number of tokens allocated by the group to each collective account, whether the corresponding threshold was reached, and any bonus paid. Additionally, following each period, subjects learned the number of points they received from each account and in total.

The experiment took place at the Bocconi Experimental Laboratory for Social Sciences (BELSS) at Bocconi University, Milan, in June 2017. Participants were mainly undergraduate students recruited using the SONA recruitment system.[9] The experiment was computerized using the *z-Tree* software (Fischbacher, 2007). At the end of the experiment, points earned by subjects were converted at an exchange rate of 1 euro per 120 points and monetary earnings were paid in cash privately. On average, subjects earned 14.50 euros for sessions lasting 60 minutes, including the time for instructions and payments. Before leaving the laboratory, subjects completed a short questionnaire containing questions on their socio-demographics and their perception of the experimental task.

4. Delegation and multiplicity: Theoretical insights and testable predictions

In this section, we present a game theoretic model of threshold public goods adapted from CCV. We then discuss how this model may be extended to incorporate delegation rules, and the impact of these extensions on the predictions of the model (in the Online Appendix, we provide a formal analysis). This discussion leads to several testable hypotheses, which guide the experimental design and analysis.

4.1. **Model of threshold public goods without delegation.** There are J players, indexed $j \in \{1, ..., J\}$. Each player receives an endowment y at the beginning of the game. Players simultaneously decide how much of their private endowment to contribute to each of N public goods. The contribution of player j to good n is denoted by $c_{j,n} \geq 0$. Let $C_n \equiv \sum_j c_{j,n}$ and $c_j = \sum_{n=1}^{N} c_{j,n}$ denote the aggregate contributions to good n and the total contributions made by player j, respectively. A player's total donations cannot exceed his endowment: $c_j \in [0, y]$.

Function $B_n(C_n) = B(C_n)$ determines the benefit each player receives from public good n. The benefit depends on whether total contributions reach some contribution threshold, τ, below which the public good fails to return any benefit. For each good n,

$$B_n(C_n) = \begin{cases} 0 & \text{when } C_n < \tau \\ C_n + b_n & \text{when } C_n \geq \tau. \end{cases} \quad (2)$$

When the threshold is reached, the public good returns a benefit to each player that is increasing in total contributions, plus a bonus of b_n associated with good n. Any unit of endowment not contributed to a public good gets directed to private consumption, where it returns a marginal benefit of two (implying a marginal per capita return to the public good is 1/2 that from private consumption). Therefore, player j earns total payoff:

$$u_j(c) = 2(y - \sum_{n=1}^{N} c_{j,n}) + \sum_{n=1}^{N} B(C_n) \quad (3)$$

We assume that $J = 4$, $y = 55$, $\tau = 132$ and $b_n \in \{20, 30\}$. These are the parameters incorporated into our experiment. They assure that groups can fund at most one public good at its threshold, that players

[8] To better analyze the impact of delegation on coordination and contributions in a setting with multiple public goods, the present experimental design departs from the original one introduced by CCV in the number of collective accounts as well as in how heterogeneity is manipulated. First, having 12 (instead of 4 in CCV) collective accounts guarantees that (i) the set containing the efficient alternatives can be entirely changed every four periods and (ii) each alternative is included in the set of efficient accounts for a single 4-period block only. Second, differently from CCV, both the sets of efficient and inefficient collective accounts contain multiple indistinguishable alternatives (more precisely, as mentioned above, 4 efficient and 8 inefficient accounts). Therefore, even under the hypothesis (validated by CCV) that subjects focus their attention on the most efficient collective accounts, they still face the risk of mis-coordinating contributions on different alternatives, as none of the efficient collective accounts in a 4-period block is focal. Therefore, at least in the first of each 4-period block, delegation can help mitigate the coordination problem, still preserving the possibility that groups develop different coordination strategy.

[9] http://www.sona-systems.com/default.aspx

are unable and unwilling to unilaterally fund a good at its threshold, and that players prefer to contribute to a public good only if they expect that others are also contributing to the same public good.

CCV consider such a framework, showing that there exists two type of equilibria. First, there exists an equilibrium in which players contribute nothing to any of the public goods. Second, for each of the public goods, there exists equilibria in which the groups provide contributions to that good exactly equal to the threshold, while providing no contributions to any other good. There are $N+1$ symmetric equilibria: one in which $c_{n,j} = 0$ for all n and j, and one for each good n in which each player contributes $c_{n,j} = \tau/J = 33$ and $c_{m,j} = 0$ for all $m \neq n$.

The threshold public good environment is a coordination game in which players want to contribute to a public good only if they expect that others are also contributing to the same good. Furthermore, the size of the contribution they want to provide depends on the contributions they expect others to provide.

As the number of goods N increases, the coordination problem among donors becomes more challenging. Even if a player expects that others will provide a contribution, it becomes less likely that everyone's contribution will go towards the same good, and more likely that the player's own contribution will be directed to an underfunded good and, therefore, wasted. This mis-coordination problem is the focus of CCV, who argue that additional goods increases the risk of mis-coordinating contributions, making it more likely that players focus on the low-risk strategies that are associated with the no-contribution equilibrium.

When players interact over several periods, there are even more equilibria to consider, but the main insights from the model regarding how adding multiple goods discourages donations continue to hold.

4.2. **Allowing delegation.** To incorporate delegation into the threshold public good framework, we add to the game an initial stage in which one of the four players, i, is appointed to serve as the intermediary, and then the other players choose how much of their endowments to transfer to player i. Denote player j's transfer by $d_j \in [0, y]$, and let $D = \sum_{j \neq i} d_j$. In the second stage of each period, all four players simultaneously choose how to distribute their endowments across the N public goods and their private account just as they did in the game without delegation; except here their endowments are updated to reflect the first stage transfers.

We consider two versions of the delegation game. In the first, player i faces no restrictions on her allocation of the transfers received from other players. She can direct as much or as little of the funds to her private account as well as to the public good as she chooses. In the second version, player i faces a "destination rule" requiring that any transfer from another player in the first stage be passed along to a public good in the second stage; the transfers cannot be directed to the intermediary's private account.

In the delegation environment with a destination rule, there exists equilibria in which the donors only contribute through the intermediary, who then funds one of the public goods at its threshold. For example, there exist equilibria in which each non-intermediary player provides some transfer d_j to the intermediary, who then contributes $c_{i,n} = 132$ to one of the public goods. When players choose such strategies as part of an equilibrium, there is no need to correctly anticipate which of the other goods the other players are going to contribute to. The non-intermediaries simply choose how much to contribute, and the intermediary then chooses the public good to fund using the groups' contributions. Such equilibria continue to exist in the repeated version of the game.

In the delegation environment with unrestricted transfers, there does not exist equilibria of the non-repeated game in which other players only contribute through the intermediary. The intermediary has an incentive to expropriate contributions for her own use rather than pass along enough transfers to reach a funding threshold. Because of this, in a one-shot game, any equilibrium that involves funding a public good entails players coordinating direct contributions on the same good. Some moderate amount of delegation may exist in equilibrium, but not to the extent that it simplifies the coordination problem among donors; it does not eliminate the need to anticipate where others will contribute as part of equilibrium.

In the repeated version of the delegation game with unrestricted transfers, delegation can be more helpful. This is because the presence of repeated interactions between the same set of players allow them to play conditional strategies, which can introduce the potential threat that players will stop contributing to any public good after an intermediary acts outside of the groups' interests. Using such strategies, one may construct equilibria in which non-intermediaries provide contributions only through the intermediary, except for in the last periods of play when players don't need the intermediary to coordinate if they simply continue to fund the same good that was funded in the previous periods. Although delegation can help groups reduce the risk of contributing to different goods in the repeated environment, this requires more complex conditional strategies than in the presence of a delegation rule.

4.3. **Testable predictions.** The theoretical analysis (see Online Appendix A) provides several predictions that help guide the experimental analysis.

In the multiple public good environment without delegation, CCV showed that players often focused on less-risky strategies. As the risk of mis-coordination increased, players were more likely to play the least risky strategy and contribute nothing to any of the public goods. In the above discussion, we considered how delegating contributions through an intermediary changes the risk of providing contributions.

Delegating contributions can reduce the risk that a donor effectively wastes his contribution by contributing to a different good than other donors. This reduction in risk is likely to increase the probability that players provide contributions (through an intermediary), which in turn increases the probability that a public good reaches its funding threshold.

At the same time, however, delegating contributions can increase the risks that the intermediary redirect money away from public good funding for her private gain. This is a possibility in the game with unrestricted delegation, but not in the environment with a destination rule. Although the theory shows that delegation can exist as part of equilibrium in both environments, the strategies involved in such equilibria are much more complicated in the game with unrestricted delegation than in the game with a destination rule, as conditional strategies and dynamic incentives are required to reduce the risk that the intermediary expropriates transfers.

These insights suggest that the probability that a public good succeeds will be higher in the game with delegation and a destination rule than in either the game without delegation or the game with unrestricted delegation. The theory does not provide clear predictions regarding the comparison of outcomes in the game without delegation and the game with unrestricted delegation. Compared to the multiple public good framework without delegation, unrestricted delegation reduces the risks associated with contributing on one dimension, while introducing a new risk on another dimension. Whether contributions and donor coordination increase or decrease in the game with unrestricted delegation will depend on whether the risk of mis-coordination or the risk of intermediary expropriation are viewed as more significant concerns for donors. This is an empirical question, which we consider in the experimental analysis below.

5. Experimental results

In the first part of the section, we focus our attention on the treatments with multiple public goods: *NoDel*, *Del*, and *DelRule*. We explore differences across treatments in overall contributions, coordination, the delegated amount, and delegation behavior. In the last part of the section, we discuss results from the three analogous treatments with a single public good, *NoDel*[1], *Del*[1], and *DelRule*[1], to investigate how the effects of delegation are mediated by multiplicity of public goods.

In the statistical analysis, we use both non-parametric and parametric techniques. The non-parametric tests are based on independent observations at the group level. Moreover, when looking at differences across treatments over all periods, we will also discuss results from the bootstrap-based methodology developed by List et al. (2019) to test multiple null hypotheses simultaneously in experimental settings with multiple treatments.

Concerning the parametric analysis, in order to account for potential dependence across periods, the estimated coefficients are based on standard errors clustered at the group level.

5.1. **Total contributions.** Figure 1 shows the mean total contributions to the collective accounts over periods in *NoDel*, *Del* and *DelRule*.

Averaging over all periods, subjects contribute 24.46 tokens in *NoDel*, 16.66 in *Del*, and 30.01 tokens in *DelRule*. Contributions in *NoDel* are placed between those in *Del* and *DelRule* and are characterized by higher volatility across periods. Downward peaks in total contributions observed in the *NoDel* treatment occur in the reshuffling periods (1, 5, and 9) and are followed by sustained contributions in the next three periods, suggesting that moderate contributions in reshuffling periods enable groups to coordinate higher contributions in the following three repetitions.

Table 1 reports results from parametric, random effects panel regressions to assess the statistical relevance of these preliminary observations.

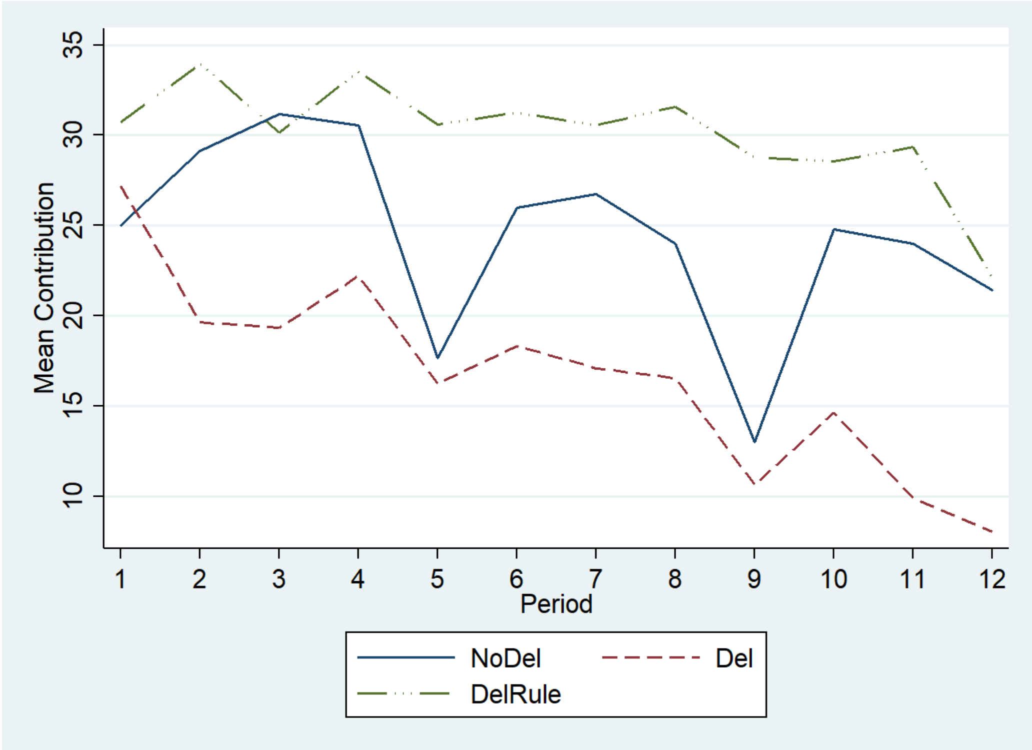

FIGURE 1. Total contributions with multiple collective accounts, by treatment and period.

Column (1) compares contributions in *NoDel* with those observed in *Del* and *DelRule* to assess the effects of delegation in a setting characterized by multiple collective accounts. The negative and significant ($p < 0.05$) coefficient of the treatment dummy *Del* indicates that introducing delegation with no destination rule is detrimental for cooperation, as it reduces contributions relative to the baseline treatment with no delegation, *NoDel*. Instead, delegation seems to stimulate contributions in *DelRule*, when the intermediary is subject to the destination rule. The difference in contributions between *DelRule* and *Del* is positive and highly significant ($p < 0.001$), while the difference between *DelRule* and *NoDel*, although positive, does not reach statistical significance ($p = 0.150$). These results are confirmed by non parametric tests. According to a (two-sided) Mann–Whitney rank-sum test, mean (over all periods) total contributions in *Del* are significantly lower than those in *DelRule* ($p < 0.001$) and *NoDel* ($p < 0.05$), while no difference is detected between *DelRule* and *NoDel* ($p = 0.311$). When accounting for multiple null hypotheses testing, the difference in contributions between the two treatments with delegation, *Del* and *DelRule*, remains highly significant ($p = 0.003$), while that between *Del* and *NoDel* reaches only marginal significance ($p = 0.095$).

Result 1. Delegation is detrimental for contributions when it is not sustained by the destination rule. Indeed, subjects make significantly larger total contributions in *DelRule* and *NoDel* than in *Del*.

Column (2) investigates the previous result by reporting estimates of the intensive (namely, the part of the treatment effect that concerns the level of the contribution, conditional on the subject choosing to contribute) and extensive (the part of the treatment effect that is attributable to the subject choosing to contribute) margins of delegation in *Del* and *DelRule*, relative to the treatment with no delegation, *NoDel*. Although the numerical value of the estimates are not directly interpretable, their sign and significance level provide further insight that complements Result 1. In particular, conditional on choosing to contribute, contributions are significantly higher in *DelRule* than in *NoDel* ($p = 0.001$). Also contributions in *Del* are higher than in *NoDel*, although in this case the difference reaches only marginal significance

TABLE 1. Total contributions with multiple collective accounts: parametric analysis

Total contributions	(1)	(2)		(3)	(4)	(5)	(6)	(7)
		Double Hurdle Model						
		Int. Mar.	*Ext. Mar.*			*NoDel*	*Del*	*DelRule*
Del	-7.800^{**}	67.535^{*}	-0.843^{***}	-8.176^{**}	-8.736^{*}			
	(3.919)	(38.325)	(0.279)	(3.384)	(5.045)			
DelRule	5.639	149.179^{***}	-0.629^{***}	3.392	3.563			
	(3.919)	(42.978)	(0.225)	(3.427)	(5.255)			
$Coord(t-1)$				7.523^{***}	7.867^{**}			
				(1.868)	(3.195)			
$Del * Coord(t-1)$					1.684			
					(4.608)			
$DelRule * Coord(t-1)$					-2.623			
					(4.571)			
Trend				-0.975^{***}	-1.045^{**}	-0.791^{***}	-1.007^{**}	-0.434
				(0.232)	(0.408)	(0.180)	(0.451)	(0.693)
$Del * Trend$					0.010			
					(0.576)			
$DelRule * Trend$					0.252			
					(0.574)			
*d*1						-6.281^{***}	4.577	-2.743
						(1.907)	(4.773)	(7.333)
*d*5						-10.463^{***}	-2.369	-1.105
						(1.661)	(4.158)	(6.388)
*d*9						-11.937^{***}	-3.953	-1.217
						(1.709)	(4.279)	(6.573)
*d*12						-1.146	-3.502	-6.569
						(1.930)	(4.832)	(7.422)
cons	24.457^{***}	-154.733^{*}	0.472^{**}	27.368^{***}	27.657^{***}	31.295^{***}	22.631^{***}	33.451^{***}
	(2.771)	(87.797)	(0.201)	(2.843)	(3.479)	(3.331)	(3.889)	(4.442)
ll	-13055.40	-7832.047		-11950.55	-11950.00	-3542.40	-4279.61	-4629.27
$Wald - \chi^2$	11.86	12.76		50.62	52.25	119.17	19.91	2.49
$p > \chi^2$	0.003	0.002		0.000	0.000	0.000	0.001	0.777
Obs.	2592	2592		2376	2376	864	864	864

Notes. This table parametrically analyzes the determinants of total contributions in *NoDel*, *Del*, and *DelRule*. Columns (1), (3), (4), (5), (6), and (7) report coefficient estimates (standard errors in parentheses) from two-way linear random effects models accounting for both potential individual dependency over periods and dependency within group. The dependent variable is the total contributions made by the subject to the twelve collective accounts in the period. Columns (1), (3) and (4) report results by pooling data from *NoDel*, *Del*, and *DelRule*. Columns (5), (6), and (7) consider data from each treatment, separately. Column (2) report estimates of the intensive and extensive margins (with standard errors clustered at the group lelvel) from a double hurdle model. $Coord(t-1)$ is a dummy that assumes value 1 if subject's group reached the threshold on one collective account in the previous period; *Trend* is a linear time trend that starts from 0; *Del* and *DelRule* are treatment dummies; $Del * Trend$, $DelRule * Trend$, $Del * Coord(t-1)$, $DelRule * Coord(t-1)$ are interaction terms. *d*1, *d*5, *d*9, and *d*12 are period dummies that assume value 1 in periods 1, 5, 9, and 12, respectively. Significance levels are denoted as follows: * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

($p = 0.078$). Moving to the extensive margins, we find that subjects are less likely to make positive contributions in treatments with delegation (for *Del*, $p = 0.003$; for *DelRule*, $p = 0.005$).[10] As it will be discussed

[10] Indeed, descriptive statistics suggest that the proportion of subjects contributing nothing to the collective accounts is 31.83% in *NoDel*, 64.47% in *Del*, and 56.25% in *DelRule*.

in the next sections, in *Del* this result effectively captures the inability of subjects to cooperate and coordinate over collective accounts. Instead, in *DelRule* the result is due to the large amount that subjects choose to transfer to the delegate, a fact that is further confirmed by the high probability to reach the threshold and the high earnings of subjects documented in this treatment. Column (3) shows how results in column (1) change when controlling for the past ability of the group to reach the threshold and adding a time trend. The coefficient of $Coord(t-1)$ is positive and highly significant ($p < 0.001$) suggesting that total contributions increase when the group successfully reached the threshold in the previous period. Finally, the negative and highly significant coefficient of the time trend confirms the existence of a decaying pattern in contributions, as highlighted by Figure 1. Both the magnitude and significance of the differences in contributions across treatments are not substantially affected by the introduction of these two additional covariates: the differences between *DelRule* and *Del* or between *NoDel* and *Del* remain positive and significant (for the two comparisons, $p < 0.001$ and $p < 0.001$, respectively), while the difference between *DelRule* and *NoDel* is not significant ($p = 0.322$).

Column (4) replicates the analysis in column (3) by adding a number of interaction terms to control for (potential) heterogeneous effects of the linear trend and the past successful provision across treatments. As shown by the results, all the interaction terms are not significant, suggesting that, relative to the baseline, we do not detect significant differences in the effects of the covariates between *Del* and *DelRule*.[11]

We also investigate the relationship between (self-reported) risk tolerance and contributions. In the post experimental questionnaire, subjects answered the "general risk question" validated by Dohmen et al. (2011): "How willing are you to take risks, in general?", with Respondents answering on a scale from 0 (not willing at all) to 10 (very willing). Then, we include the risk tolerance and corresponding treatment interactions as additional covariates in columns (1) and (4) of Table 1.[12] We find that risk tolerance significantly increases contributions in *NoDel* only ($p = 0.036$ in the extended version of column 1 and $p = 0.030$ in the extended version of column 2), while it exerts no significant effects in *Del* ($p = 0.678$ in the extended version of column 1 and $p = 0.657$ in the extended version of column 2) as well as in *DelRule* ($p = 0.136$ in the extended version of column 1 and $p = 0.190$ in the extended version of column 2). A possible explanation for this result is that relatively-more risk averse subjects in *NoDel* react to the risk of mis-coordination by reducing their contributions. Instead, delegation in Del and *DelRule* represents a form of insurance against mis-coordination and, therefore, neutralizes the relationship between risk attitude and contributions.

Columns (5), (6), and (7) focus on each of the three treatments, separately. We are mainly interested in assessing whether the three treatments differ from each other in the decaying pattern and the effects of reshuffling the efficient collective accounts. In order to properly identify the effects of reshuffling, for each treatment, we modify the specification in column (3) by adding dummies for periods 1, 5, 9, separately. We also include a dummy for period 12 to look at potential ending game effect. Finally, we exclude $Coord(t-1)$ from the three regressions in order to identify the effect of period 1.

Concerning the effects of the time trend, we find that contributions significantly decline over repetitions in *NoDel* ($p < 0.001$) and *Del* ($p < 0.05$), while they do not exhibit any particular time pattern in *DelRule* ($p < 0.531$).

Every four periods, the four efficient public goods were randomly reshuffled. As highlighted by Figure 1, the effect of reshuffling is strong in *NoDel*, where subjects cannot use delegation to solve the coordination problem. Indeed, in this treatment, total contributions substantially fall in periods 1, 5 and 9 (for all dummies: $p < 0.001$). In *Del* and *DelRule*, reshuffling does not have any significant effect on contributions.

Result 2. Delegation attenuates the negative effects of reshuffling the relative efficiency of the public goods on total contributions. Moreover, contributions decline more rapidly in *Del* than in *DelRule* or *NoDel*.

In a similar experimental setting characterized by multiple threshold collective accounts, CCV showed that subjects prefer to contribute to the most efficient alternatives, even when the inefficient collective

[11] We also detect no difference between *Del* and *DelRule* when performing formal tests to compare the interaction terms (for the difference between $Del * Trend$ and $DelRule * Trend$: $p = 0.671$; for the difference between $Del * Trend$ and $DelRule * Trend$: $p = 0.671$; for the difference between $Del * Coord(t-1)$ and $DelRule * Coord(t-1)$: $p = 0.355$.

[12] Detailed results are available upon request. We thank an anonymous Referee for this interesting observation.

TABLE 2. Contributions to efficient and inefficient alternatives with multiple collective accounts

Period	1	1 − 4	5	5 − 8	9	9 − 12	12	*All*
NoDel								
Eff. pgs	18.560	26.343	11.524	20.193	8.772	18.183	19.472	21.573
	(6.327)	(11.699)	(7.453)	(13.453)	(9.329)	(15.321)	(17.901)	(12.810)
Ineff. pgs	0.516	0.188	4.319	2.701	2.806	2.264	1.972	1.718
	(1.945)	(0.519)	(6.894)	(7.512)	(8.034)	(8.336)	(8.367)	(5.243)
Diff.	18.044***	26.155***	7.205***	17.492***	5.966**	15.919***	17.500***	19.855***
Del								
Eff. pgs	21.998	19.441	12.767	15.625	8.399	9.674	6.684	14.913
	(16.336)	(14.565)	(15.889)	(14.504)	(12.698)	(12.486)	(12.959)	(12.387)
Ineff. pgs	0.425	0.154	2.488	0.644	0.479	0.290	0.625	0.363
	(0.857)	(0.273)	(6.832)	(1.704)	(1.285)	(0.674)	(2.358)	(0.667)
Diff.	21.573***	19.287***	10.279**	14.981***	7.920***	9.384***	6.059**	14.550***
DelRule								
Eff. pgs	25.285	27.935	26.222	28.426	26.806	24.944	17.396	27.102
	(12.639)	(8.841)	(12.737)	(8.944)	(11.999)	(10.674)	(15.245)	(8.419)
Ineff. pgs	1.303	1.120	0.666	0.318	1.264	1.110	1.940	0.850
	(2.857)	(2.650)	(2.062)	(0.752)	(4.713)	(1.761)	(4.875)	(1.267)
Diff.	23.982***	26.815***	25.556***	28.108***	25.542***	23.834***	15.456***	26.252***
Obs. (per treat)	18	18	18	18	18	18	18	18

Notes. This table reports the mean contributions (standard deviations are reported in parentheses) to efficient and inefficient collective accounts in *NoDel*, *Del*, *DelRule*, over periods the table shows significance levels from a (two-sided) Wilcoxon signed-rank test for the null hypothesis that the difference between the contribution to the efficient and inefficient options is null. Significance levels are denoted as follows: $^{*}p < 0.1$, $^{**}p < 0.05$, and $^{***}p < 0.01$.

account is salient and might represent a coordination device. The tendency to opt for efficient collective accounts finds further empirical support in the present paper. Table 2 reports the mean contribution to efficient and inefficient collective accounts in *NoDel*, *Del*, and *DelRule*, over periods.[13] According to a (two-sided) Wilcoxon signed-rank test, the mean contribution to the efficient collective accounts is, over all periods, substantially higher than that to the inefficient alternatives in all treatments ($p < 0.01$). A more detailed look at differences in contributions to the efficient public goods across treatments reveals a positive and significant difference between *DelRule* and *Del* (according to a two-sided Mann–Whitney rank-sum test, $p < 0.001$) as well as between *NoDel* and *Del* ($p = 0.0576$), while no significant difference is found when comparing *DelRule* with *NoDel* ($p = 0.486$).[14]

Result 3. With multiple public goods, subjects contribute substantially more to more-efficient goods than to less-efficient alternatives.

5.2. **Successful provision of collective accounts.** We now consider the ability of groups to coordinate contributions on the same public good and successfully reach the required threshold. As discussed in the theoretical section, delegation may reduce the risk of donor coordination. It allows group members to centralize the choice of allocating the group's resources across collective accounts on the intermediary. Table 3 reports the mean proportions of successful provision in *NoDel*, *Del*, and *DelRule*, over periods.

Over all periods, *DelRule* is the treatment with the highest percent (66.2%) of groups contributing at or above the threshold of one of the collective accounts, followed by *NoDel* (39.4%) and *Del* (29.6%). According to a Mann-Whitney rank-sum test (two-sided), the mean proportion of periods a group reaches

[13]The mean contributions to the efficient (inefficient) collective accounts in a period is given by the ratio between the total contributions to the efficient (inefficient) alternatives and the number of efficient (inefficient) collective accounts to which, in that period, the subject allocated strictly positive amounts.

[14]The same ranking holds true when focusing on total contributions are taken into consideration. Finally, due to the small magnitude, we do not analyze differences across treatments in the amount contributed to the inefficient public goods.

TABLE 3. Mean proportion of successful provision with multiple collective accounts

Period	1	1 − 4	5	5 − 8	9	9 − 12	12	*All*
NoDel	0.000	0.389	0.000	0.361	0.056	0.431	0.500	0.394
	(0.000)	(0.115)	(0.000)	(0.113)	(0.054)	(0.117)	(0.118)	(0.115)
Del	0.389	0.375	0.222	0.333	0.167	0.181	0.111	0.296
	(0.115)	(0.114)	(0.098)	(0.111)	(0.088)	(0.091)	(0.074)	(0.108)
DelRule	0.500	0.653	0.667	0.694	0.667	0.639	0.444	0.662
	(0.118)	(0.112)	(0.111)	(0.109)	(0.111)	(0.113)	(0.117)	(0.111)
NoDel − Del	-0.389^{***}	0.014	-0.222^{**}	0.028	−0.111	0.250^{**}	0.389^{**}	0.098
NoDel − DelRule	-0.500^{***}	-0.264^{**}	-0.667^{***}	-0.333^{***}	-0.611^{***}	-0.208^{*}	0.056	-0.268^{**}
Del − DelRule	−0.111	-0.278^{**}	-0.445^{***}	-0.361^{***}	-0.500^{***}	-0.458^{***}	-0.333^{**}	-0.366^{***}
Obs. (per treat)	18	18	18	18	18	18	18	18

Notes. This table reports mean proportions (standard errors of the proportions are reported in parentheses) of successful provision – namely, reaching the threshold of one collective account – over periods in *NoDel*, *Del*, and *DelRule*. The table also shows significance levels from a nonparametric (two-sided) Mann–Whitney rank-sum test for the null hypothesis that the proportion in two treatments is the same. The other remarks of Table 2 apply.

the threshold is significantly higner in *DelRule* than in either *NoDel* ($p = 0.014$) or *Del* ($p = 0.003$). Statistical significance of the differences is confirmed when accounting for multiple null hypotheses testing, as the difference in proportions between *DelRule* and *Del* or *NoDel* remain highly significant (respectively, for the two comparisons: $p = 0.006$ and $p = 0.021$), while the difference between *Del* and *NoDel* is not significant ($p = 0.369$).

Thus, delegation leads to greater coordination only in *DelRule*, where the intermediary is constrained by the destination rule to contribute at least as much as she receives from the rest of the group.

Result 4. With multiple collective accounts, delegation increases the ability of the group to successfully reach the threshold of a collective account only when the intermediary's behavior is limited by the destination rule.

5.3. **Subjects' earnings.** We now look at how previous results translate into differences in subjects' earnings across treatments. Figure 2 shows the mean earnings over periods in *NoDel*, *Del* and *DelRule*.

Averaging over all periods, subjects earn 133.40 points in *NoDel*, 128.07 points in *Del*, and 162.13 points in *DelRule*. Again, we observe a large variability in earnings in *NoDel*, with downward peaks occurring in the reshuffling periods (1, 5 and 9) when coordination is more difficult to achieve, and upward peaks reached in the subsequent three periods. Again, a plausible interpretation of this pattern is that subjects use (moderate) contributions in the reshuffling periods as a signal to achieve coordination in subsequent rounds. The highest earnings are registered in *DelRule*, where group members are more successful in coordinating and contributing above the threshold.

These initial observations are formally investigated in Table 4, which shows the mean earnings in *NoDel*, *Del* and *DelRule*.

Over all periods, according to a Mann-Whitney rank-sum test (two-sided), the difference between *DelRule* and both *NoDel* and *Del* are significant ($p = 0.034$ and $p = 0.011$, respectively). Again, differences remain significant when accounting for multiple null hypotheses testing (for the difference between *DelRule* and *NoDel*, $p = 0.031$; for the difference between *DelRule* and *Del*, $p = 0.023$). The difference between *Del* and *NoDel* is non significant using either a standard Mann-Whitney rank-sum test ($p = 0.874$) or when accounting for multiple null hypotheses testing ($p = 0.650$), suggesting that the lower contributions in *Del* do not necessarily lead to lower average payoffs.

We also consider how mean earnings differ from 110, the payoff associated with the no-contribution equilibrium. Only in *DelRule* do subjects earn significantly more than what they could get by entirely allocating the endowment in the private account, according to a (two-sided) Wilcoxon signed-rank test ($p < 0.001$). In the other two treatments, although the difference between earnings and 110 is positive, it is only marginally significant (in *NoDel*: $p = 0.078$; in *Del*: $p = 0.061$). In the reshuffling periods of *NoDel*,

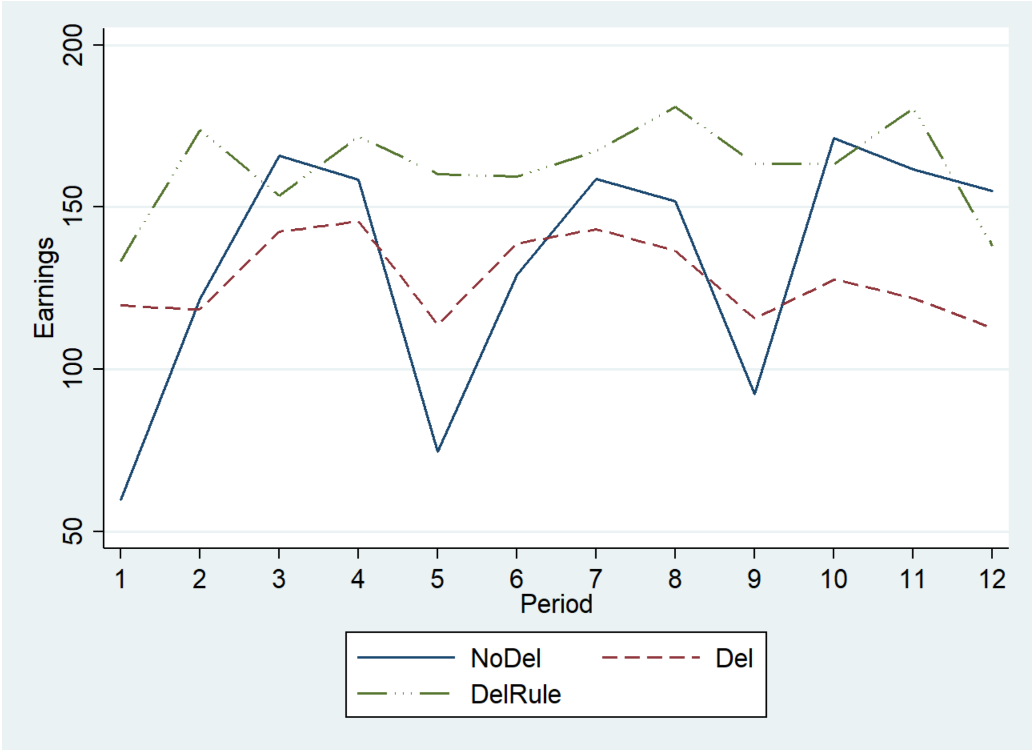

FIGURE 2. Subjects' earnings with multiple collective accounts, by treatment and period.

TABLE 4. Subject's earnings with multiple collective accounts

Period	1	$1-4$	5	$5-8$	9	$9-12$	12	*All*
NoDel	59.972	126.444	74.667	128.611	92.444	145.132	154.944	133.396
	(23.628)	(47.307)	(24.622)	(41.774)	(35.398)	(40.814)	(61.156)	(37.962)
Del	119.750	131.556	113.806	133.104	115.750	119.549	112.667	128.069
	(67.306)	(44.728)	(56.799)	(38.760)	(43.778)	(32.856)	(39.951)	(32.838)
DelRule	133.417	158.125	160.222	166.944	163.361	161.313	138.056	162.127
	(71.841)	(51.259)	(65.399)	(50.889)	(62.320)	(42.6712)	(64.523)	(37.221)
NoDel $-$ 110	-50.028^{***}	16.444	-35.333^{***}	18.611	-17.556^{***}	35.132^{**}	44.944^{**}	23.296^{*}
Del $-$ 110	9.750	21.556	3.806	23.104	5.570	9.549	2.667	18.069^{*}
DelRule $-$ 110	23.417^{*}	48.125^{***}	50.222^{***}	56.944^{***}	53.361^{***}	51.313^{***}	28.056	52.127^{***}
NoDel $-$ *Del*	-59.778^{***}	-5.112	-39.139^{***}	-4.493	-23.306^{**}	25.583	42.277^{*}	5.327
NoDel $-$ *DelRule*	-73.445^{***}	-31.681^{*}	-85.555^{***}	-38.333^{**}	-70.917^{***}	-16.181	16.888^{*}	-28.731^{**}
Del $-$ *DelRule*	-13.667	-26.569^{*}	-46.416^{*}	-33.840^{*}	-47.611^{*}	-41.764^{**}	-25.389	-34.058^{**}
Obs. (per treat)	18	18	18	18	18	18	18	18

Notes. This table reports mean earnings (standard deviations are reported in parentheses) over periods in *NoDel*, *Del*, and *DelRule*. For each treatment, the table reports results of a (two-sided) Wilcoxon signed-rank test for the null hypothesis that earnings are equal to 110, namely the level that is associated with the zero contribution equilibrium. Finally, the table shows results from a nonparametric (two-sided) Wilcoxon rank sum test for the null hypothesis that the mean earnings in two treatments are the same. The other remarks of Table 2 apply.

the difference is negative and highly significant (in period 1, $p < 0.001$; in period 5, $p < 0.001$; in period 9, $p = 0.006$). Thus, delegation, if sustained by the destination rule, stimulates cooperation among group members and increases their earnings.

Result 5. With multiple collective accounts, delegation is profitable and significantly increases subjects' earnings only when it is sustained by the destination rule.

In our experiment, delegation does not impose any administrative cost on group members. However, in the real world, administrative and fundraising costs can be high and undermine the potential coordination benefits documented in our experiment.[15] For instance, according to data made public online[16], the U.S. United Way network's administration/overhead rate is around 14.5%, very competitive with the nation's top 100 nonprofits. Moreover, it is well below industry standards and recommendations (like the 25% rate suggested by the Office of Personnel Management).

Given the results in Table 4, it follows that, over all periods, subjects' earnings in *DelRule* are 21.54% larger than in *NoDel*, thus suggesting that, in order to nullify the social benefits of delegation, administrative costs should amount to (at least) 21.54%.

We also parametrically compare the effect of delegation on earnings with the benchmark administrative costs. In particular, in the online appendix (Table A.1) we report results from the same econometric specification undertaken in column (1) of Table 1, but using the individual earnings as dependent variable and including two interactions to account for differences in earnings between the delegate and non delegated subjects in *Del* and *DelRule*. In addition, since the main effect on earnings are observed in the reshuffling periods, we replicate the same regression by including data on periods 1, 5, and 9, only. Our interest focuses on the difference in profits when comparing the delegate in *DelRule* with the generic subject in *NoDel*. Over all periods, the increase in profits of the delegate are 28.66%, large enough to compensate both the benchmark administrative costs of 14.5% ($p = 0.176$) and 25% ($p = 0.727$). Moreover, relative to *NoDel*, even the non delegated subjects register a (substantial) increase of 19.16% in their earnings ($p < 0.001$). Thus, delegation in *DelRule* produces and increase in welfare that goes well above the benchmark administrative costs.

The results are even stronger when focusing in the reshuffling periods, namely when coordination of donors is much harder to achieve and the intermediaries play a larger role in potentially coordinating contributions. Indeed, in this case, relative to *NoDel*, the increase in earnings in *DelRule* are 94.21% for a non delegated subject and 122.36% for the delegate, being the change for the latter category substantially higher than benchmark administrative costs (in both cases, $p < 0.001$).

5.4. **Delegated amounts and contributions.** The previous results suggest that, in *DelRule*, delegation may help groups coordinate on a public good and increase their expected payoffs.

Figure 3 shows the amounts delegated by the group members to the intermediary, as well as her total contributions to the collective accounts in *Del* and *DelRule*.

Three important observations emerge from Figure 3. First, the amounts transferred by group members to the intermediary are higher in *DelRule* than in *Del*. Over all periods, the mean delegated amounts are 85.44 tokens in *DelRule* and 47.69 tokens in *Del*, respectively. Second, while the intermediary contributes more than what is transferred by the group in *DelRule*, there is no substantial difference between delegated amounts and the intermediary's total contributions in *Del*. Over all periods, the difference between the intermediary's total contribution and the delegated amounts is 24.99 in *DelRule* and 3.27 in *Del*. Third, both the delegated amounts and the intermediary's total contributions substantially decay over repetitions in *Del*, but remain stable in *DelRule*.

Table 5 reports descriptive statistics on the delegated amounts and the intermediary's total contributions in *Del* and *DelRule* over all periods, together with results from non-parametric tests.

Over all periods, both the delegated amounts and the intermediary's total contributions are substantially higher in *DelRule* than in *Del*. According to a Mann-Whitney rank-sum test (two-sided), the differences between *Del* and *DelRule* in both variables are highly significant (for the delegated amounts: $p < 0.001$; for the intermediary's total contributions: $p < 0.001$). These results remain highly significant when accounting for multiple null hypotheses testing (for both the delegated amounts and the intermediary's total contributions: $p < 0.001$).

[15]We thank an anonymous Referee for this important observation.

[16]See the section "Where does the money go?" at https://www.unitedway.org/contact-us/faqs

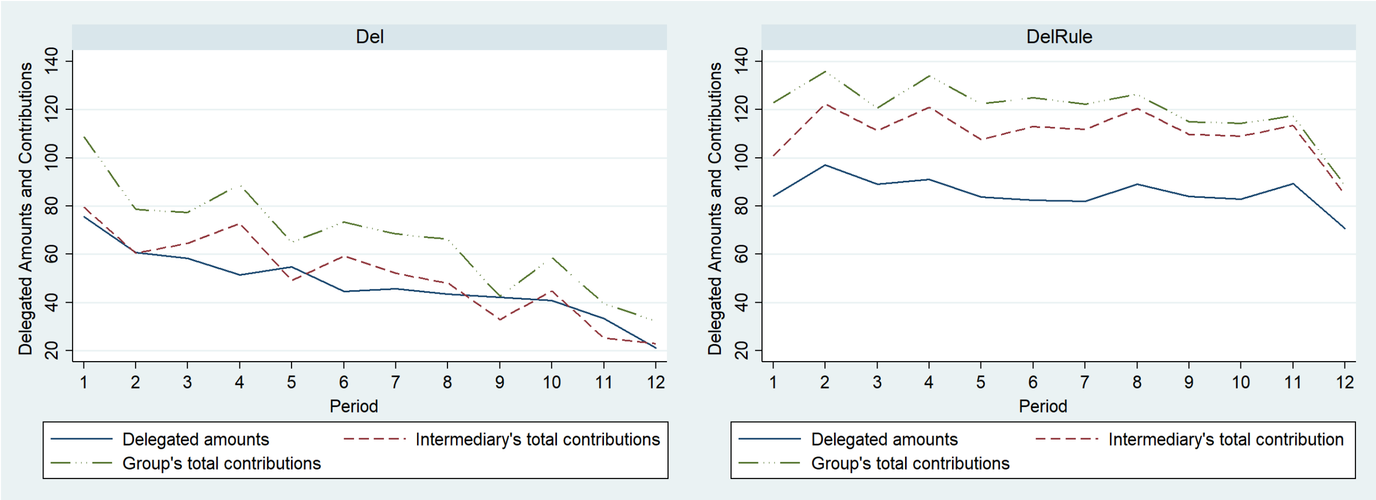

FIGURE 3. Delegated amounts and intermediary's total contributions with multiple collective accounts, by treatment and period.

TABLE 5. Delegated amounts and intermediary's total contributions with multiple collective accounts

Period	1	1 − 4	5	5 − 8	9	9 − 12	12	*All*
Int.'s cont.								
Del	79.444	69.319	49.111	52.111	32.944	31.472	22.944	50.968
	(60.361)	(50.750)	(59.726)	(48.825)	(53.822)	(37.327)	(39.867)	(40.734)
DelRule	100.778	113.861	107.556	113.208	109.722	104.236	84.778	110.435
	(43.821)	(31.253)	(44.231)	(7.506)	(40.439)	(41.231)	(53.743)	(34.547)
Del − DelRule	−21.334	−44.542**	−58.445***	−61.097***	−76.778***	−72.764***	−61.834***	−59.467***
Del.Am.								
Del	75.667	61.569	54.833	47.153	42.222	34.361	21.167	47.694
	(26.677)	(2.430)	(37.477)	(32.584)	(35.512)	(27.611)	(27.391)	(28.818)
DelRule	84.222	90.347	83.722	84.278	84.000	81.708	70.667	85.444
	(37.060)	(26.489)	(33.897)	(29.721)	(30.506)	(31.913)	(43.013)	(26.926)
Del − DelRule	−8.555	−28.778***	−28.889**	−37.125***	−41.778***	−47.347***	−49.500***	−37.750***
Int.'s cont. − Del.Am.								
Del	3.777	7.750	−5.772	4.958	−9.278	−2.934	1.777	3.274
DelRule	16.556***	23.514***	23.834***	28.930***	25.722***	22.528***	14.111***	24.991***
Obs. (per treat)	18	18	18	18	18	18	18	18

Notes. This table reports means (standard deviations are reported in parentheses) of both the delegated amounts and intermediary's total contributions over periods in *Del* and *DelRule*. The table also shows results from a nonparametric (two-sided) Wilcoxon rank sum tests for the null hypotheses that the mean delegated amounts and the intermediary's mean contributions in the two treatments are the same. Finally, for each treatment, the table reports results of a (two-sided) Wilcoxon signed-rank test for the null hypothesis that the delegated amounts are equal to the intermediary's total contributions. The other remarks of Table 2 apply.

Next, we compare the intermediary's total contributions with the transfers received from the group members in the first stage. In *DelRule*, the intermediary contributes substantially more than the delegated amounts, while no remarkable differences are detected in *Del*. Indeed, over all periods, the difference between the intermediary's total contribution and the delegated amounts in *DelRule* is 24.99 tokens (around 29% of what is transferred by the group) and highly significant according to a (two-sided) Wilcoxon signed-rank test ($p < 0.001$). In *Del* the difference drops to 3.27 tokens and is not significantly different from zero ($p = 0.617$).[17]

Result 6. With multiple collective accounts, the destination rule increases the amount transferred by the group members in the delegation phase. Moreover, in *DelRule*, the intermediary's total contributions are on average 29.25% higher than the total amount delegated by the members of the group.

The previous result does not take into account the difference in the proportion of successful groups between *DelRule* and *Del* (Result 4). In order to better understand the interplay between the intermediary's total contribution and the delegated amounts, we now focus on groups that successfully reached the threshold of a collective account. For these groups, Figure 4 shows the delegated amounts, the intermediary's contributions, the contributions made by the other three group members, and the group's aggregate contributions to the financed collective account over all periods in *DelRule* and *Del*.

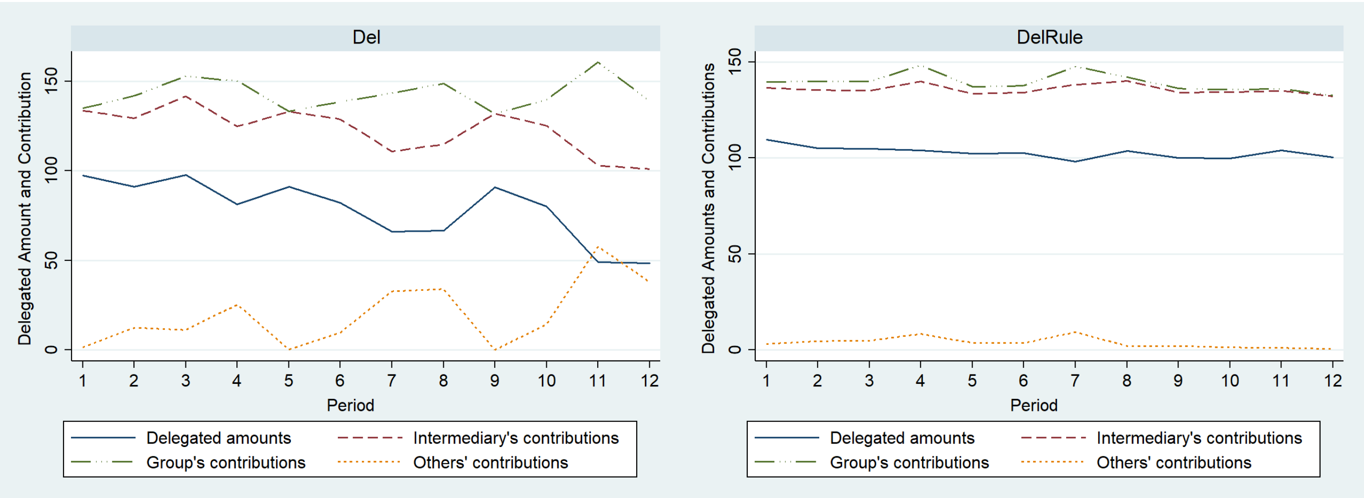

Figure 4. Delegated amounts and contributions to the financed collective account in successful groups with multiple alternatives, by treatment and period.

The figure provides a number of interesting insights. First, in contrast to Figure 3, we document no substantial difference between *Del* and *DelRule* in the group's aggregate contributions, settling in both treatments around 140 tokens. Second, successful groups transfer more resources to the intermediary in *DelRule* than in *Del*, a result that confirms what was reported in Result 6. Third, when focusing on successful groups, we document a positive difference between the intermediary's contributions and the delegated amounts in both treatments, with its size being somewhat bigger in *Del* than in *DelRule*. Table 6 formally investigates the validity of the previous graphical observations.

According to a (two-sided) Mann-Whitney rank-sum test, over all periods, there are no significant differences in group's aggregate contributions to the financed collective account between *Del* and *DelRule* ($p = 0.493$). Nevertheless, we document notable differences in the way in which delegation is used in the two treatments. First, the presence of the destination rule significantly increases the groups' willingness to transfer money to the intermediary (for the difference in the delegated amounts between *Del* and *DelRule*, $p = 0.002$). Second, in order to reach the threshold and due to the difference in the delegated

[17] We also investigate whether the intermediary contributes out of her own wallet (namely, net of the delegated resources) more than what, on average, other group members invest (namely, the sum between the resources transferred to the intermediary in the first phase and the amount contributed in the second phase) in the two phases of the experiment. We find that, in both treatments with delegation, the intermediary contributes out of her own wallet less than what invested by any of the other group members, with the difference being substantially bigger in *Del* than in *DelRule*. Indeed, over all periods, the intermediary contributes out of her wallet, 3.274 in *Del* and 24.991 in *DelRule*, while the investment of any other group member is 21.119 in *Del* and 31.798 in *DelRule*. The difference between intermediary's contribution and the average investment of the other group members is highly significant in *Del* ($p < 0.001$) and significant in *DelRule* ($p = 0.012$).

TABLE 6. Delegated amounts and contributions in successful groups with multiple collective accounts

Period	1	1 − 4	5	5 − 8	9	9 − 12	12	*All*
Group's cont.								
Del	135.000	143.764	133.250	142.242	132.000	141.000	139.000	141.807
	(4.546)	(16.024)	(1.258)	(9.502)	(0.000)	(9.716)	(5.657)	(9.450)
DelRule	139.667	143.026	137.167	141.859	136.333	135.794	132.625	139.915
	(9.526)	(13.184)	(6.978)	(15.315)	(8.223)	(6.795)	(0.916)	(8.817)
Del − DelRule	−4.667	0.738	−3.917	0.383	−4.333*	5.206	6.375**	1.892
Del. am.								
Del	97.286	87.194	91.250	71.017	90.667	72.125	48.500	78.701
	(9.526)	(18.395)	(4.573)	(21.6523.2654)	(8.145)	(23.584)	(12.021)	(23.265)
DelRule	109.556	103.099	102.333	100.823	100.250	135.794	100.375	101.940
	(28.566)	(17.607)	(18.297)	(14.726)	(17.284)	(23.584)	(16.578)	(12.038)
Del − DelRule	−12.270	−15.905*	−11.083	−29.806***	−9.583	−63.669***	−51.875**	−23.239***
Int.'s cont.								
Del	36.286	42.215	41.750	46.075	41.333	45.75	52.500	43.789
	(19.508)	(12.976)	(4.573)	(6.069)	(17.285)	(7.161)	(3.536)	(11.337)
DelRule	27.000	34.526	31.167	36.224	34.000	33.211	31.750	33.792
	(20.316)	(14.054)	(18.150)	(12.625)	(18.061)	(14.468)	(16.611)	(10.672)
Del − DelRule	9.286	7.689	10.583	9.851*	7.333	12.539**	20.750**	9.997**
Others' cont.								
Del	1.429	14.354	0.250	25.150	0.000	23.125	38.000	19.317
	(2.225)	(18.046)	(0.500)	(27.556)	(0.000)	(27.754)	(21.213)	(23.590)
DelRule	3.111	5.401	3.667	4.813	2.083	1.8	0.500	4.182
	(5.510)	(7.762)	(6.372)	(8.223)	(3.232)	(2.834)	(0.926)	(6.210)
Del − DelRule	−1.682	8.593*	−3.417	20.337**	−2.083	21.325	37.500**	15.135*
Obs.	26	28	16	26	15	21	10	30

Notes. This table reports the mean delegated amounts (standard deviations are reported in parentheses), the mean of the group's aggregate contributions, the mean of the intermediary's contributions, and the mean contributions made by the other three non-intermediary group members to the financed collective account in *Del* and *DelRule*, by restricting the attention to successful groups. The table also shows results from a nonparametric (two-sided) Wilcoxon rank sum tests for the null hypotheses that means in the two treatments are the same. The other remarks of Table 2 apply.

amounts, the intermediary contributes a larger share of her own endowment in *Del* than in *DelRule* ($p = 0.014$). A reasonable explanation of this result is that, by preventing expropriation by the intermediary, the destination rule stimulates delegation and, therefore, reduces the necessity of the intermediary to use their own money to reach the threshold.

Result 7. With multiple collective accounts, the destination rule makes delegation more effective within successful groups: it increases the delegated amounts and reduces the necessity for the intermediary to use her own endowment to reach the threshold.

In the Online Appendix, we investigate differences across treatments and determinants of intermediary's behavior as well as its effect on groups' inclination to cooperate.

First, we show that, over all periods, the proportion of delegates expropriating resources is 36.6% in Del, with the large majority of these cases (86.1%) being associated with full expropriation,[18] and very frequently (81% of the cases) expropriation was an efficient decision because the intermediary did not have enough resources to meet the threshold. The proportion of intermediaries contributing more than what received from the group is substantially larger in *DelRule* (68.5%) than in *Del* (42.6%), with the difference being highly significant according to a proportion test ($p < 0.001$). We also find that both delegate's

[18]Namely, the intermediary contributes nothing and entirely expropriates the amounts received from group members.

contributions and the probability of observing crowding-in positively depend on the delegated amounts, with the relationship being particularly pronounced up to the level that allows the intermediary to reach the threshold. The probability of observing the delegate to expropriate resources in *Del* is stimulated by the delegated amounts, although it substantially decreases when the group transfers enough to allow the intermediary to reach the threshold.

Second, concerning the effects of delegate's behavior on groups' cooperation, we find that observing an intermediary expropriating resources in *Del* substantially reduces a group's contributions and the delegated amounts in subsequent periods. On the other hand, in both *Del* and *DelRule*, observing an intermediary's crowding-in does not exert any relevant effect on the group's behavior.

5.5. **Treatments with a single collective account.** In order to investigate the interplay between delegation and multiplicity of public goods, we run three additional treatments, *NoDel*[1], *Del*[1], and *DelRule*[1], that are analogous to the multiple public good treatments but with only a single collective account to which players may contribute.

With a single collective account, coordination among donors is likely to be easier than in the setting with multiple collective accounts. This is because successfully funding a single public good only requires that subjects contribute enough in total to reach the threshold; there is no risk that subjects contribute enough to reach a threshold, but inefficiently spread their contributions out across different goods. It is this aspect of mis-coordination that delegation most-directly addresses. Therefore, we expect delegation to be potentially less effective at improving donor coordination and payoffs in the single public good environment. At the same time, in the environment with unrestricted delegation, the risk of expropriation by the intermediary is independent of the number of collective accounts. Therefore, we expect that the lack of a destination rule in a delegation environment has a similar detrimental effect on coordination and payoffs with a single public good as it had in the multiple public good setting. The experimental evidence is generally consistent with these expectations.

Figure 5 shows the mean contributions to the single collective account and the mean earnings over periods in *NoDel*[1], *Del*[1] and *DelRule*[1].

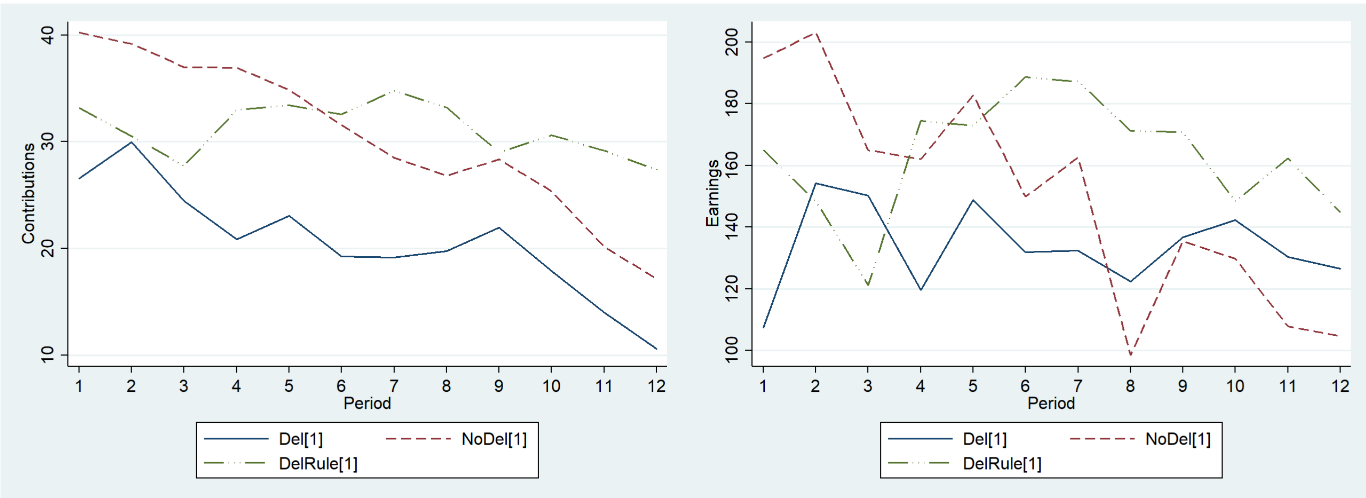

FIGURE 5. Contributions and earnings with a single collective account, by treatment and period.

Averaging over all periods, subjects contribute 30.51 tokens in *NoDel*[1], 20.63 in *Del*[1] and 31.22 tokens in *DelRule*[1]. In all periods, contributions in *DelRule*[1] are well above those in *Del*[1], suggesting that even in the setting with a single collective account, the destination rule strongly increases group's overall contributions. No remarkable difference is observed between *NoDel*[1] and *DelRule*[1], while contributions in *Del*[1] are lower than those in the other two treatments.

Table 7 replicates the parametric analysis of Table 1 by using data from the three treatments with a single collective account.

TABLE 7. Total contributions with a single collective account: parametric analysis

Total contribution	(1)	(2)	(3)	(4) $NoDel[1]$	(5) $Del[1]$	(6) $DelRule[1]$
$Del[1]$	-9.882^{***}	-7.936^{***}	-14.481^{***}			
	(3.349)	(2.832)	(4.711)			
$DelRule[1]$	0.703	0.765	-8.028^{*}			
	(3.349)	(2.819)	(0.357)			
$Coord(t-1)$		7.937^{***}	5.065^{*}			
		(1.452)	(2.607)			
$Del[1] * Coord(t-1)$			7.314^{*}			
			(3.743)			
$DelRule[1] * Coord(t-1)$			-0.152			
			(3.560)			
Trend		-1.050^{***}	-1.777^{***}	-2.018^{***}	-1.311^{***}	0.053
		(0.187)	(0.357)	(0.184)	(0.276)	(0.593)
$Del[1] * Trend$			0.545			
			(0.479)			
$DelRule[1] * Trend$			1.521^{***}			
			(0.479)			
$d1$				-1.321	-1.151	2.018
				(1.950)	(2.926)	(6.284)
$d5$				1.390	0.564	2.057
				(1.699)	(2.549)	(5.474)
$d9$				2.949^{*}	4.710^{*}	-2.571
				(1.748)	(2.623)	(5.633)
$d12$				-2.191	-2.691	-4.354
				(1.974)	(2.961)	(6.360)
cons	30.513^{***}	31.403^{***}	37.404^{***}	41.544^{***}	27.721^{***}	31.162^{***}
	(2.368)	(2.497)	(3.666)	(2.192)	(3.427)	(3.883)
ll	-12516.05	-11415.19	-11407.77	-3530.07	-3874.19	-4500.94
$Wald-\chi^2$	12.49	91.88	109.58	238.20	47.84	1.11
$p > \chi^2$	0.002	0.000	0.000	0.000	0.000	0.953
Obs.	2592	2376	2376	864	864	864

Notes. This table replicates the parametric analysis presented in Table 1 by pooling data from $NoDel[1]$, $Del[1]$, and $DelRule[1]$. $Del[1] * Trend$, $DelRule[1] * Trend$, $Del[1] * Coord(t-1)$, $DelRule[1] * Coord(t-1)$ are interaction terms. The other remarks of Table 1 apply.

From column (1), and in line with the results in the setting with multiple collective accounts, delegation with no destination rule discourages contributions. Both the differences between $Del[1]$ and $NoDel[1]$, and between $Del[1]$ and $DelRule[1]$ are negative and highly significant (in the first case, $p = 0.003$; in the second case, $p = 0.002$). Again, although positive, the difference between $DelRule[1]$ and $NoDel[1]$ is not significant ($p = 0.277$). These findings are confirmed by non parametric tests. According to a two side Mann-Whitney rank-sum test, mean contributions (over all periods) in $Del[1]$ are significantly lower than those in $DelRule[1]$ ($p = 0.019$) and $NoDel[1]$ ($p = 0.025$), while no difference is detected between $DelRule[1]$ and $NoDel[1]$ ($p = 0.912$).

Result 8. With a single collective account, subjects make larger contributions in $DelRule[1]$ and $NoDel[1]$ than in $Del[1]$. There is no significant difference in contributions between $DelRule[1]$ and $NoDel[1]$.

TABLE 8. Mean proportion of successful provision with a single collective account

Period	1	$1-4$	5	$5-8$	9	$9-12$	12	*All*
$NoDel[1]$	0.833	0.764	0.777	0.542	0.444	0.306	0.167	0.537
	(0.088)	(0.100)	(0.009)	(0.117)	(0.117)	(0.109)	(0.088)	(0.118)
$Del[1]$	0.278	0.403	0.444	0.347	0.389	0.319	0.222	0.356
	(0.106)	(0.117)	(0.117)	(0.112)	(0.115)	(0.110)	(0.098)	(0.113)
$DelRule[1]$	0.667	0.583	0.722	0.750	0.667	0.583	0.500	0.639
	(0.111)	(0.116)	(0.106)	(0.102)	(0.111)	(0.116)	(0.118)	(0.113)
$NoDel[1]-Del[1]$	0.555^{***}	0.361^{***}	0.333^{**}	0.195	0.055	-0.013	-0.055	0.181^{*}
$NoDel[1]-DelRule[1]$	0.166	0.181^{**}	0.055	-0.208^{*}	-0.223	-0.277^{**}	-0.333^{**}	-0.102
$Del[1]-DelRule[1]$	-0.389^{**}	-0.180	-0.278^{*}	-0.403^{***}	-0.278^{*}	-0.264^{**}	-0.278^{*}	-0.283^{**}
Obs. (per treat)	18	18	18	18	18	18	18	18

Notes. This table reports mean proportions (standard errors of the proportions are reported in parentheses) of successful provision – namely, reaching the threshold of one collective account – over periods in *NoDel*[1], *Del*[1], and *DelRule*[1]. The other remarks of Table 3 apply.

Concerning the other determinants of individual contributions, column (2) confirms that even in the setting with a single collective, contributions decline over repetitions (the coefficient of *Trend* is negative and highly significant, $p < 0.001$) and positively respond to the group's successful provision in the previous period (the coefficient of $Cood(t-1)$ is negative and highly significant, $p < 0.001$).

Column (3) documents some differences across treatments in the decaying pattern and the effects of past successful provision on contributions. In particular, the interaction term $DelRule[1] * Trend$ is positive and highly significant ($p < 0.01$), suggesting that the linear time trend is less pronounced in $DelRule[1]$ than in $NoDel[1]$. Similar conclusions emerge when comparing the coefficient of the linear time trend in $Del[1]$ and $DelRule[1]$, as the difference between the two interaction terms, $DelRule[1] * Trend$ and $Del[1] * Trend$, is positive and significant ($p = 0.031$). Moreover, $DelRule[1]$ is the only treatment in which the linear time trend presents a non significant coefficient (for the linear combination of *Trend* and $Del[1] * Trend$: $p = 0.421$). When looking at the effects of the past successful provision, no difference is detected between $NoDel[1]$ and $DelRule[1]$ (for the coefficient of $DelRule[1] * Coord(t-1)$: $p = 0.966$), while the effect is significantly stronger in $Del[1]$ than in the other two treatments (for the coefficient of $Del[1] * Coord(t-1)$: $p = 0.051$; for the difference between the two interaction terms, $DelRule[1] * Coord(t-1)$ and $Del[1] * Coord(t-1)$, $p = 0.039$).

Here, there is no reshuffling of the efficient collective accounts. The last three columns document no remarkable differences in contributions in periods 1, 5, 9, and 12, thus confirming that the effects documented in the setting with multiple collective accounts can be genuinely attributed to the reshuffling procedure used to select the four efficient collective accounts.[19]

With a single collective account, group members do not face the risk of mis-coordinating contributions to different alternatives. Nevertheless, even in the single collective account setting, delegation can potentially stimulate cooperation. For instance, by delegating resources, other group members can signal their intention to cooperate to reach the threshold and trigger the delegate's positive response. We investigate these considerations in Table 8.

over all periods, $DelRule[1]$ is associated with the highest percent of successful contribution (63.9%), followed by $NoDel[1]$ (53.7%) and $Del[1]$ (35.6%). According to a Mann-Whitney rank-sum test (two sided), only the difference between $Del[1]$ and $DelRule[1]$ is significantly different from 0 ($p = 0.026$). Instead, the other two differences are less pronounced, reaching marginal significance between $NoDel[1]$ and $Del[1]$ ($p = 0.069$) and being not significant between $NoDel[1]$ and $Del[1]$ ($p = 0.238$). When accounting for multiple null hypotheses testing, only the difference between $DelRule[1]$ and $Del[1]$ remains

[19]Only in $NoDel[1]$ and $Del[1]$ the coefficient attached to the dummy for period 9 is positive and reaches marginal significance, $p = 0.092$ and $p = 0.073$, respectively.

TABLE 9. Subject's earnings with a single collective account

Period	1	$1-4$	5	$5-8$	9	$9-12$	12	*All*
$NoDel[1]$	194.722	181.181	182.778	148.396	135.472	119.444	104.694	149.674
	(67.959)	(53.975)	(65.969)	(50.940)	(77.655)	(38.760)	(47.717)	(38.956)
$Del[1]$	107.528	132.903	148.917	133.875	136.778	133.951	126.500	133.576
	(71.199)	(44.827)	(68.6179)	(48.768)	(67.894)	(50.393)	(47.717)	(40.147)
$DelRule[1]$	164.917	152.250	172.917	179.979	170.750	156.563	144.778	162.931
	(74.774)	(35.922)	(71.027)	(40.337)	(64.290)	(48.439)	(74.375)	(33.604)
$NoDel[1]-110$	84.722^{***}	71.181^{***}	72.778^{***}	38.396^{***}	25.472	19.444	-5.306	39.674^{***}
$Del[1]-110$	-2.472	22.903^{*}	38.917	23.875	26.778	23.951	16.500	23.576
$DelRule[1]-110$	54.917^{***}	42.250^{***}	62.917^{***}	69.979^{***}	60.750^{***}	46.563^{***}	34.778^{*}	52.931^{***}
$NoDel[1]-Del[1]$	87.194^{***}	48.278^{***}	33.861	14.521	-1.306	-14.507	-21.806	16.098
$NoDel[1]-DelRule[1]$	29.805^{**}	28.931^{**}	9.861	-31.583^{*}	-35.278	-37.119^{**}	-40.084	-13.257
$Del[1]-DelRule[1]$	-57.389^{*}	-19.347	-24.000	-46.104^{**}	-33.972	-22.612	-18.278	-29.355^{**}
Obs. (per treat)	18	18	18	18	18	18	18	18

Notes. This table reports mean (standard deviations are reported in parentheses) earnings over periods in $NoDel[1]$, $Del[1]$, and $DelRule[1]$. The other remarks of Table 4 apply.

significant ($p = 0.040$). Thus, with a single collective account, delegation is either useless (when comparing $DelRule[1]$ with $NoDel[1]$) or detrimental for successful provision of the collective account (when comparing $Del[1]$ with $NoDel[1]$).

Result 9. With a single collective account, delegation either reduces group's ability to reach the threshold when there is no destination rule, or it does not have any significant effect when the intermediary's choices are constrained by the destination rule.

Moving to earnings, the right panel of Figure 5 and Table 9 report the mean earnings over periods in $NoDel[1]$, $Del[1]$ and $DelRule[1]$.

Averaging over all periods, subjects earn 149.67 points in $NoDel[1]$, 133.58 points in $Del[1]$, and 162.93 points in $DelRule[1]$. $Del[1]$ exhibits the worst earning performance over periods, confirming the fact that, with a single collective account and no destination rule, delegation undermines cooperation. According to a Mann-Whitney rank-sum test (two-sided), both the difference between $Del[1]$ and $NoDel[1]$ as well as the difference between $Del[1]$ and $DelRule[1]$ are negative, although only the latter case reaches statistical significance (in the first case: $p = 0.146$; in the second case: $p = 0.025$). The difference between $Del[1]$ and $DelRule[1]$ remains significant when accounting for multiple null hypotheses testing ($p = 0.070$).

Result 10. With a single collective account, delegation is detrimental for subjects' earnings: it either reduces earnings when there is no destination rule, or it does not affect their level when the intermediary's choices are constrained by the destination rule.

In aggregate, the results from the treatments with a single collective account are consistent with our expectations. Delegation with a destination rule is less important for facilitating cooperation in the single public good environment than it is in the multiple public good environment, as evidenced by the smaller differences between the outcomes in $DelRule[1]$ and $NoDel[1]$ than were previously observed between *DelRule* and *NoDel*. At the same time, the presence of unrestricted delegation in $Del[1]$ is detrimental for contributions, coordination and payoffs, just as previously observed in *Del*. The detrimental effects of unrestricted delegation are perhaps even more surprising in the single public good environment than it was with multiple public goods. Subjects could simply ignore the intermediary; any strategies that were possible in the no-delegation environment are also possible in the single public good environment.

Although this is also true in the multiple threshold public good environment, the fact that delegation has less benefit may make ignoring delegation a more-salient strategy in the single public good case.[20]

That unrestricted delegation leads to worse options even when it could easily be ignored suggests that the possibility of delegation increases the perceived risk or strategic complexity associated with contributing directly or through the intermediary. The fact that delegation leads to worse outcomes only in the unrestricted case and not with the destination rule suggests that it is not the increased complication to the strategic setting introduced by delegation that discourages contributions. Instead, the detrimental effects of unrestricted delegation are consistent with an increase in the perceived uncertainty about the contributions of others and the risk of essentially wasting one's contributions by directing them to an otherwise underfunded good that discourage giving.

By comparing contributions in *NoDel* and *NoDel*[1], the analysis in the Online Appendix also provides insights into the effects of multiplicity of public goods on contributions and coordination. This investigation is closely related to the analysis conducted by CCV. Among other results, CCV found that contributions and coordination were significantly lower when subjects faced four identical public goods than when they are presented with a single public good; when there were four goods and one good stood out as being more efficient than the other three, contributions were similar to what was observed in the single public good setting. The current multiple public good environment is different from any of the cases considered in CCV in that donors face 12 alternative public goods and four of them stand out as being more efficient than the other eight. In the current environment, multiplicity only plays a marginal role in affecting group performance. Going from an environment with a single public good to one in which there are 12 public goods and four of them stand out as efficient is less detrimental for contributions than going to an environment with only four public goods, all equally efficient. We discuss this difference in more detail in the online appendix, but we hypothesize that the efficiency differences between the public goods leads the subjects to initially shift their focus to achieving coordination on an efficient good rather than shifting their attention to a no-contribution strategy.

6. Discussion and conclusion

Intermediary NGOs, community chest organizations, Telethons and other philanthropic initiatives play prominent roles in charitable giving. They collect contributions from individual donors and coordinate their efforts across causes and projects. Such organizations potentially offer several benefits, from encouraging giving to helping donor learn about the most pressing issues. Of particular interest to the current paper is the role these organizations play in improving the efficiency of philanthropic giving, helping facilitate coordination among donors. Intermediary organizations, for example, can direct donors' contributions to a select set of programs, increasing their chance of making a difference, and reducing the risk that well-intentioned donors spread their contributions too thinly across too many programs and causes to have a meaningful impact.

From earlier experiments, we know that such risks of mis-coordination among donors can discourage contributions to public goods and lead donors to shy away from charitable giving. This suggests that intermediary organizations, to the extent that they reduce the risk of donor mis-coordination, may encourage contributions and increase the success of donor supported programs and projects.

The current paper investigates this issue in a series of lab experiments using threshold public goods, which require donors to coordinate contributions to be successful. This is a similar setting as CCV, except that we add to the environment an intermediary player. Others can choose to provide contributions through the intermediary, to contribute directly to any of several public goods, or to not contribute at all. The intermediary chooses how to allocate their own resources and the contributions provided to her by others across goods.

Perhaps unsurprisingly, we find that under the right conditions, the presence of an intermediary can increase public good success and overall welfare. More interestingly, however, we show how the presence of an intermediary can also have the opposite effect, as it discourages contributions and reduces the probability of public goods receiving enough funding to be successful. In our experimental setting, the

[20] In the online appendix, we also report results on the delegated amounts and the contributions of the delegate in *Del*[1] and *DelRule*[1]. Even with a single collective account, the destination rule increases the delegated amount and on average induces the intermediary to contribute 37.02% more than what is transferred by the group.

benefit of an intermediary depends on whether or not the intermediary is formally committed not to redirect donations received from others to uses that may be beneficial to the intermediary but are not preferred by the donors themselves. Although the theoretical analysis shows that formal commitment is not needed for an intermediary for directing delegated contributions to the socially optimal public goods, the experimental analysis finds that formal commitment is essential for encouraging donor contributions and public good success.

Traditionally, the introduction of destination rules in the nonprofit sector has been justified by the necessity to guarantee institutional transparency, justice and correspondence between donors' initial intent and NGOs' actions. Our results add a further economic justification to introduce these formal restrictions. By reducing the perceived risk that an NGO could misuse donations, destination rules encourage donations, while allowing the intermediary to facilitate coordination across alternative projects, producing substantial welfare improvements for the society.

References

Aghion, P. and Tirole, J. (1997). Formal and real authority in organizations. *Journal of Political Economy*, 105(1):1–29.

Alfoldi, E. A., Clegg, L. J., and McGaughey, S. L. (2012). Coordination at the edge of the empire: The delegation of headquarters functions through regional management mandates. *Journal of International Management*, 18(3):276–292.

Andreoni, J. (1989). Giving with impure altruism: Applications to charity and ricardian equivalence. *Journal of Political Economy*, 97:1447–1458.

Andreoni, J. (1998). Toward a theory of charitable fund-raising. *Journal of Political Economy*, 106(6):1186–1213.

Andreoni, J. and Gee, L. (2015). Gunning for efficiency with third party enforcement in threshold public goods. *Experimental Economics*, 18(1):154–171.

Ansink, E., Koetse, M., Bouma, J., Hauck, D., and van Soest, D. (2017). Crowdfunding public goods: An experiment. working paper.

Atkinson, R. (2008). Obedience as the foundation of fiduciary duty. *J. Corp. L.*, 34:43.

Bac, M. (2002). Restricted charitable donations and the "cy pres" doctrine. *European Journal of Law and Economics*, 14(1):15–25.

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

Bernard, M., Dreber, A., Strimling, P., and Eriksson, K. (2013). The subgroup problem: When can binding voting on extractions from a common pool resource overcome the tragedy of the commons? *Journal of Economic Behavior & Organization*, 91:122–130.

Bernasconi, M., Corazzini, L., Kube, S., and Marechal, M. A. (2009). Two are better than one! individuals' contribitons to unpacked public goods. *Economics Letters*, 104(1):31–33.

Blackwell, C. and McKee, M. (2003). Only for my own neighborhood? preferences and voluntary provision of local and global public goods. *Journal of Economic Behavior and Organization*, 52(1):115–131.

Bolle, F. and Vogel, C. (2011). Power comes with responsibility—or does it? *Public Choice*, 148(3-4):459–470.

Bouma, J., Nguyen, T., van der Heijden, E., and Dijk, J. (2018). Analysing group contract design using a lab and a lab-in-the-field threshold public good experiment. working paper.

Brody, E. (1998). The limits of charity fiduciary law. *Md. L. Rev.*, 57:1400.

Brown, S., Goetzmann, W., Liang, B., and Schwarz, C. (2012). Trust and delegation. *Journal of Financial Economics*, 103(2):221–234.

Buchholz, W. and Sandler, T. (2017). Successful leadership in global public good provision: Incorporating behavioural approaches. *Environmental and Resource Economics*, 67(3):591–607.

Butera, L. and Houser, D. (2018). Delegating altruism: Toward an understanding of agency in charitable giving. *Journal of Economic Behavior & Organization*, 155:99–109.

Cason, T. N. and Zubrickas, R. (2018). Donation-based crowdfunding with refund bonuses. working paper.

Charness, G. and Sutter, M. (2012). Groups make better self-interested decisions. *Journal of Economic Perspectives*, 26(3):157–76.

Chlass, N., Gangadharan, L., and Jones, K. (2015). Charitable giving and intermediation. Technical report. Monash Business School - Dept. of Economics, ISSN 1441-5429, DP 18/15.

Coffman, L. C. (2017). Fundraising intermediaries inhibit quality-driven charitable donations. *Economic Inquiry*, 55(1):409–424.

Corazzini, L., Cotton, C., and Valbonesi, P. (2015). Donor coordination in project funding: Evidence from a threshold public goods experiment. *Journal of Public Economics*, 128:16–29.

Di Falco, S., Magdalou, B., Masclet, D., Villeval, M. C., and Willinger, M. (2016). Can transparency of information reduce embezzlement? experimental evidence from tanzania.

Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., and Wagner, G. G. (2011). Individual risk attitudes: Measurement, determinants, and behavioral consequences. *Journal of the European Economic Association*, 9(3):522–550.

Drouvelis, M., Nosenzo, D., and Sefton, M. (2017). Team incentives and leadership. *Journal of Economic Psychology*, 62:173–185.

Economist, T. (2017). A philanthropic boom: donor-advised funds. https://www.economist.com/finance-and-economics/2017/03/23/a-philanthropic-boom-donor-advised-funds.

Fischbacher, U. (2007). Z-tree: Zurich toolbox for ready-made economic experiments. *Experimental Economics*, 10:171–178.

Giving.USA.Foundation (2018). *Giving USA 2018: The Annual Report on Philanthropy*. Giving USA Foundation.

Gneezy, U., Keenan, E. A., and Gneezy, A. (2014). Avoiding overhead aversion in charity. *Science*, 346(6209):632–635.

Goodwin, I. J. (2005). Donor standing to enforce charitable gifts: Civil society vs. donor empowerment. *Vand. L. Rev.*, 58:1093.

Gur, N. and Bjørnskov, C. (2017). Trust and delegation: Theory and evidence. *Journal of Comparative Economics*, 45(3):644–657.

Hamman, J. R., Weber, R. A., and Woon, J. (2011). An experimental investigation of electoral delegation and the provision of public goods. *American Journal of Political Science*, 55(4):738–752.

Hammon, J. R., Loewenstein, G., and Weber, R. A. (2010). Self-interest through delegation: An additional rationale for the principal-agent relationship. *American Economic Review*, 100(4):1826–46.

Hauge, K. E. and Rogeberg, O. (2015). Representing others in a public good game. *Games*, 6(3):381–393.

Herz, M., Hutzinger, C., Seferagic, H., and Windsperger, J. (2016). Trust, decision rights delegation, and performance—the case of franchising. *Journal of Small Business Management*, 54(3):973–991.

Jack, B. K. and Recalde, M. P. (2015). Leadership and the voluntary provision of public goods: Field evidence from bolivia. *Journal of Public Economics*, 122:80–93.

Kocher, M. G., Tan, F., and Yu, J. (2018). Providing global public goods: Electoral delegation and cooperation. *Economic Inquiry*, 56(1):381–397.

Levati, M. V., Sutter, M., and Van der Heijden, E. (2007). Leading by example in a public goods experiment with heterogeneity and incomplete information. *Journal of Conflict Resolution*, 51(5):793–818.

List, J. A., Shaikh, A. M., and Xu, Y. (2019). Multiple hypothesis testing in experimental economics. *Experimental Economics*, pages 1–21.

Liu, P., Swallow, S. K., and Anderson, C. M. (2016). Threshold-level public goods provision with multiple units: Experimental effects of disaggregated groups with rebates. *Land Economics*, 92:515–533.

Löschel, A. and Rübbelke, D. (2014). On the voluntary provision of international public goods. *Economica*, 81(322):195–204.

Makowsky, M. D., Orman, W. H., and Peart, S. J. (2014). Playing with other people's money: Contributions to public goods by trustees. *Journal of Behavioral and Experimental Economics*, 53:44–55.

Moir, R. (2006). Multiple public goods and lottery fund raising. In Isaak, I. M. and Davis, D., editors, *Experiments Investigating Fundraising and Charitable Contributors*, pages 121–142. Elsevier.

Oxoby, R. J. (2013). Paretian dictators: constraining choice in a voluntary contribution game. *Constitutional Political Economy*, 24(2):125–138.

Rivas, M. F. and Sutter, M. (2011). The benefits of voluntary leadership in experimental public goods games. *Economics Letters*, 112(2):176–178.

Sengul, M., Gimeno, J., and Dial, J. (2012). Strategic delegation: A review, theoretical integration, and research agenda. *Journal of Management*, 38(1):375–414.

Stoddard, B., Cox, C., and James, W. (2019). Incentivizing provision of collective goods: Allocation rules.

Stoddard, B., Walker, J. M., and Williams, A. (2014). Allocating a voluntarily provided common-property resource: An experimental examination. *Journal of Economic Behavior & Organization*, 101:141–155.

Susan G. Komen Foundation (2010). Consolidated financial statements and supplemental schedules, 2009-2010.

UnitedWay (2016). Annual report 2016. https://s3.amazonaws.com/uww.assets/site/annual_report/2016/UWWAnnualReport2016.pdf.

van den Steen, E. (2006). The limits of authority: Motivation versus coordination. working paper.

Vickers, J. (1985). Delegation and the theory of the firm. *The Economic Journal*, 95:138–147.

ONLINE APPENDIX

Appendix A. Theoretical Analysis

In this Appendix section, we present an analysis of the game theoretic model of multiple threshold public goods described in the body of the paper.

A.1. **One-shot threshold public good game.** Consider first the threshold public good environment without delegation as presented in the body of the paper. For the purpose of theoretical analysis, we initially allow for players to differ in their endowments, $\hat{y}_j \geq 0$. To maintain consistency with the experimental setting, assume there are four players, $J = 4$, and four public goods, $N = 4$, each with bonus level $b_n = 30$ and contribution threshold $\tau = 132$. Although the experimental setting includes 12 public goods, only four of the goods are "efficient" in any period. CCV presents evidence (which the current paper supports) that players limit attention the most-efficient goods. Therefore, to simplify the theoretical analysis, we focus only on four goods with the efficient payoff structures.

When $\hat{y}_j = 55$ for each player, this environment describes the game without delegation. Assuming asymmetric endowments sum to 220 (i.e. $\sum_j \hat{y}_j = 220$) we are then describing the contribution stage of the unrestricted delegation game. For now, we focus on pure strategy Nash Equilibria of this environment.

From the perspective of any player, the marginal benefit of an additional contribution to any public good is 0 below the threshold, 1 above the threshold, and 162 ($= \tau + b_n$) for the contribution that brings the total contribution to the threshold. The marginal benefit of a contribution to a player's private account is 2.

First, we can establish that there does not exist an equilibrium in which any public good is funded above its threshold. Given that the marginal benefit of a contribution to one's public account exceeds the marginal benefit to an individual player of a contribution above the threshold of a public account, the players would always have an incentive to reduce their contribution to a public good that is funded in excess of its threshold.

Second, we can establish that there does not exist an equilibrium in which any public good receives positive contributions below its threshold. Any player that contributed to an underfunded good would have an incentive to deviate and instead direct their contributions to their private account (or potentially to increase their contribution such that total contributions reach the threshold).

Therefore, any equilibrium must involve either no contributions to any good, or contributions to only one good with total contributions equal to the threshold, τ.

Now, we determine player j's best response contribution given the contribution strategies of other players. Suppose that the total contributions of all players besides j to public good n sum to C_{-j}.

If $\hat{y}_j < \tau - C_{-j}$, then player j cannot afford a contribution level that ensures that the public good reaches its threshold. In this case, player j's best response regarding good n is to contribute nothing. Similarly, if $\tau \leq C_{-j}$, then the public good reaches its threshold regardless of any contribution level from j and j's best response is again to contribute nothing.

The more interesting case involves $0 < \tau - C_{-j} \leq \hat{y}_j$. Here, player j can afford a contribution that funds the public good at its threshold. We already know that j prefers not to provide a contribution that leads to group's aggregate contributions falling below or above the threshold. Therefore, we must determine when j prefers to contribute $c^* = \tau - C_{-j}$ versus when j prefers to direct that amount to his private account.

Directing contribution c^* to good n results in a benefit to player j from this contribution of $\tau + b_n = 162$. In contrast, directing $c^*_{j,n}$ to the private account results in benefit of $2c^*_{j,n} = 264 - 2C_{-j}$. When $\hat{y}_j > c^*_{j,n}$, player j's best response involves contributing if

$$264 - 2C_{-j} \leq 162 \;\Rightarrow\; 51 \leq C_{-j}.$$

Players want to contribute to a good only if they expect that the contributions from others are at least 51. This shows that a player would never want to unilaterally fund a public good, which then implies that there is an equilibrium in which no player contributes to any good.

Players are willing to contribute up to $132 - 51 = 81$ to a good if it means that the good will reach its threshold. In the case where $\hat{y}_j \leq 81$ for each player (including the case where $\hat{y}_j = 55$ for each player), this implies that players are willing to contribute their entire endowments if this is what is required to reach the threshold given the contribution profile of others. Therefore, any feasible contribution profile c^* such that players only contribute to good n and total contributions to n equal the threshold is an equilibrium.

In the case where $\hat{y}_j > 81$ for one or more players, the equilibrium contribution profile is restricted to involve contributions of no more than 81 from each player.

Finally, suppose that one of the players, i, chooses how to allocate both her endowment, $\hat{y}_i$, and another source of funds, $\hat{z}_i$. The other players only have their endowments, $\hat{y}_j$. Total funding is the same as before with $\hat{z}_i + \sum_j \hat{y}_j = 220$. This revised environment better captures the contribution stage subgame of the delegation environment.

In the case of unrestricted delegation, $\hat{z}_i$ and $\hat{y}_i$ are equivalent from the perspective of player i and the environment is equivalent to one where $\hat{y}_i$ is increased to account for both of i's funds and $\hat{z}_i$ is set to zero. Therefore, the analysis of the unrestricted delegation subgame is captured by the analysis of the asymmetric endowment game above.

In the case with a destination rule, player i is restricted in that its contribution to a public good must be at least $\hat{z}_i$. Player i will have an incentive to use $\hat{z}_i$ effectively and direct it to the funded public good, if feasible. This means that player i's best response depends on $\hat{z}_i$ in much the same way that the best responses of others depend on C_{-j} as described in the above analysis. Player i prefers to contribute to a public good if

$$\tau - C_{-i} \leq \hat{z}_i + \hat{y}_i \quad \text{and} \quad 51 \leq C_{-i} + \hat{z}_i.$$

If $\hat{z}_i \geq \tau - C_{-i}$, then i prefers to contribute $c_i = \hat{z}_i$. If i prefers to contribute and $\hat{z}_i < \tau - C_{-i}$, then i prefers $c_i = \tau - C_{-i}$. The other players still prefer to contribute when $51 < C_{-j}$.

In this environment, player i is willing to contribute up to $\hat{z}_i + \min\{\hat{y}_i, 81\}$ to reach the threshold of a good. In the case where $\hat{y}_i = 55$, player i is willing to unilaterally fund a public good at its threshold as long as $\hat{z}_i \geq 132 - 55 = 77$, and there will be equilibria where i contributes $c_i = \tau$ and others contribute nothing. There are other equilibria in such an environment as well, including those that exist with unrestricted delegation and others that involve player i contributing more than $\hat{z}_i$ but less than τ to a good that also receives funding from other players.

An equilibrium refinement. In our multiple threshold public good environment, the alternative goods are identical and therefore indistinguishable to the players at the beginning of the game. This means that equilibria that require multiple players to coordinate contributions on the same good, in the absence of communication or focal points, is likely unreasonable. To eliminate these concerns, we can limit attention to player strategies that do not distinguish between the four goods. Specifically, we can relax the focus on pure strategy equilibria and instead consider contribution strategies in which players choose how much to contribute, but randomly choose which good receives these contributions.

Imposing such an equilibrium refinement eliminates equilibria that require players to correctly anticipate which of the goods others will contribute to. When two players contribute, there is now only a 1/4 probability that they both contribute to the same good. When all players contribute, there is only a 1/64 probability that they all contribute to the same good. These low probabilities of successful coordination mean that the expected benefits of contributing are greatly reduced. In the initial multiple threshold public good games with symmetric and asymmetric endowments, there do not exist any equilibria that survive this refinement and in which players contribute to public goods. Only the no-contribution equilibrium survives this refinement.

In the environment with a destination rule on $\hat{z}_i$, whenever there exists equilibria in which player i unilaterally funds a public good, there also exists a payoff equivalent equilibrium in which she unilaterally funds a public good chosen at random. There is no need to coordinate contributions with other players, and therefore randomly choosing which public good to fund does not decrease the probability that a threshold will be reached. This equilibrium survives the refinement requiring that contribution strategies not distinguish between identical goods.

A.2. **Adding a delegation stage to the one-shot game.** Here, we extend the multiple threshold public good framework to allow delegation during an initial stage of the game, as discussed in the body of the paper. In the first (delegation) stage of the game, four players are each endowed with $y = 55$, and one player, say i, is randomly selected to serve as the intermediary. Then the other players must decide how much of their endowments to transfer to player i. Let d_j denote the amount that player j delegates to player i. Let $D = \sum_{j \neq i} d_j$ denote the sum of transfers.

In the contribution stage of the game, all players including i engage in the threshold public good game with multiple alternatives described previously. For all players besides the intermediary, $\hat{y}_j = y - d_j$. For the intermediary, i, $\hat{y}_i = y$ and $\hat{z}_i = D$.

In the game with unrestricted delegation, there does not exist an equilibrium in which non-intermediaries provide contributions only through the intermediary. That is, there does not exist an equilibrium in which players provide transfers to the intermediary with the expectation that the intermediary passes the transfers received along to a public good in the contribution stage. This is because, as we previously established, there does not exist a subgame equilibrium in which player i is willing to unilaterally fund a public good.

This does not mean that there does not exist an equilibrium in which non-intermediaries provide transfers in the unrestricted delegation environment. Such equilibria exist, but they require that other players also contribute directly to the same public good that the intermediary contributes to in the contribution stage of the game. No such equilibria survive an equilibrium refinement requiring that contribution strategies not distinguish between specific goods. The only equilibrium to survive such a refinement is the no-contribution equilibrium in which no player provides a transfer in the delegation stage or a direct contribution in the contribution stage of the unrestricted delegation environment.

In the game with a destination rule, there exist equilibria in which players provide transfers to the intermediary in the delegation stage and only the intermediary provides a contribution to a public good in the contribution stage.

We can restrict attention to equilibria in which each subgame equilibrium survives the refinement requiring that contribution strategies not distinguish between identical goods. This means that players anticipate that the intermediary will unilaterally fund a public good whenever $D \geq 77$ (player i would be willing to fund a good for any $D \geq 51$, but can only afford to do so when D is within y of the threshold). This means that, in any subgame perfect equilibrium under the refinement in which a public good receives funding, the non-intermediaries transfer a total of $D = 77$ to player i in the delegation stage, and player i contributes $c_i = 132$ to a randomly selected good in the contribution stage. In addition to such equilibria, the no-delegation no-contribution equilibrium continues to exist.

A.3. **Repeated game.** The experimental treatments involve twelve rounds of repeated interactions between the players in each group. Therefore, the one-shot analysis applies only to the final round of play. Furthermore, the refinement that focuses attention on strategies that do not distinguish between identical goods only applies in the initial period before differences in past contributions across goods may allow groups to distinguish otherwise identical goods from one another. It is the repeated interaction that may provide rational players an incentive to contribute to goods they do not expect to reach their threshold in early periods with the hopes that early contributions may increase coordination in later periods. Furthermore, the intermediary in the game with unrestricted delegation may not redirect transfers to her private account in order to maintain future cooperation, even if she would have an incentive to expropriate such transfers in a one shot game.

In this section, we establish that the repeated nature of the experimental treatments implies the existence of equilibria in both delegation environments in which players only contribute through the intermediary in most periods.

Establishing this is straightforward for the game with delegation and a destination rule. Such an equilibrium exists for the one-shot version of the game, and therefore continues to exist in each round of the repeated version of the game.

To establish this for the game with unrestricted delegation, we start with a three-round version of the game. Once we establish that two repetitions are enough to sustain an equilibrium in which players only contribute through the intermediary in the first round, it follows that, with additional rounds of the game, we can sustain such strategies as part of an equilibrium in all but the final two rounds of play.

Consider the following subgame perfect equilibrium strategy in the second and third (final) rounds of the repeated interaction.

(1) If, in the previous round, a public good was successfully funded at its threshold and each player contributed no more than 22 to the private account, then contribute 33 directly to the same public good that was previously funded.

(2) Otherwise, delegate nothing and contribute nothing.

If all players adopt such a strategy, then depending on the first round outcome, the second and third rounds will either involve a no-delegation, no-contribution equilibrium or an equilibrium in which players coordinate to successfully fund a public good at its threshold. Unlike in the one-shot game, coordinating contributions on the same public good chosen by other players is feasible here because by the second round of play, the previous successful funding of a good may serve as a focal point.

In the first round of play, the players choose the actions that ensure cooperation in the second round. Each of the non-intermediaries transfers 33 and the intermediary contributes $c_i = 132$ to one of the goods at random. Such a strategy assures a payoff to all players over the three rounds of play equal to

$$(2 \times 22 + 162) \times 3 = 618.$$

The intermediary could expropriate the transfers made by the group in the delegation stage to instead receive

$$(2 \times 154) + (2 \times 55) \times 2 = 308 + 220 = 528.$$

In order to maintain cooperation in the later two rounds, the intermediary does not expropriate contributions in the first round. Similar incentives keep the non-intermediaries from reducing their contribution below 33.

Delegation in the first stage, when the public goods are indistinguishable, does not require that players choose a specific good to which to direct their contributions. Because players contribute through the intermediary who can then randomly choose a public good to which to allocate contributions, this equilibrium survives the refinement that requires strategies to treat indistinguishable goods similarly.

This analysis has established that, in both delegation environments, there are equilibria in which contributing through an intermediary helps groups overcome the coordination problem among donors that arises with multiplicity of public goods. In the unrestricted delegation game, this requires that players employ conditional strategies that are more complicated than the history independent delegation strategies that may be employed by non-intermediaries in the delegation game with destination rule.

Appendix B. Further results in treatments with multiple collective accounts

B.1. **Subjects' earnings with multiple collective accounts: parametric analysis.** Table A.1 parametrically analyzes differences in subjects' earnings across treatments. It is used in section 5.3 to compare earnings (of both the intermediary and non delegated subjects) in *DelRule* with the benchmark administrative cost levels (14.5% and 25%) provided by United Way (in the section "Where does the money go?" at https://www.unitedway.org/contact-us/faqs).

B.2. **Intermediary's behavior with multiple public goods.** In this section, we focus on the intermediary's behavior to investigate its determinants and its effects on contributions and delegated amounts.

Table A.2 reports frequency of alternative types of intermediary behavior in *Del* and *DelRule*, by using the following three categories: (a) crowding-in, occurring when the intermediary contributes more than the delegated amounts, (b) expropriation, referring to a situation in which the intermediary contributes less than what is transferred by the group, and (c) balance, namely when the intermediary's total contributions coincide with the delegated amounts. In all cases, we restrict our attention to observations that are associated with strictly positive delegated amounts (*Del.Am*). Of course, due to the presence of the destination rule, expropriation cannot be observed in *DelRule*.

First, we show that, overall periods, the proportion of delegates expropriating resources is 36.6% in Del, with the large majority of these cases (86% of the expropriate episodes) being associated with full expropriation (namely, the intermediary contributes nothing and entirely expropriates the amounts received from group members). The proportion of intermediaries contributing more than what is received from the group is substantially larger in *DelRule* (68.5%) than in *Del* (42.6%), with the difference being highly significant according to a proportion test ($p < 0.001$).

What factors contribute to the intermediary's behavior? On the one hand, conditional reciprocity might induce the intermediary to contribute a larger portion of their own endowment when faced with larger transfers from others in the group. When others are perceived to be doing their part to reach a threshold, the intermediary may feel compelled to do the same. Moreover, at a more fundamental level, higher contributions from others, thereby providing the intermediary with enough funding to unilaterally reach

TABLE A.1. Subject's earnings with multiple collective accounts: parametric analysis

Subject's earnings	*All periods*		*Periods* 1, 5, 9	
	(1)	(2)	(3)	(4)
Del	−5.326	−14.213	40.740***	26.231**
	(11.687)	(11.754)	(12.330)	(12.505)
DelRule	28.731**	25.563**	76.639***	71.312***
	(11.687)	(11.754)	(12.330)	(12.505)
Del ∗ *Delegate*		35.546***		58.037***
		(4.989)		(8.324)
DelRule ∗ *Delegate*		12.674**		21.308**
		(4.991)		(8.324)
cons	133.396***	133.396***	75.694***	75.694***
	(8.264)	(8.264)	(8.719)	(8.719)
ll	−14538.431	−14510.159	−3565.983	−3539.608
$Wald - \chi^2$	9.83	67.04	38.68	93.85
$p > \chi^2$	0.007	0.000	0.000	0.000
Obs.	2592	2592	648	648

Notes. This table reports coefficient estimates (standard deviations in parentheses) from two-way linear random effects models accounting for both potential individual dependency over periods and dependency within group. The dependent variable is the earnings of the subject in the period. Columns (1) and (2) report results by pooling data from *NoDel*, *Del*, and *DelRule* in all periods. Columns (3) and (4) use data from the reshuffling periods (1, 5, and 9) only. *Delegate* is a dummy that takes a value of 1 if the subject has been assigned the role of delegate in the period. *Del* ∗ *Delegate* and *DelRule* ∗ *Delegate* are interaction terms. The other remarks of Table 1 apply.

TABLE A.2. Intermediary's behavior with multiple collective accounts

Period	1	1 − 4	5	5 − 8	9	9 − 12	12	*All*
Del								
$f(Expropriation)$	0.389	0.361	0.500	0.361	0.500	0.375	0.222	0.366
$Cont. - Del.Am.$	−46.857	−40.846	−40.111	−41.038	−36.222	−41.296	−38.250	−41.063
$f(Balance)$	0.000	0.000	0.000	0.000	0.000	0.014	0.000	0.005
$f(Crowding - in)$	0.611	0.556	0.389	0.458	0.222	0.264	0.222	0.426
$Cont. - Del.Am.$	36.000	40.500	36.857	43.152	39.750	44.842	46.250	42.348
DelRule								
$f(Balance)$	0.500	0.319	0.333	0.250	0.333	0.306	0.444	0.292
$f(Crowding - in)$	0.500	0.681	0.667	0.736	0.667	0.639	0.444	0.685
$Cont. - Del.Am.$	33.111	34.551	35.750	39.302	38.583	35.261	31.750	36.473
Obs. (per treat)	18	72	18	72	18	72	18	216

Notes. This table reports proportions of the three possible intermediary's behaviors, crowding-in, expropriation, and balance, in *Del* and *DelRule*, as well as the corresponding mean difference between the intermediary's total contributions and the delegated amounts.

the threshold, can increase the viability of a collective account and minimize the risks of mis-coordinating contributions. On the other hand, the intermediary may have incentives to expropriate transfers. This is the case if she does not expect expropriation to trigger players to coordinate on substantially worse outcomes in the future. It may also occur when donors do not provide sufficient transfers to bring the collective account thresholds within reach of the intermediary.

In line with these preliminary considerations, Table A.3 parametrically investigates the determinants of both the intermediary's contributions and the probability of the two main categories of the intermediaries' behavior: expropriation and crowding-in.

TABLE A.3. Contributions, crowding-in, and expropriation by the intermediary: parametric analysis

	Total contributions				*Pr(Crowding − in)*				*Pr(Expropriation)*	
	Del		*DelRule*		*Del*		*DelRule*		*Del*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$d(Del.Am. \geq 77)$	67.150***	25.099**	58.857***	29.678***	0.429***	0.066	0.419***	0.189***	−0.199***	−0.440***
	(7.847)	(11.199)	(4.118)	(4.147)	(0.045)	(0.127)	(0.022)	(0.065)	(0.074)	(0.127)
$d(Del.Am. \geq 132)$			18.594***	13.405**			−0.488***	−0.389***		
			(7.149)	(6.419)			(0.075)	(0.091)		
$Del.Am.$		0.754***		1.794***		0.014***		0.013**		0.004**
		(0.145)		(0.133)		(0.003)		(0.006)		(0.002)
$Del.Am.^2$				−0.007***		$-7.2 * 10^{-5}$**		$-6.0 * 10^{-5}$*		
				(0.001)		$(3.1 * 10^{-5})$		$(3.2 * 10^{-5})$		
cons	30.695***	7.456	68.803***	−5.647						
	(6.751)	(6.567)	(4.786)	(4.895)						
$ll(lpl)$	−1116.023	−1105.243	−981.442	−904.625	−125.321	−104.502	−77.598	−68.502	−138.020	−134.465
$Wald - \chi^2$	73.24	123.23	225.58	964.02	26.81	36.55	42.42	57.32	6.99	11.70
$p > \chi^2$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.003
Obs.	216	216	216	216	216	216	216	216	216	216

Notes. Columns (1)-(4) of this table report coefficient estimates (standard errors in parentheses) from two-way linear random effects models accounting for both potential individual dependency over periods and dependency within group and using the intermediary's total contributions as dependent variable. Columns (5)-(10) report Probit marginal effect estimates (robust standard errors clustered at the group level in parentheses) over all periods. In particular, models in columns (5)-(8) use a dummy that takes a value of 1 if the intermediary's total contributions are (strictly) greater than the delegated amounts as dependent variable. Models in columns (9)-(10) use a dummy that takes a value of 1 if the intermediary's total contributions are (strictly) lower than the delegated amounts as dependent variable. $Del.Am.$ ($Del.Am.^2$) is the (square of the) delegated amounts. $d(Del.Am. \geq 77)$ and $d(Del.Am. \geq 132)$ are dummies that take a value of 1 if the delegated amounts are (weakly) greater than 77 and 132, respectively. In models that refer to *Del*, we exclude $d(Del.Am. \geq 132)$ from the covariates because of lackness of observations. Indeed, in this treatment, there is a single observation (out of 216) in which the intermediary received more than 132 tokens from the group. $Del.Am.^2$ is excluded from models in columns (2), and (10) because its coefficient is never significant. The other remarks of Table 1 apply.

As confirmed by columns (2) and (4), in both *Del* and *DelRule*, the intermediary responds positively to what was transferred by the group, with the response being stronger when group members transfer at least 77 tokens. In particular, the coefficient of $d(Del.Am. \geq 77)$ is positive, large in size, and significant in both treatments (in *Del*, $p = 0.025$; in *DelRule*, $p < 0.001$). Moreover, as confirmed by the positive and highly significant ($p < 0.001$) coefficient of *Del.Am.* in column (2), we find that in *Del* the more group members transfer to the intermediary, the higher the intermediary's own contributions are. Also in *DelRule* the intermediary's contributions respond positively to the delegated amounts although in this case, the relationship is concave (the coefficient of $Del.Am.^2$ is negative, with $p < 0.001$) and reaches its maximum when the delegated amounts approach 130 tokens.

Columns (6) and (8) document a concave relationship between the probability of observing the intermediary's crowding-in and the delagated amounts, as the coefficient of $Del.Am.^2$ is negative and significant in both regressions (in *Del*, $p = 0.020$; in *Del*, $p = 0.061$).

When focusing on *DelRule*, we also find that the probability of observing the intermediary's crowding-in increases when the group transfers at least 77 tokens (the coefficient of $d(Del.Am. \geq 77)$ is positive, with $p = 0.004$), but decreases when the delegated amounts are already sufficient to reach the threshold (the coefficient of $d(Del.Am. \geq 132)$ is negative, with $p < 0.001$).

Finally, when looking at results in column (10), we find that the probability of observing expropriation decreases when the intermediary receives at least 77 tokens from the group in the delegation phase (the coefficient of $d(Del.Am. \geq 77)$ is negative, with $p = 0.001$). However, the previous effect is somewhat counterbalanced by the positive and significant effect of the delegated amounts ($p = 0.018$), thus confirming that the more group members transfer to the intermediary, the larger her incentive becomes to expropriate resources.

As discussed when presenting the experimental design, the role of delegate in *Del* and *DelRule* was randomly and independently assigned in every period. Thus, it might be interesting to investigate whether delegate's behavior is affected by the extent of her experience in that role.[21] Therefore, we extend the analysis in Table A.3 by following two different empirical strategies: (i) including a variable that, in every period, counts the number of times in which, up to that period period, the subject has been assigned to the role of delegate; (ii) including 3 dummies, $d_{Del}(2)$, $d_{Del}(3)$, and $d_{Del}(4)$, such that the generic dummy $d_{Del}(s)$ assumes value 1 from the period the subject plays for the the s-th time in the role of delegate. In other words, with the first strategy, we look at the direct effect of experience in the role of delegate on delegate's total contributions, as well as on the probability of observing crowding-in and expropriation of the delegate. Instead, by using linear combinations of the three dummies built according to the second strategy, we look at how being assigned for at least two, three, four periods to that role affect delegate's behavior, relative to a situation in which the role of delegate was assigned for one period only. Results are reported in Table A.4.

[21]We thank an anonymous Referee for this suggestion.

TABLE A.4. Contributions, crowding-in, expropriation and delegate's experience: parametric analysis

	Total contributions				*Pr(Crowding − in)*				*Pr(Expropriation)*	
	Del		*DelRule*		*Del*		*DelRule*		*Del*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Num.Delegate	-3.793^{*}		0.289		-0.041		-0.001		0.027	
	(2.177)		(0.824)		(0.027)		(0.016)		(0.035)	
Del. for at least 2 periods		-10.715^{*}		3.211		-0.061		0.022		0.072
		(6.465)		(2.463)		(0.072)		(0.024)		(0.098)
Del. for at least 3 periods		0.844		1.938		0.014		0.009		-0.120
		(7.289)		(2.856)		(0.078)		(0.045)		(0.101)
Del. for at least 4 periods		-15.829^{**}		2.512		-0.169		0.021		0.141
		(7.822)		(3.206)		(0.108)		(0.065)		(0.129)
$d(Del.Am. \geq 77)$	26.361^{**}	27.629^{**}	29.343^{***}	29.015^{***}	0.084	0.084	0.190^{***}	0.186^{***}	-0.446^{***}	-0.449^{***}
	(11.164)	(11.124)	(4.248)	(4.274)	(0.126)	(0.121)	(0.071)	(0.071)	(0.127)	(0.123)
$d(Del.Am. \geq 132)$			13.620^{**}	12.942^{**}			-0.389^{***}	-0.391^{***}		
			(6.454)	(6.415)			(0.093)	(0.091)		
Del.Am.	0.679^{***}	0.677^{***}	1.802^{***}	1.796^{***}	0.014^{***}	0.013^{***}	0.013^{**}	0.013^{**}	0.004^{**}	0.004^{***}
	(0.148)	(0.149)	(0.135)	(0.135)	(0.003)	(0.003)	(0.006)	(0.006)	(0.002)	(0.002)
$Del.Am.^2$			-0.007^{***}	-0.007^{***}	$-7.6 * 10^{-5***}$	$-7.4 * 10^{-5***}$	$-6.0 * 10^{-5*}$	$-6.0 * 10^{-5*}$		
			(0.001)	(0.001)	$(2.8 * 10^{-5})$	$(2.7 * 10^{-5})$	$(3.2 * 10^{-5})$	$(3.2 * 10^{-5})$		
cons	19.180^{**}	15.899^{*}	-6.513	-7.578						
	(9.287)	(8.413)	(5.415)	(5.206)						
ll(lpl)	-1103.771	-1101.868	-904.565	-903.733	-102.765	-101.825	-68.500	-68.386	-133.892	-130.627
$Wald - \chi^2$	123.71	129.19	967.83	971.22	87.07	107.21	57.25	62.95	12.32	33.68
$p > \chi^2$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.000
Obs.	216	216	216	216	216	216	216	216	216	216

Notes. This table adds controls for subject's experience in the role of delegate to specifications in Table A.3. *Num.Del* is a counting variable that, in every period, is equal to the number of times in which, up to that period period, the subject has been assigned to the role of delegate. Results in the second, fourth, sixth, eigth, and tenth models are obtained by including 3 dummies, $d_{Del}(2)$, $d_{Del}(3)$, and $d_{Del}(4)$ where the generic dummy $d_{Del}(s)$ assumes value 1 from the period the subject plays for the the s-th time in the role of delegate. The table reports the linear combinations and (corresponding t-tests significance levels) of the three dummies. The other remarks of Table A.3 apply.

We find limited evidence of the effects of experience on delegate's behavior. In particular, when including the counting variable (built according to the first strategy), we find that, after controlling for the other covariates, the number of times a subject has been assigned to the role of delegate only exerts a negative and marginally significant effect on total contributions in *Del* ($p = 0.081$), while never reaches statistical significance in the other regressions. Sign, magnitude, and statistical significance of the other covariates remain almost unchanged when including the role counting variable. Similarly, when following the second strategy, no significant differences emerge between fresh and veteran delegates in *DelRule*. In *Del*, the strongest result is that subjects experiencing the role of delegate for at least four periods contribute less than fresh delegates ($p = 0.043$). Only an additional result reaches marginal significance in *Del*, namely subjects experiencing the role of delegate for at least two periods contribute slightly less than fresh delegates ($p = 0.097$). All of the remaining effects under the second strategy are not significant and, again, the effects of the other covariates remain qualitatively unchanged.

The last step in analyzing the intermediary's behavior is aimed at assessing its effects on the behavior of the other group members. As highlighted in the theoretical section, the repeated nature of the experiment allows for the possibility of dynamic conditional strategies. Delegation and cooperation may be sustained in *Del* through strategies in which observing the expropriation of transfers in one period leads players to behave less cooperatively in the future. We parametrically investigate these intuitions in Table A.5. In particular, the table analyzes the effects of the intermediary's crowding-in and expropriation on the group's aggregate contributions and the delegated amounts, by accounting for the number of times that specific behavior has occurred.

TABLE A.5. The effects of the intermediary's behavior on contributions and delegated amounts: parametric results

	Total contributions				*Delegated amounts*			
	Any amount		*Full*		*Any amount*		*Full*	
	Crowd − in	*Exprop.*	*Crowd − in*	*Exprop.*	*Crowd − in*	*Exprop.*	*Crowd − in*	*Exprop.*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
From 1^{st} *occurrence*	0.787	−7.812*	0.186	−7.188*	−0.623	−4.522***	1.586	−3.386**
	(3.502)	(4.127)	(2.803)	(3.928)	(1.248)	(1.451)	(1.071)	(1.400)
From 2^{nd} *occurrence*	1.703	−10.079**	4.209	−11.455***	0.065	−9.821***	−0.926	−9.406***
	(3.669)	(4.127)	(4.287)	(4.157)	(1.328)	(1.492)	(1.601)	(1.521)
From 3^{rd} *occurrence*	4.032	−13.435***	3.804	−17.771***	0.471	−13.071***	1.597	−14.886***
	(3.851)	(4.567)	(4.742)	(4.755)	(1.377)	(1.647)	(1.756)	(1.729)
From 4^{th} *occurrence*	4.762	−14.609***	−2.219	−21.731***	2.078	−15.739***	−0.446	−20.825***
	(3.951)	(5.407)	(5.667)	(7.985)	(1.410)	(1.946)	(2.137)	(2.794)
Del	−0.227		0.024		−4.442*		−5.632**	
	(4.574)		(4.072)		(2.694)		(2.661)	
DelRule	4.693		5.247					
	(4.216)		(3.644)					
Cons	24.457***		24.457***		28.318***		27.791***	
	(2.606)		(2.484)		(1.949)		1.852	
ll	−13042.316		−13042.811		−5055.255		−5056.624	
$Wald - \chi^2$	40.10		41.38		194.92		191.13	
$p > \chi^2$	0.011		0.002		0.000		0.000	
Obs.	2592		2592		1296		1296	

Notes. Results reported in this table are based on two-way linear random effects models accounting for both potential individual dependency over periods and dependency within group. The dependent variable in the first two models is the total contributions made by the subject to the twelve collective accounts in the period in *NoDel* (used as baseline), *Del*, and *DelRule*. The dependent variable in the last two models is the delegated amounts in *Del* and *DelRule* (used as baseline). The covariates in the first and third models are the treatment dummies, *Del* and *DelRule*, the constant, 9 dummies, $d_{exp}(1), ..., d_{exp}(9)$, for situations in which the intermediary expropriates delegated resources, and 11 dummies, $d_{crowd-in}(1), ..., d_{crowd-in}(11)$ for situations characterized by the intermediary's crowding-in. The generic dummy $d_{exp}(s)$ ($d_{crowd-in}(s)$) assumes value 1 from the period after the group observes for the s-th time the intermediary contributing less (more) than what received from the group in the delegation phase. The only difference in the second and fourth models is that, in these specifications, there are 9 dummies for expropriation, 8 dummies for crowding-in, and the definitions used to build the dummies is more restrictive as it refers to full expropration (full crowding-in), namely when the intermediary received strictly positive transfers from the group and contributed nothing (her overall endowment). The table reports the linear combinations and (corresponding t-tests significance levels) of the first four dummies of crowding-in (expropriation). Results remain qualitatively unchanged when we include a set of interaction terms between the dummies capturing crowding-in and the treatment dummies (which, moreover, are found to be never significant). The other remarks of Table 1 apply.

Results suggest that controlling for the intermediary's crowding-in and expropriation substantially reduces differences in contributions across treatments. Indeed, for both types of intermediary's behaviors and under both the general and the more restrictive definitions, treatment dummies, as well as their difference, are not significant any longer (in the first model, $p = 0.960$ for *Del*, $p = 0.266$ for *DelRule*, and $p = 0.269$ for their difference; in the second model, $p = 0.995$ for *Del*, $p = 0.150$ for *DelRule*, and $p = 0.194$ for their difference). Moreover, as expected, while experiencing crowding-in does not seem to substantially affect contributions, the cumulative effects of observing expropriation for the first, the second, the third, and the fourth time are significant and monotonically increase in magnitude (passing from -7.812 to -14.609 in the first model and from -7.188 to -21.731 in the second model).

Moving to the delegated amounts, while the main considerations on the significance and magnitude of the effects of the intermediary's crowding-in and expropriation are confirmed, in the last two models we document a significant difference between *Del* and *DelRule*. Indeed, after including the crowding-in and expropriation covariates, the coefficient of the treatment dummy *Del* is marginally significant in the first model ($p = 0.099$) and significant in the second model ($p = 0.034$).

Appendix C. Impact of multiplicity on group performance

The now focus on the pure effect of introducing multiple collective accounts on group performance. In their study, CCV find a strong, negative effect of multiplicity on contributions, subjects' earnings and the group's ability to reach the threshold. In particular, they identify the negative effect of multiplicity by comparing results from the same benchmark treatment with a single collective account with a setting in which subjects could contribute to four identical collective accounts. In addition, the authors find that enhancing salience facilitates contributions and coordination only when the salient collective account stands out as the most efficient alternative. Since the present study is aimed at analyzing the effects of delegation in a threshold public good experiment with multiple alternatives, we deliberately decided to design *NoDel* as a hybrid version of the CCV treatment with four identical collective accounts. Indeed, subjects in *NoDel* faced twelve collective accounts, four of which were reshuffled every four periods and were thus indistinguishable but still associated with a higher bonus relative to the remaining eight alternatives. Of course, this ad-hoc design feature of *NoDel* is motivated by our interest in assessing the role of delegation in a setting that is characterized by the risk of mis-coordinating contributions across multiple alternatives. However, it might also alter the pure (negative) effect of multiplicity (as documented by CCV), as subjects in *NoDel* might respond to the presence of the four salient and efficient alternatives by increasing their contributions.[22] Table A.6 parametrically assesses the effects of multiplicity by comparing individual contributions, proportions of successful provision and earnings between *NoDel* and *NoDel*[1].

Estimates in columns (1), (3), and (5) suggest that when not controlling for differences between treatments in the linear time trend and the effects of past successful provision, multiplicity plays only a marginal role in affecting group's performance. Indeed, as shown by estimates in column (1), although negative, the coefficient of *NoDel* is not significant ($p = 0.103$) thus confirming no remarkable difference in contributions between *NoDel* and *NoDel*[1]. Similar conclusions emerge when looking at earnings and probability of successful contributions. From columns (3) and (5), *NoDel*[1] and *NoDel* do not significantly differ either in earnings ($p = 0.191$) or in the ability of groups to reach the threshold ($p = 0.157$).

As suggested by columns (2), (4) and (6), the previous results substantially change when accounting for treatment specific effects of the linear time trend and past successful provision.

Looking at contributions, both *NoDel*[1] and *NoDel* exhibit a significant decaying pattern (both the coefficient of *Trend* and the linear combination of *Trend* and $NoDel * Trend$ are negative, with $p < 0.001$). In both treatments the past successful provision plays no significant role in inducing subjects to contribute (neither the coefficient of $Coord(t-1)$ nor the linear combination of $Coord(t-1)$ and $NoDel * Coord(t-1)$ are significant, with $p = 0.157$ and $p = 0.240$, respectively). Interestingly, when controlling for the additional covariates, the difference in contributions between *NoDel* and *NoDel*[1] becomes highly significant (for the coefficient of *NoDel*: $p = 0.007$).

[22] This intuition finds supporting evidence in Result 3 which confirms that, even in *NoDel*, subjects contribute substantially more to the efficient collective accounts.

TABLE A.6. The effects of multiplicity on total contributions, earnings, and the proportions of successful provision

	Total contributions		*Earnings*		*Successful provision*	
	(1)	(2)	(3)	(4)	(5)	(6)
$NoDel$	-6.056	-11.158^{***}	-16.278	-63.543^{***}	-0.144	-0.287^{**}
	(3.711)	(4.135)	(12.460)	(15.895)	(0.101)	(0.137)
$Trend$		-1.973^{***}		-8.360^{***}		-0.052^{***}
		(0.173)		(0.808)		(0.012)
$NoDel * Trend$		1.069^{***}		10.787^{***}		0.048^{***}
		(0.232)		(1.086)		(0.014)
$Coord(t-1)$		1.881		6.385		0.427^{***}
		(1.328)		(6.188)		(0.085)
$NoDel * Coord(t-1)$		-0.330		-14.316		0.013
		(1.872)		(8.715)		(0.140)
$cons$	30.513^{***}	40.398^{***}	149.674^{***}	192.094^{***}		
	(2.624)	(3.046)	(8.810)	(11.920)		
ll	-7241.05	-6520.89	-9813.55	-8872.90	-293.91	-220.73
$Wald - \chi^2$	2.66	227.38	1.71	163.70	1.95	91.38
$p > \chi^2$	0.103	0.000	0.191	0.000	0.163	0.000
$Obs.$	1728	1584	1728	1584	432	396

Notes. Results reported in this table are obtained by pooling data from $NoDel[1]$ and $NoDel$. Columns (1)-(4) of the table report coefficient estimates (standard errors in parentheses) from two-way linear random effects models accounting for both potential individual dependency over periods and dependency within-group. The dependent variable in columns (1) and (2) is the overall contribution made by the subject to the twelve collective accounts in the period. The dependent variable in columns (3) and (4) is subject's earnings in the period. Columns (5) and (6) report Probit marginal effect estimates (robust standard errors clustered at the group level in parentheses) over all periods and using a dummy that takes a value of 1 if the aggregate contributions made by members of the group in the period is (weakly) greater than the threshold, 132. The other remarks of Table (1) apply.

Moving to subjects' earnings in column (4), we detect a strong difference in the effect of the linear time trend between $NoDel[1]$ and $NoDel$ (for the coefficient of $NoDel * Trend$: $p < 0.001$). In particular, while earnings in $NoDel[1]$ significantly decrease over repetitions (the coefficient of *Trend* is negative with $p < 0.001$) they exhibit an increasing time pattern in $NoDel$ (the linear combination of *Trend* and $NoDel * Trend$ is positive, $p < 0.001$). Again, the past successful provision has no significant effects on earnings (both the coefficient of $Coord(t-1)$ and the linear combination of $Coord(t-1)$ and $NoDel * Coord(t-1)$ are not significant, with $p = 0.302$ and $p = 0.196$, respectively). As for contributions, after including treatment specific covariates in the regression, the difference in earnings between $NoDel[1]$ and $NoDel$ becomes negative and highly significant (for the coefficient of $NoDel$: $p < 0.001$).

Finally, column (6) focuses on the probability to reach the threshold. We detect a significant decaying pattern in $NoDel[1]$ (for the coefficiet of *Trend*: $p = 0.036$) while $NoDel$ exhibits no significant time trend (for the linear combination of *Trend* and $NoDel * Trend$: $p = 0.568$). The past successful provision makes groups more able to reach the threshold in both $NoDel[1]$ and $NoDel$ (for both the coefficient of $Coord(t-1)$ and the linear combination between $Coord(t-1)$ and $NoDel * Coord(t-1)$: $p < 0.001$), with no significant difference in the effect being detected between the two treatments (for the coefficient of $NoDel * Coord(t-1)$: $p = 0.924$). As with contributions and earnings, after controlling for the additional covariates, the negative effects of multiplicity on groups' ability to reach the threshold become significant (for the coefficient of $NoDel$: $p = 0.036$).

Appendix D. Delegated amounts and contributions in $Del[1]$ and $DelRule[1]$

Results 8, 9, and 10 suggest that delegation does not stimulate contributions and the ability to reach the threshold when group members face a single collective account. To better investigate the negative role of

Table A.7. Delegated amounts and the intermediary's total contributions with a single collective account

Period	1	1 − 4	5	5 − 8	9	9 − 12	12	*All*
Del. am.								
Del[1]	46.444	36.417	21.611	20.292	21.778	13.042	2.889	23.250
	(25.327)	(22.058)	(21.310)	(25.456)	(26.808)	(18.291)	(6.425)	(21.090)
DelRule[1]	80.167	79.903	76.944	73.444	64.556	63.597	60.556	72.315
	(24.006)	(26.199)	(28.565)	(24.621)	(31.134)	(26.038)	(31.914)	(23.350)
Del[1] − *DelRule*[1]	−33.723***	−43.486***	−55.333***	−53.152***	−42.778***	−50.555***	−57.667***	−49.065***
Int.'s Cont.								
Del[1]	47.167	44.792	34.667	29.569	35.389	20.792	8.500	31.718
	(41.543)	(29.132)	(40.703)	(35.805)	35.001)	(19.377)	(16.195)	(25.636)
DelRule[1]	110.167	103.333	103.722	103.278	91.722	90.639	87.778	99.083
	(29.576)	(30.232)	(36.032)	(32.419)	(42.600)	(35.199)	(44.575)	(29.194)
Del[1] − *DelRule*[1]	−63.000***	−58.541***	−69.055***	−73.709***	−56.333***	−69.847***	−79.278***	−67.365***
Int.'s cont. − Del.am.								
Del[1]	0.723	8.375	13.056	9.277	13.611**	7.750	5.611	8.468*
DelRule[1]	30.000***	23.430***	26.778***	29.834***	27.166***	27.042***	27.222***	26.768***
Obs. (per treat)	18	18	18	18	18	18	18	18

Notes. This table reports mean delegated amounts and the mean of the intermediary's total contributions over periods in *Del*[1] and *DelRule*[1]. The other remarks of Table 5 apply.

delegation, we now focus our attention on the intermediary's contributions and the amounts transferred by the other group members in the delegation phase. Figure A.1 shows the mean delegated amounts and the mean contributions of the intermediary over periods in *Del*[1] and *DelRule*[1].

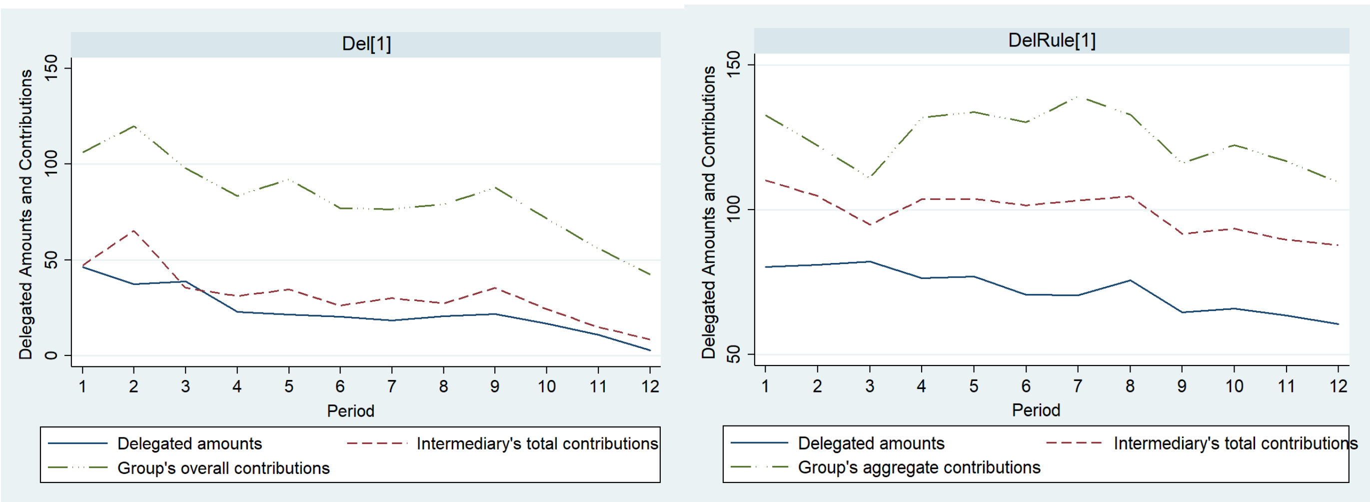

Figure A.1. Delegated amounts and contributions with a single collective account, by treatment and period.

Interestingly, although there are relevant differences in their magnitude, the previous graphs confirm the two main empirical observations drawn with multiple collective accounts. First, the delegated amounts are higher when delegation is combined with the destination rule. Table A.7 reports descriptive statistics and results from non parametric tests.

Across all periods, the mean delegated amounts are 72.32 tokens in and 23.25 tokens in *DelRule*[1] and *Del*[1], respectively. Second, on average, only in *DelRule*[1] we observe the intermediaries' total contributions to be higher than the delegated amounts: across all periods, the difference is 26.77 tokens in $DelRule[1]$ but it drops to 8.47 in $Del[1]$.

Over all periods, both the delegated amounts and the intermediary's total contributions in $DelRule[1]$ are substantially higher than those in $Del[1]$. According to a Mann-Whitney rank-sum test (two-sided), for both variables, the differences between $Del[1]$ and $DelRule[1]$ are negative and highly significant (for the delegated amounts, $p < 0.001$; for the intermediary's total contributions, $p < 0.001$) and remain highly significant after accounting for multiple null hypotheses testing (for both the delegated amounts and the intermediary's total contributions, $p < 0.001$). Moreover, even in the single collective account setting, the intermediary contributes significantly more than what is received from the group in $DelRule[1]$ ($p < 0.001$), while the difference, although still positive, is only marginally significant in $Del[1]$ ($p < 0.067$).

Appendix E. Instructions

[Instructions were originally written in Italian. The following sample refers to the treatment *DelRule*]

INSTRUCTIONS

Welcome. Thanks for participating in this experiment. If you follow the instructions carefully you can earn an amount of money that will be paid to you in cash at the end of the experiment. During the experiment you are not allowed to talk or communicate in any way with the other participants. If you have questions raise your hand and one of the assistants will come to you. The rules that you are reading are the same for all participants.

General rules

In this experiment there are 24 persons who will interact for 12 periods. At the beginning of the experiment you will be randomly and anonymously assigned to a group of four people. Therefore, of the other three people in your group you will know neither the identity nor the earnings. Finally, the composition of your group will remain unchanged throughout the experiment.

How earnings are determined

In each of the 12 periods you and each other subject in your group will be assigned an endowment of 55 tokens. Thus, the group will have a total of 220 tokens.

During each period you participate in two consecutive phases.

PHASE 1: How many tokens do you want to transfer to the DELEGATE?

At the beginning of PHASE 1, the computer will randomly select one of the four members of your group to be designated to the role of DELEGATE. If you are selected to play the role of DELEGATE, then you will not make any choice in PHASE 1. On the contrary, if another member of your group is selected to play the role of DELEGATE, then you have to choose how many of the 55 tokens of your initial endowment to transfer to the DELEGATE. At the end of PHASE 1, the computer will inform you about how many tokens have been transferred by the members of your group to the DELEGATE as well as your EFFECTIVE endowment in PHASE 2. In particular, if you are selected to play the role of DELEGATE, you will participate in PHASE 2 with an effective endowment of 55 tokens plus those transferred to you by the other group members. Instead, if another member of your group is selected to play the role of DELEGATE, you will participate in PHASE 2 with an effective endowment of 55 tokens minus what you have transferred to the DELEGATE. Note that, regardless of the choices made your group members in PHASE 1, your group will dispose of 220 tokens in PHASE 2.

PHASE 2: How many tokens do you want to allocate to the PRIVATE ACCOUNT and COLLECTIVE ACCOUNTS?

In PHASE 2, you have to decide how to allocate your effective endowment of tokens between an PRIVATE ACCOUNT and twelve COLLECTIVE ACCOUNTS respectively denominated WHITE, YELLOW,

GREEN, RED, LIGHT BLUE, BLUE, GRAY, VIOLET, BROWN, PINK, BLACK and ORANGE. The thirteen accounts generate a return expressed in points according to the following rules.

PRIVATE ACCOUNT. You receive points from the PRIVATE ACCOUNT every time you allocate tokens to it. In particular, for each token allocated by you to the PRIVATE ACCOUNT, you receive 2 points.

COLLECTIVE ACCOUNTS WHITE, YELLOW, GREEN, RED, LIGHT BLUE, BLUE, GRAY, VIOLET, BROWN, ROSE, BLACK and ORANGE. You receive points from any of the twelve COLLECTIVE ACCOUNTS if and only if the number of tokens allocated to it by your group is greater than or equal to a pre-specified number that is called ”threshold”. The threshold is the same across the twelve collective accounts and is represented by 132 tokens.

In particular:

(a) If the number of tokens allocated to a COLLECTIVE ACCOUNT by your group is less than or equal to the threshold on 132 tokens, then you do not receive any point from those tokens.

(b) If the number of tokens allocated to a COLLECTIVE ACCOUNT by your group is equal to or greater than the threshold of 132 tokens, then:

- for each token allocated by you or by any other person in your group in that COLLECTIVE ACCOUNT, you receive 1 point;
- additionally, you receive a ”bonus” in points. The size of the bonus depends on the COLLECTIVE ACCOUNT to which the tokens are allocated. In periods 1, 5 and 9, the computer will randomly select four of the twelve COLLECTIVE ACCOUNTS. The bonus assigned to the four selected COLLECTIVE ACCOUNTS will consist of 30 points, while the bonus assigned to the remaining eight COLLECTIVE ACCOUNTS will consist of 20 points. The four COLLECTIVE ACCOUNTS with higher bonus will be the same for all members of the group and will remain unchanged for the three subsequent periods (i.e. the four COLLECTIVE ACCOUNTS selected in period 1 will remain the same in periods 2, 3 and 4; the four COLLECTIVE ACCOUNTS selected in period 5 the same remain in periods 6, 7 and 8; finally, the four COLLECTIVE ACCOUNTS selected in period 9 will remain the same in the periods 10, 11 and 12).

How to make your choice in PHASE 2.

At the beginning of PHASE 2, the computer will display your effective endowment and thirteen input fields, one for the PRIVATE ACCOUNT and one for each of the twelve COLLECTIVE ACCOUNTS. In each of the twelve input fields associated with the COLLECTIVE ACCOUNTS, the computer will display the bonus size, 20 or 30 points, assigned to the COLLECTIVE ACCOUNT in that period. For each subject in the group, the order in which the twelve input fields for the COLLECTIVE ACCOUNTS are displayed on the screen is randomly determined by the computer. The number of tokens you allocate to an account cannot be greater than your effective endowment and the sum of your allocations must be equal to your effective endowment.

Moreover, if you are selected to play the role of DELEGATE, the sum of your allocations in the twelve COLLECTIVE ACCOUNTS cannot be less than the number of tokens transferred to you by the other group members in PHASE 1. This means that the DELEGATE of the group is required to allocate in the twelve COLLECTIVE ACCOUNTS at least as much as transferred by the group members in PHASE 1.

At the end of PHASE 2 of each period, the computer will display how many tokens you have allocated to the PRIVATE ACCOUNT, how many tokens you have allocated to each of the twelve COLLECTIVE ACCOUNTS, how many tokens have been allocated by your group to each of the twelve COLLECTIVE ACCOUNTS, how many points you have obtained from the PRIVATE ACCOUNT, how many points you have obtained from each of the twelve COLLECTIVE ACCOUNTS and how many points you have obtained in total in the period. At the end of the experiment the total number of points you have obtained in the 12 periods will be converted into Euro at the rate 120 points = 1 Euro.