Pro-Rich and Progressive: Policy Selection and Contributions in Threshold Public Goods Experiments*

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Abstract

Experiments with multiple threshold public goods provide insight into how groups overcome coordination issues to collectively select and fund one option from a set of alternatives. We investigate how funding, selection, and success of public goods are impacted by endowment and preference heterogeneity. Groups tend to focus on and successfully fund the option that is preferred by the wealthiest group member, demonstrating a wealthy-interest policy bias even in the absence of corruption, politics, and information asymmetries. At the same time, we demonstrate how groups converge to divide costs in highly progressive ways, with differences in voluntary contributions mostly offsetting differences in endowments or benefits received. We discuss implications for policy selection, charitable giving, and public finance.

Keywords: Multiple public goods; Donor heterogeneity; Crowdfunding; Lab experiment.

JEL codes: C91, C92, H40, H41, L31.

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1 Introduction

Echoing George Orwell, Paul Krugman conveys the popular view that the rich wield undue power over policy: "America's wealthy exert huge political influence. Our ideals say that all men are created equal, but in practice a small minority is far more equal than the rest of us" [Krugman, 2020]. Existing institutions may perpetuate plutocracy by providing channels for those with deep pockets to engage in rent-seeking, government capture, or the shaping of public opinion. Political campaigns rely on donations for funding for elections [e.g., Francia et al., 2003]; policymakers and bureaucracies respond to spending on lobbying [e.g., Baumgartner et al., 2009]; and public opinion may be swayed by spending on advertising or public relations campaigns [e.g., Page et al., 2019].[1]

In this paper, we step back from the formal institutions, politics, and persuasion channels that are frequently blamed for driving decisions that benefit the wealthy. We present an experiment in which groups of individuals who are heterogeneous in either endowments or preferences can successfully select and implement a public good from a set of viable alternatives by coordinating their financial support on one option. Ours is a setting of informal groups working together to select and fund a policy in the absence of politics, formal institutions, asymmetric information, communication, or channels of rent-seeking and capture of the policy making process. Even without these channels of influence, we show how groups tend to focus on and implement the policy option preferred by the highest income member of the group. In the simplest setting of collective policy selection, policy emerges that is biased in favor of the richest person.

The groups in our setting tend to implement the policies preferred by the wealthiest member not because of a corrupt or explicitly biased system, but because people view that policy as the most-feasible option for attracting sufficient support and being successfully implemented. Groups face coordination problems as they need to consolidate sufficient support behind one of several different public goods, and the preferred good of the highest income individual serves as a focal point that helps the broader group coordinate their contributions. It is the policy that individuals expect others to consolidate their support behind, leading them to also put their support behind that option.

This main result suggests that eliminating opportunities for the wealthy to directly engage in rent seeking, persuasion, or government capture may not fully remove the policy bias in their favor. Political parties may still look to the preferences of the wealthiest members when forming

[1]The literature on each of these topics is extensive. See also Bauer et al. [2007], Lessig [2011], and Goss [2016] for overviews of how the wealthy influence policy, Stratmann [2005] for a partial review of the literature on money in politics, Gimpel et al. [2008] for consideration of how wealthy donors influence elections outside of their own locations, and Grossman and Helpman [1994], Hall and Deardorff [2006] and Cotton [2012] for alternative models of influence through lobbying.

beliefs about which candidate or policy platform is most feasible to consolidate support behind. Communities may look to the preferences of the wealthiest residents when forming beliefs about which local public good is most feasibly implemented. The results extend to non-policy settings as well. Philanthropists, for example, may look to the preferences of the wealthiest donors when forming beliefs about which charity or cause offers the greatest potential for success. In each of these cases, groups look to the preferences of the wealthy not because the wealthy have an information advantage or are only willing to contribute to their preferred options, but rather because of the mutual expectation that others are also looking to the preferences of the wealthy for guidance on where to direct their attention and support.

A deeper look at the experiment and analysis highlights several other contributions of the paper. First, the dynamics of contributions across multiple periods of interaction provide more nuanced insights into the ways in which implemented policy "follows the money." In treatments without endowment differences, contributors in later periods tend to focus their attention on the public good that received the highest contributions in the early periods. In this way, early momentum begets later success, suggesting that attracting greater support early is essential for long-term success. In contrast, when endowments and preferences differ, the attention of groups tend to focus on the option preferred by the wealthiest group member even from the earliest periods. In other words, the richest person did not *need* to contribute more early to ensure the success of their preferred good; the group's collective attention focused on and ensured the success of their preferred good even when they were not the largest contributor in the initial periods. The policy bias in favor of the wealthiest may exist independent of how much they actually spend in favour of their preferred options.

Second, our experiment allows us to observe not only which public good is implemented, but also how groups of individuals divide the collective costs of funding successful goods. We observe groups adopting highly progressive contribution patterns, where higher income individuals *voluntarily* contribute more to support the public good, even when they do not receive additional benefits from the implemented good.

The experimental design has implications for the interpretation of the results regarding the distribution of voluntary contributions. First, the treatments allow us to determine the degree to which differences in contributions are driven by differences in ability-to-pay (i.e., endowed income) and willingness-to-pay (i.e., benefits received) for the implemented public good. In this respect, our results show that both the ability-to-pay and the willingness-to-pay are important drivers of individual contributions. In particular, in the treatment with heterogeneity in both preferences and endowments, we find that the two contribution drivers coexist, leading the wealthy to contribute more to her preferred public good relative to what she would have done in a setting

in which preferences over public goods were aligned across group members. Second, the experiment is calibrated to ensure that individuals always have an incentive to do their part to ensure the success of the public good. They prefer to contribute in the way that they believe others expect them to contribute to ensure success (i.e., to the expected good and in the expected amount), even when they do not believe the choice of good or division of costs is optimal or fair. This means that the incentives to contribute and the corresponding contribution patterns do not reflect individual preferences, but rather reflect their beliefs over the collective expectations of the group. This allows us to learn about the policy choice and distribution of contributions that people expect to arise in such environments, rather than about their preferences over the alternative options.

Together, these results show that groups converge to adopt highly progressive contribution profiles that largely offset both ex ante inequality caused by differences in endowments and ex post inequality caused by differences in benefits received from the funded public good. Indeed, in the treatment with heterogeneous agents, we find that coordinating contributions on the public good preferred by the wealthy not only is beneficial for all group members, but also reduces within-group inequality.

In this way, our work complements an extensive public finance literature that considers the feasibility of implementing different types of tax systems. The literature has traditionally focused on the relative merits of different types of tax policy [e.g. Musgrave, 1959, Lindahl, 1919, Mirrlees, 1971, Saez, 2011], how institutions affect the implementation of alternative systems [e.g. Feldstein, 1976, Ito and Krueger, 1992], or public support for different types of systems [e.g. Weinzierl, 2017]. Rather than focus on design, formal institutions, or preferences over tax systems, we look at the distribution of contributions that emerges in a simple environment with voluntary participation. If the same contributions to the public goods that we observe in our treatments were collected through taxes instead of provided voluntarily, the equivalent tax system would be extremely progressive, working towards equity in outcomes. This does not mean that individuals prefer such highly progressive tax systems; rather it reflects a collective expectation about how costs will be divided into successful groups. To the extent that the same collective expectations apply more generally, the results suggest that highly-progressive systems may be more in line with expectations about the structure of reasonable tax policy.

Finally, our paper provides a systematic contribution to the public goods literature. It is the first study to introduce donor heterogeneity into a multiple threshold public goods environment. We show how such a framework can be used to study questions related to the role of income differences on the selection of policies, the emergence of (voluntary) tax systems, and the impact of these factors on inequality within the group.

The paper is organized as follows. Section 2 develops the literature review, the theoretical

framework, and testable implications. Section 3 presents the experimental design. Section 4 summarizes the data and presents the results of the analysis. Section 5 discusses the results in the context of charitable giving, policy selection, and tax structures, highlighting implications for the relevant literature in these areas. Section 6 concludes, discussing applications of the framework in future research.

2 Theoretical framework

The threshold public good environment, where successful projects require minimum funding and the support of multiple donors, provides insights into fundraising activities [Andreoni, 1998]. Recent work has extended the threshold public good environment by including multiple goods, each vying for funding success within a limited pool of available funding, to consider donor selection of crowdfunded and philanthropic projects [e.g., Corazzini et al., 2015, 2019]. The current paper extends the multiple threshold public goods environment to incorporate both income and preference heterogeneity, showing that such a framework provides insights beyond charitable giving, with relevant applications to how income or wealth differences influence program and policy selection, how groups evolve to splitting collective costs across individuals, and the potential impact of these concerns on inequality.

We are the first to incorporate donor heterogeneity into the multiple threshold public good environment, although others have considered various forms of donor heterogeneity in environments with a single threshold public good [e.g., Bagnoli and McKee, 1991, Rappoport and Suleiman, 1993, Marks and Croson, 1999, Brekke et al., 2017].[2] Our extended framework has several advantages over this past literature for studying our questions of interest. The multiplicity of public goods in our framework allow us to ask novel questions about public good selection, and whether the successful public goods tend to benefit richer or poorer members of the groups that implement them. Additionally, this past work has focused on differences in income and benefits in separate treatments, showing that both can affect contribution patterns within the groups.[3]

[2]There is also an extensive literature considering donor heterogeneity in more-commonly studied continuous public goods environments [e.g., Chan et al., 1999, Cherry et al., 2005, Uler, 2011, Maurice et al., 2013, Duquette and Hargaden, 2021, Sheremeta and Uler, 2021]. The nature of equilibrium and the incentives in such environments are fundamentally different from those in threshold public goods games, where donors must coordinate to achieve success. Such settings are not designed to study the questions about successful coordination, group selection of a common public good, or the division of budgets within a group. Overall this literature has shown that heterogeneity can, but does not necessarily, reduce voluntary contributions towards the collective good [Cherry et al., 2005, Duquette and Hargaden, 2021].

[3]In Rappoport and Suleiman [1993] and Brekke et al. [2017], individual with different levels of endowment tend to contribute similar shares of their endowments towards the public good. While Bagnoli and McKee [1991] does not formally provide such an analysis, in our analysis of their data, we find that those with higher endowed incomes tend to contribute more in absolute but not relative terms, contributing a smaller share of their endowments. In Bagnoli and McKee [1991], we also see those that receive higher pay-

2.1 Multiple threshold public goods game with heterogeneous agents

We extend the multiple threshold public good framework [e.g., Corazzini et al., 2015] to incorporate donor heterogeneity in endowed income and preferences, allowing for differences in both individual ability to pay and willingness to pay for alternative public goods. The four treatments include sessions with donor heterogeneity on both dimensions, donor heterogeneity in only endowed income, donor heterogeneity in only preferences over the alternative options, and no donor heterogeneity on either dimension. Each session of our experiment involves groups of four individuals, with each individual choosing how much of their private endowment to contribute to each of several alternative threshold public goods.

To provide structure to the discussion of the treatments and hypotheses, we formally describe a simple single-period threshold public goods contribution game that allows for heterogeneity and is calibrated with our model parameters. There are 4 agents (the donors) and 4 public goods. The experiment technically involves 8 public goods, but the 4 payoff dominant options are the only ones that we observe any contributions to; we can therefore simplify the theoretical discussion by focusing only on these 4 goods. Each agent j chooses how much of their income endowment, $y_j > 0$, to contribute to each of the public goods. We denote with $c_{j,n} \geq 0$ the contribution made by agent j to public good n. Let $C_n \equiv \sum_j c_{j,n}$ and $C_j \equiv \sum_{n=1}^{N} c_{j,n}$ represent the aggregate contributions to public good n and the total contributions made by agent j, respectively. The total contributions made by agent j cannot exceed her endowment, $C_j \in [0, y_j]$.

Function $B_{j,n}(C_n)$ determines the benefit agent j receives from public good n. The benefit depends on whether the overall amount contributed by the 4 agents to good n reaches a threshold level, τ – the minimum contribution necessary for that public good to succeed. Specifically, for each good n,

$$B_{j,n}(C_n) = \begin{cases} 0 & \text{when } C_n < \tau \\ C_n + b_{j,n} & \text{when } C_n \geq \tau. \end{cases} \tag{1}$$

By the previous expression, if agents fail to reach the threshold level, then the public good does not return any benefit, and the contributions are lost. Instead, when the threshold is reached, the public good returns a benefit to player j that is increasing in total contributions, plus a bonus of $b_{j,n}$ the size of which depends on the agent's preferences for that good. Any unit of endowment not contributed to a public good gets directed to private consumption, where it returns a marginal benefit greater than that from any public good. In each session of the experiment, the marginal benefit from uncontributed funds is 2 (implying a marginal per capita return to the public good

offs from the public good contributing more towards its success; but such differences are at least in part driven by a design in which equal contributions are inconsistent with equilibrium.

is $1/2$ that from private consumption). Therefore, player j earns total payoff:

$$u_j(c_j) = 2(y_j - \sum_{n=1}^{N} c_{j,n}) + \sum_{n=1}^{N} B_{j,n}(C_n) \tag{2}$$

In all treatments of our experiment, parameters are such that group members can fund at most one public good at its threshold, that each group member has an endowment which allows them to fund at least an equal share of a public good, that each player is 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. We assume a constant contribution threshold $\tau = 132$ and aggregate value of endowments $\sum_{j=1}^{4} y_j = 220$ across treatments. In the *homogeneous* treatment, $y_j = y = 55$ and $b_{j,n} = 30$ for each of the public goods. In the treatments with donor heterogeneity in endowments, $y_j \in \{34, 48, 62, 76\}$. In the treatments with heterogeneity in preferences over public goods, each public good returns a bonus of $b_{j,n} = 39$ when $j = n$ and $b_{j,n} = 27$ for the other 3 players for which $j \neq n$. That is, each agent has their own preferred good, which returns them a higher payoff than for the other players, while maintaining an average bonus across all four players equal to 30.

Corazzini et al. [2015] summarizes the equilibria associated with the multiple threshold public good game before focusing on a setting with homogeneous players. It shows that two type of equilibria exist: (i) a "no contribution" equilibrium in which $c_{n,j} = 0$ for all n and j, and (ii) many equilibria in which agents successfully fund a public good by collectively contributing an amount to it equal to the threshold while providing no contributions to any other good. For this later case, given our experimental parameters, any combination of contributions such that $c_{\bar{n},j} \leq y_j$, $C_n = \sum_j c_{\bar{n},j} = 132$, and $c_{n',j} = 0$ for $n' \neq \bar{n}$ constitutes an equilibrium.

The threshold public goods framework is effectively a coordination game played between the individual agents. Achieving an equilibrium that involves the successful funding of a public good requires coordination on both the selection and amount. Each agent wants to coordinate their contribution on the public good that is also receiving contributions from others. Furthermore, each agent wants to contribute the amount necessary to make up the differences between the threshold and the total contributions of the other agents. The parameters ensure that each agent always prefers to "do their part" to ensure that a public good succeeds, when they can afford to do so given their endowment, rather than not contribute and let the public good fail.

We can consider how the introduction of donor heterogeneity in both endowment and preferences influences the likelihood that groups succeed in funding a public good, and how both the selection of which public good receives funding and differences in contributions across individuals depend on differences in individual ability to pay and willingness to pay for the implemented

public good. These are primarily empirical questions, as the many theoretical equilibrium of the game permit a broad set of feasible outcomes. The successful funding of any of the public goods is consistent with equilibrium; as is no funding to any of the goods. Additionally, any feasible distribution of contributions across agents such that total contributions reach the threshold is consistent with an equilibrium of the game.

2.2 Testable hypotheses

Neither the equilibrium concept nor common refinements tell us which of the many equilibria are most likely to occur. Rather, the strategic setting is a complex coordination game played among the agents, where the outcome is a Nash Equilibrium only when all four players choose strategies that are consistent with the same equilibrium. In such settings, playing the game multiple times can allow group members to adjust their contributions in response to the observed behavior of others in order to increase the likelihood of coordination in later rounds of interaction.[4] Furthermore, the presence of focal points may draw the group's collective attention towards some outcomes, increasing the likelihood of certain outcomes occurring relative to others.[5]

The experiment allows us to explore alternative hypotheses involving coordination in a heterogeneous threshold public goods environment. In particular, we explore concepts related to how heterogeneity influences coordination.[6] This includes considering which public goods receive contributions and how contributions differ across agents.

The first hypothesis considers whether the preferences of the wealthiest donor may serve as a focal point, making one of the public goods stand out from the others. Mutual recognition that the groups attention may focus on the good preferred by the wealthiest agent may pull contributions to that good. In particular, this possibility is consistent with an implicit pro-rich bias in society that has been documented in the psychology literature [e.g., Fiske, 2010, Mattan and Cloutier,

[4]The finitely repeated nature of the interaction adds additional equilibria during early rounds of play. The analysis, however, is primarily interested in which outcomes players converge to in the later interactions. An outcome of the final round of interaction is consistent with the subgame perfect equilibrium of the repeated game only if it is a Nash Equilibrium of the one shot game.

[5]Starting from Scholling [1960], a large number of papers has documented focal points can facilitate coordination in strategic settings with at least partially aligned preferences. Corazzini et al. [2015] provides a discussion of focal points specific to multiple threshold public goods games, and report experimental findings that are generally consistent with the theory of Harsanyi and Selten [1988] who posit that groups will focus on either payoff dominant outcomes or risk dominant outcomes (which corresponds to no contributions in our experiment). Devetag and Ortmann [2007] summarize the broader literature and when coordination is more likely on efficient versus risk dominant outcomes. Mehta et al. [1994], Bardsley et al. [2010], and Crawford et al. [2008], among others, show how the decision context and asymmetries across payoffs can affect the emergence of focal points, and the processes and attitudes within groups in coordination games.

[6]The experimental study was preregistered in OSF (https://doi.org/10.17605/OSF.IO/BRQVX). The only prediction that was not preregistered is Hypothesis 3, which was added to facilitate readability. Similarly, for expositional reasons, we implemented some changes in both wording and format of the hypotheses with respect to those initially preregistered, of course keeping unchanged their content.

2020].

Hypothesis 1. *With heterogeneous endowments and preferences, groups tend to coordinate their contributions on and are more likely to successfully fund the public good that is preferred by the agent with the highest endowment.*

There are three features of our experiment that justify the validity of this initial hypothesis. First, the values of the bonuses and the level of the threshold are set in a way that any symmetric or asymmetric equilibrium in which heterogeneous agents successfully contribute above the threshold payoff-dominates the zero-contribution profile. This means that, independently from their specific preferences over the public goods, their initial endowments, and the amounts allocated to the funded public good, group members are always better off in successfully coordinating on one public good than in the zero-contribution equilibrium in which no public good is funded.[7] Second, introducing heterogeneous endowments changes the relative weights of the four group members (who respectively hold 15.45%, 21.82%, 28.18%, and 34.55% of the overall group endowment in the experiment) and makes the ability of the group to reach the threshold strongly contingent on the contribution choice of the wealthiest subject, potentially making coordination easier in groups where the wealthiest individuals work towards that goal.[8] Third, given the importance of the contribution of the wealthy for the group to reach the threshold of a public good, her preferences over the alternatives become pivotal, as it is reasonable to expect, especially in early periods, that she will allocate resources to the public good assigning the highest bonus to her.

The next two hypotheses concern how the distribution of contributions depends on individual characteristics. The experiment allows us to distinguish between alternative models of group coordination that drive the contributions of the individuals in equilibrium. Specifically, we consider the possibility that individual differences in contributions account for the differences in endowments and preferences across the groups, with those who have larger endowments or who

[7] Consider the limit situation of a wealthiest agent in an asymmetric equilibrium in which (i) the agent contributes her endowment entirely to a "non-selected" public good and (ii) the group successfully reaches the threshold of that good. In this situation, the wealthiest agent earns 152 points, exactly as much as she could have obtained by deviating and allocating her endowment to the private good. Apart from this extreme case, all group members, independently from their preferences over public goods and their initial endowments, obtain strictly higher payoffs in any of the symmetric or asymmetric equilibria in which the threshold is reached than in the zero-contribution profile.

[8] Indeed, when group members differ in the amount of resources they can potentially allocate to the public goods, there are many asymmetric equilibria in which the wealthiest subject, whose endowment alone accounts for around 58% of the threshold, contributes more than the other group members. In addition, although there still exist equilibria in which the wealthiest subject contributes less than the others and the threshold is reached, it is very unlikely that these contribution profiles will be effectively observed, as they require the remaining three group members to allocate too large shares of their endowments to the same public good. For instance, any asymmetric equilibrium in which one public good is successfully funded and the wealthiest agent contributes nothing requires the remaining three group members to allocate around 92% of their overall endowment to the public good.

receive larger benefits from the funded good providing larger contributions compared to others. The conjecture on the positive relationship between endowments and contributions follows from the considerations advanced for the first hypothesis and the large evidence reported by previous studies considering a setting with a single public good. In turn, when preferences over the multiple public goods are heterogeneous, over-contributing to one's preferred alternative represents a reasonable strategy to pull other group members' contributions to the same option in later periods.

Hypothesis 2. *Ability-to-pay driven contributions – Agents with higher endowments tend to contribute more than agents with lower endowments to successful public goods.*

Hypothesis 3. *Willingness-to-pay driven contributions – An agent that receives a higher bonus from a successful public good tends to contribute more to that good than other agents.*

We will test the two hypotheses in isolation, analyzing the contribution patterns in two settings, one with only endowment differences and one with only preference differences. Then, we will assess the relative importance of ability-to-pay and willingness-to-pay in a treatment where there are both the dimensions of agent heterogeneity, and to what extent the two individual characteristics explain the observed contribution differences across agents.

Finally, we consider the extent to which agent heterogeneity influences the likelihood that groups successfully fund a public good. In our settings, introducing either or both preference and endowment heterogeneity do not change the general nature of the many equilibrium outcomes of the game. However, both types of heterogeneity add to the complexity of the strategic environment, the effect of which is likely to depend on the type of heterogeneity added and whether that heterogeneity introduces potential mechanisms or focal points to help facilitate group coordination.

Preference heterogeneity alone introduces a source of disagreement among agents. Also, it decreases the modal payoff associated with achieving coordination.[9] These components may decrease the perceived probability of successful coordination and discourage agents from contributing to any public good. At the same time, preference heterogeneity adds nothing to the environment that is expected to serve as a common focal point for the group and help facilitate coordination. Thus, we expect introducing preference heterogeneity alone to reduce the likelihood of coordination among groups.

Now consider the implications of introducing endowment heterogeneity alone. There are reasons to think that the coordination problems under endowment heterogeneity could be less severe

[9] Average payoffs from coordination remain constant, as one player sees and increase in payoffs and the other three players see a decrease in payoffs.

than under preference heterogeneity. Here, endowment differences do not lead to disagreements within the group about which good is best. There is greater complexity to the game, but there may also be collective expectations about the wealthiest agent being more responsible for contributing to the goods, potentially reducing free-riding problems and encouraging coordination. It is unclear whether the net effects of endowment heterogeneity is more likely to increase or decrease coordination; as such we adopt a null hypothesis of no change.

Finally, consider the situation in which both sources of heterogeneity are simultaneously introduced. In this case, in line with the previous hypotheses, the disagreement that is due to differences in preferences over the alternative public goods is compensated by the fact that the public good preferred by the wealthy stands out as a viable coordination device for the group members. In this case, we expect coordination to increase.

Hypothesis 4. *Introducing preference heterogeneity in a setting with homogeneous endowments complicates the strategic environment faced by group members and, consequently, reduces coordination and profits relative to the other treatments. Combining preference heterogeneity with endowment heterogeneity facilitates coordination by enhancing salience on the public good preferred by the wealthiest agent.*

In addition to these formal hypotheses, we explore how heterogeneity affects the dynamic patterns of contributions that emerge across periods. In particular, we consider the relationship between early period contributions and later period contributions, and how such patterns may be affected by agent heterogeneity.

3 Experimental Design

Our experiment introduces donor heterogeneity in endowments and preferences into a threshold public goods game with multiple viable alternatives. The experiment includes four distinct treatments using a between subject design:

- *P&E_Diff Treatment* - There is donor heterogeneity in both preferences (in terms of the bonuses realized from successfully funding a public good) and endowed income.
- *P_Diff Treatment* - There is donor heterogeneity only in preferences. All subjects are assigned the same endowed income.
- *E_Diff Treatment* - There is donor heterogeneity only in endowed income. All subjects are assigned identical payoff functions for each of the public goods.
- *Homogeneous Treatment* - There is no donor heterogeneity, with all subjects assigned identical payoff structures and endowments. This treatment is similar in structure to previous multiple threshold public goods experiments.

Treatment *P&E_Diff* may be considered our main treatment, as it allows us to explore public good selection in a setting of income inequality and differences in preferences over which public goods should be prioritized. Only in this treatment are the public goods distinguishable form one another in a qualitative way: each public good is preferred by a single agent, who can be rank ordered in terms of their endowment. All agents know which public good corresponds to the largest endowment, which to the second largest, and so on.[10] With no other distinguishing features across public goods, agents may rely on the aligned agent's wealth as a focal point in determining to which of the public goods to contribute. Therefore, we use *P&E_Diff* to explore who's public good receives funding and how groups emerge to split the costs of public good funding.

Treatments *P_Diff* and *E_Diff* allow us to further explore questions regarding the division of funding obligations across heterogeneous individuals, determining the extent to which differences in contributions are driven by differences in individuals' ability to pay versus differences in their willingness to pay for the implemented public good. Treatment *Homogenous* provides a baseline against which to compare the other treatments to determine how heterogeneity influences total funding and the rate of public good success.

A total of 240 subjects participated in the experiment, with 60 individuals participating in each of the 4 treatments. For each treatment, we run 5 sessions with 12 subjects divided into unchanging groups of 4 people. This implies that, for each treatment, we collected data on 15 independent groups. Each group interacted for 12 sequential periods, in each period playing a threshold public good game with each other. Between periods, participants received feedback about their group's contributions during the previous period.

At the beginning of each experiment, group members are assigned an endowment level, which represents their budget in each period. Total endowments across all individuals equal 220 token in each period of each treatment, but the distribution of these tokens across individuals depends on the treatment. In each period of each treatment, each subject simultaneously chooses how much of their individual endowment to contribute to each of eight available public goods. Any amount of their endowment that they do not contribute to a public good goes into a private account, which provides an individual payout of two points per token at the end of the experiment. Any amount contributed to a public good potentially provides a benefit to each group member, but only if total contributions to that public good reached the threshold of 132 tokens (60 percent of the total group allocation) in a given period. If the total number of tokens contributed

[10] In the other treatments, no such distinction between public goods is possible. Either they are equally preferred by all agents (in the treatment with only endowment heterogeneity or the treatment with no heterogeneity), or they are individually preferred by indistinguishable agents (in the treatment with only preference differences).

by the group to a collective account is lower than 132, then the subjects do not receive any points from that account, and contributions to that account are forfeited. If the overall number of tokens contributed to a collective account is at least 132, each group member receives one point for every token contributed into that account plus an additional bonus. When we introduce preference heterogeneity, it will come through differences in the size of the individual bonus subjects receive with the success of different public goods.

3.1 Treatment *P&E_Diff*

In the full heterogeneity treatment, participants are randomly assigned an endowment level and preferred public good.

Endowment differences: The four subjects within a group are randomly assigned to the four income levels (34, 48, 62, or 76), which defines the endowment they receive in each of the 12 sequential periods of play. The total group endowment is 220. A subject's initial assignment remains unchanged throughout the 12 periods. The endowment distribution used in the experiment presents a relatively large variance, with the highest endowment in the group more than doubling the one assigned to the poorest group member.

Preference differences: Each of the four subjects is assigned a different one of the eight available public goods to be the 'preferred' alternative throughout the experiment. We refer to the four public goods preferred by the group members as the 'selected' goods, while the remaining alternatives are simply indicated as 'non-selected'. When contributions to a subject's preferred good reach the threshold in a period, that subject receives a bonus payment of 39 points, and the three other group members receive bonus payments of 27 points. This bonus payment is in addition to the uniform payout to all group members equal to one point per token contributed to that good's account in that period. If one of the four non-selected public goods is funded at or above its threshold, then each subject receives a uniform bonus of 20 points in that period, plus the payout of one point per token contributed to that good. Each subject's endowment and preferred good is observable by the other group members.

The differences in bonus payments represent a relatively small-magnitude difference in preferences. If, for example, the public good preferred by one subject is funded at its threshold, that good will return a total payout of 171 points to one subject that prefers it and a payout of 159 points to each of the other group members. It should be clear that subjects prefer to coordinate their contributions on a selected public good and reach the threshold, even if coordination takes place on a public good preferred by one of the other subjects.

3.2 Homogeneous donor and one-dimensional heterogeneity treatments

In treatment *Homogeneous*, all four donors in each group have the same endowment (55 tokens) each period and share preferences over the public goods. In this treatment, four of the public goods are 'selected' goods, any of which will provide a uniform bonus of 30 points plus one point for each contributed token to each of the four group members in any period in which it reaches its threshold of 132 tokens. If one of the other four ('non-selected') goods has total contributions above its threshold, the bonus from that good is only 20 points combined with one point per contributed token. The bonuses are calibrated so that the total group bonus across all four groups members is the same as for the four preferred goods in the *P&E_Diff* treatment.

The *Homogeneous* treatment is most similar to the baseline treatment in Corazzini et al. [2015], where homogeneous donors faced four public goods none of which stood out as strictly preferred for the group. In this environment, the multiplicity of reasonable donation options makes coordination among donors more difficult to achieve compared to the case of a single public good.[11] In the homogeneous treatment, four goods stand out as equally reasonable options.

Additionally, we run both *E_Diff* and *P_Diff* treatments, which represent environments in which only one source of donor heterogeneity is present. In *E_Diff*, donors differ in their endowments in the same way they did in the heterogeneous donor treatment but have the same preferences in the way that they did in the homogeneous donor treatment. In *P_Diff*, donors have the same endowments as in the homogeneous donor treatment but differ in their preferences as in the heterogeneous donor treatment.

3.3 Procedures

The experiment was run in February 2021. In accordance with COVID-19 lockdown restrictions, all sessions were run online in a "lab-on-the-web" environment [Buso et al., 2020]. In particular, in order to participate in the experiment, subjects were required to join a Zoom session from a computer with a well-functioning internet connection, webcam, microphone, and audio. They were also asked to connect from an isolated and quiet room and to remain seated throughout the experiment. At their arrival, subjects were initially moved to a virtual waiting room that guaranteed their anonymity. Subjects accessed the virtual welcome room one by one, keeping their microphone and webcam switched on. After ascertaining participants' identity and checking the quality of their digital infrastructure, experimenters disabled subjects' webcam and microphone

[11] Corazzini et al. [2015] showed that the coordination problems that arise from the multiplicity of public goods is reduced if one of the goods stands out as the best available option for all donors. Such an alternative environment would leave little room for endowment or preference differences to improve coordination across goods.

and made their zoom profiles entirely anonymous by removing any possible distinctive element (such as pictures, colors, initials) and assigning a random identification number. Then, subjects were moved to the experimental room, and, in case of necessity, they could communicate through the zoom chat. In particular, the chat allowed subjects to send private messages to the experimenter only, being any further possibility to interact with the other participants disabled.
At the beginning of the experiment, experimenters shared their video and read the instructions aloud (the English translation of the instructions in *P&E_Diff* is included in the appendix). Before the first period started, subjects were asked to answer control questions at their terminal. When necessary, answers to the questions were privately checked and explained through the chat. At any time during the experiment, subjects had the possibility to click a button and access a table summarizing the main instructions of the experiment.

At the beginning of each period, the computer showed each subject nine boxes, one for the private account and eight for the collective accounts. In order to avoid frame effects, the eight collective accounts were presented to subjects using neutral color names. Moreover, the order in which the collective accounts appeared on the screen was randomly determined by the computer for each subject. Finally, each of the eight boxes of the collective accounts showed the threshold and the size of the corresponding bonus. Given the nine boxes, in each period, every subject chose how to allocate her endowment entirely over the alternative accounts.

In treatments with heterogeneity, the assignment of endowments and preferences was common knowledge. In particular, at the beginning of each session, subjects were randomly assigned one of four letters, either A, B, C, or D. In *E_Diff* and *P&E_Diff*, the order of the letters matched the order of the endowments, with A and D being respectively associated with the lowest (34 tokens) and highest (76 tokens) endowments. To facilitate subjects' assimilation of the information, a summary table reporting, for each letter, the corresponding endowment and, in *P&E_Diff* and *P_Diff*, the corresponding preferred collective account was included in the screen used by subjects to make their choices.[12]

In order to enhance comparability across treatments and rule out potential framing effects that are related to the particular color distribution used in the experiment, we kept the assignment of colours to the selected and non-selected public goods to each group unchanged across sessions. This feature of our experimental design allowed us to compare, group by group, the coordination rate and the contribution to the type-specific preferred public goods in *P&E_Diff* and *P_Diff* to the corresponding benchmarks in *E_Diff* and *Homogeneous*.

At the end of every period, each subject was informed about the number of tokens allocated by the group to (each of) the collective account(s), whether the corresponding threshold was

[12] A picture of the choice screen used in *P&E_Diff* is included in the appendix.

reached, and any bonus paid. Additionally, following each period, subjects learned the number of points they received from each account and in total. At the end of the experiment, subjects were privately paid using a payment rate of one euro per 100 points.

On average, they earned 11.42 euros for sessions lasting about 90 min, including the time for identification, instructions, and a post-experimental questionnaire. All payments were made through PayPal. Participants were drawn from the subject pool of the VERA-lab of the University of Venice, "Ca' Foscari" (Italy), including more than 2,500 subjects. Participants were mainly undergraduate students in Economics, Management, Language Studies, and Philosophy, and they were recruited using ORSEE [Greiner, 2015]. The experiment was computerized and executed online employing z-Tree Unleashed [Duch et al., 2020].

4 Experimental Results

The analysis of the experimental data proceeds in three steps. First, we look at how groups coordinate their contributions over the alternative public goods. This allows us to test whether, as stated in Hypothesis 1, subjects in *P&E_Diff* coordinate their contributions on the public good preferred by the wealthy. Second, we study how group members split the cost of funding a public good and assess the empirical validity of the ability-to-pay and the willingness-to-pay hypotheses (2 and 3) in the three treatments with agents' heterogeneity: *E_Diff*, *P_Diff*, and *P&E_Diff*. Third, by focusing our attention on the treatments with endowment heterogeneity, *E_Diff* and *P&E_Diff*, we illustrate the implications of the two contribution drivers on welfare inequality within the group. Finally, we assess differences across treatments in coordination, contributions, and individual profits to assess the effects of the different sources of heterogeneity on group performance. In this respect, our main goal is to test whether, as stated by Hypothesis 4, introducing preference heterogeneity alone, by enhancing disagreement across group members, reduces coordination and cooperation.

In the statistical analysis, we use both non-parametric and parametric techniques. The non-parametric tests are based on 15 independent observations at the group level per treatment. Similarly, in order to account for potential dependence across periods, the estimated coefficients in the parametric regressions are based on standard errors clustered at the group level.

4.1 To which public goods do group members contribute?

For each treatment, Table 1 reports the proportion of successful contributions to selected and non selected public goods over all periods.

Table 1: Contributions and coordination on public goods: descriptive statistics.

	Homogeneous	*P_Diff*	*E_Diff*	*P&E_Diff*
Coordination on Selected PGs	0.500	0.344	0.539	0.567
PG preferred by A	0.211	0.161	0.156	0.017
PG preferred by B	0.050	0.150	0.089	0.000
PG preferred by C	0.039	0.000	0.028	0.006
PG preferred by D	0.200	0.033	0.267	0.544
Coordination on Non-Selected PGs	0.000	0.000	0.000	0.000
$Obs.\ (per\ treatment)$	180	180	180	180
Total Contribution	32.474	29.435	32.169	34.022
	(19.722)	(21.608)	(22.696)	(23.766)
Contribution to Selected PGs	31.200	28.574	31.674	33.519
	(20.171)	(21.525)	(22.649)	(23.879)
Contribution to Non-Selected PGs	1.274	0.861	0.496	0.503
	(6.975)	(5.385)	(3.369)	(3.151)
$Obs.\ (per\ treatment)$	720	720	720	720

Notes. This table reports, for each treatment, the proportion of successful coordination on selected and non-selected public goods, as well as on each of the four selected public goods according to preferences of the subject-types. Since the color assignment of the public goods has been kept unchanged across treatments, the preferred alternatives in *Homogeneous* and *E_Diff* are defined by matching the color of the corresponding benchmarks in the two treatments with heterogeneous preferences, *P_Diff* and *P&E_Diff*. The table also reports the mean (total) contribution (standard deviations are reported in parentheses) to all public goods, as well as what contributed to the selected and the non-selected alternatives separately.

P&E_Diff is the treatment with the highest coordination rate (56.7%), followed by *E_Diff* (53.9%), *Homogeneous* (50.0%), and, finally, *P_Diff* (34.4%). In all treatments, successful coordination exclusively occurred on one of the selected public goods. In line with this result, contributions to selected public goods are significantly higher than what was allocated to non-selected alternatives (according to a two-sided Wilcoxon signed-rank, $p < 0.001$ in all treatments).

Table 1 also shows the distribution of successful coordination over the four selected public goods in every treatment. Conditional on having reached the threshold, group members in *P&E_Diff* coordinate their contributions on the public good preferred by the wealthiest subject, D, around 96% of the times, with this proportion being higher than in any other treatment (ac-

cording to a two-sided proportion test, $p < 0.001$ for any pairwise comparisons between *P&E_Diff* and the other treatments in the proportion of coordination on the public good preferred by D).

To further validate this result, Table 2 unpacks, for each type of subject in *P&E_Diff*, the mean contribution to each of the four selected public goods. Note again, subject A has the lowest endowment, and subject D has the highest.

Table 2: Type-specific contributions to the selected public goods in *P&E_Diff*.

	P&E_Diff			
	A	B	C	D
PG preferred by A	2.522	2.250	2.828	2.422
	(7.277)	(8.519)	(9.841)	(10.446)
PG preferred by B	0.061	2.411	0.250	0.711
	(0.498)	(6.657)	(1.263)	(4.045)
PG preferred by C	0.361	1.356	4.372	1.372
	(2.032)	(4.300)	(13.396)	(6.401)
PG preferred by D	16.561	18.517	32.661	45.422
	(13.969)	(17.706)	(24.599)	(30.061)
$Obs.$	180	180	180	180

Notes. This table reports, for each subject-type, the mean contribution (standard deviations are reported in parentheses) to the four selected public goods in *P&E_Diff*.

The public good preferred by the wealthiest subject attracts the contributions of other group members. Indeed, all types of subjects contribute significantly more to the public good preferred by D than to any of the remaining three selected public goods (according to a two-sided Wilcoxon signed-rank test, when comparing the amount contributed to the public good preferred by D to any other alternative, $p < 0.010$ for each type of subject), indicating that A, B, and C are willing to give up from their own preferred public good to reach coordination on one alternative. The salience of the public good preferred by D is observed only when preference heterogeneity is combined with endowment heterogeneity. Indeed, compared to *P&E_Diff*, contributions in *P_Diff* follow a less polarized pattern as (i) groups tend to equally coordinated on two selected public

goods, the one preferred by A and the one preferred by B, and (ii) the distribution of type-specific contributions over selected public goods is more sparse than in *P&E_Diff*.

Result 1. *In P&E_Diff, all subject-types contribute substantially more to the public good preferred by the wealthiest group member than to any other alternative.*

Result 1 continues to hold when focusing on the first period only, thus when ruling out the potential effect of repetitions on coordination and the possibility that the wealthiest agent uses her early contribution choices to signal the alternative to support in later periods to the rest of the group. Indeed, by restricting the attention to the contribution choices of subjects A, B, and C (thus excluding the wealthiest group member, D) in the first period, a two-sided Wilcoxon signed-rank test confirms that the contribution to the public good preferred by D (42.33 tokens), is significantly higher than what contributed to the alternative preferred by A (11.40, $p = 0.012$), by B (7.80, $p < 0.01$), or by C (23.07, $p = 0.088$), respectively. Consistently with the previous empirical observation, we also find that the number of group members (excluding D) contributing at least one token to the public good preferred by D in the first period (40) is significantly higher than the corresponding number associated with the alternative preferred by A (25, $p = 0.062$), by B (17, $p < 0.01$), or by C (23, $p < 0.01$).

These findings corroborate the empirical validity of Hypothesis 1, whereby in *P&E_Diff* the public good preferred by the wealthiest subject represents an effective coordination device for the rest of the group. Other empirical observations provide further insight to understand the dynamics of successful contributions in the four treatments. First, we find strong path dependence in coordination, as group members keep going on contributing to the same public good on which they reached coordination in early periods. Indeed, of the 60 groups in the experiment, 9 (15.00%) never reached coordination, 49 (81.67%) are non-switching and reached coordination always on the same alternative across periods, and only 2 (3.33%) switched coordination from one public good to another during the 12 periods.[13]

Second, group members amply use the signalling power of "unsuccessful" contributions (not allowing the group to reach the threshold) in early periods to select the alternative to coordinate on in later periods. Indeed, by focusing on the non-switching groups, subjects reach coordination on the public good that attracted the highest level of contributions in the first period (occurring, respectively, in 76.92%, 85.71%, 84.62%, and 44.44% of the groups in *P&E_Diff*, *E_Diff*, *Homoge-*

[13]Interestingly, the two switching groups exhibited a relatively low ability to successfully coordinate contributions during the experiment. The first group participating in *P&E_Diff* reached coordination in 6 periods (5 on one public good and 1 on another alternative), while the second group participating in *P_Diff* reached coordination in (only) 3 periods. Among the 9 groups that never reached coordination, 5 participated in *P_Diff*, 2 in *Homogeneous*, 1 in *E_Diff*, and 1 in *P&E_Diff*.

neous, and *P_Diff*). The evidence becomes even stronger when focusing on the second period (occurring, respectively, in 92.31%, 85.71%, 66.67%, and 100% of the cases in *P&E_Diff*, *E_Diff*, *P_Diff*, and *Homogeneous*).

4.2 How do groups effectively split the costs of public goods?

The results presented in the previous section describe to which public good subjects coordinate. We now answer to the second question, namely how group members split the cost of successfully funding a public good. In particular, our interest focuses on the empirical validity of Hypotheses 2 and 3 that identify the ability-to-pay and willingness-to-pay as the main drivers of individual contributions in the treatments introducing heterogeneity.

Endowment heterogeneity does not necessarily imply that wealthy subjects contribute more than less-wealthy group members. Indeed, as discussed in the theoretical section, treatments with endowment heterogeneity always admit a symmetric equilibrium profile in which everyone contributes the same amount. Moreover, since the sum of the endowments of A, B, and C is greater than the threshold, there exists a large number of equilibria in *E_Diff* and *P&E_Diff* in which the wealthiest subject, D, contributes nothing. Nevertheless, as argued above, the (perceived) need to have those disposing of larger shares of the group endowment to make their part to reach the threshold on one public good puts forward Hypothesis 2 conjecturing the existence of a positive relationship between subject's contribution and the level of her endowment.

Moving to the second driver, Hypothesis 3 suggests that, in treatments with preference heterogeneity, a subject is willing to contribute more when her group members successfully coordinate contributions on her preferred alternative. In other words, we conjecture the existence of a positive relationship between the size of the bonus assigned by the financed public good to a subject and her total contribution.

Table 3 parametrically investigates the determinants of individual total contribution in *E_Diff*, *P_Diff*, and *P&E_Diff* when focusing on the groups that exhibited high ability to coordinate over the 12 periods of the experiment. Specifically, for each treatment, we denote by HC groups the groups that successfully coordinated for a number of periods that is above the median in the treatment. Reversely, LC groups are groups that successfully coordinated for a number of periods that is below the median in the treatment. The appendix shows that the analysis in Table 3 is robust to the inclusion of LC groups in the analysis.[14]

[14]Tables A.1, A.2, and A.3 in the appendix replicate the parametric analysis in Table 3 (i) by including all groups, and (ii) by replacing the individual overall contribution with the amount contributed to the funded public good as the dependent variable. These robust checks confirm almost entirely the results reported in Table 3.

Table 3: Determinants of total contributions in HC groups in *E_Diff*, *P_Diff* and in *P&E_Diff*: parametric results.

	E_Diff		*P_Diff*		*P&E_Diff*	
Total contribution	(1)	(2)	(3)	(4)	(5)	(6)
Endowment	0.770***	0.793***			0.880***	0.853***
	(0.132)	(0.139)			(0.108)	(0.115)
Assigned bonus			0.274***	0.325***	0.366***	0.469***
			(0.051)	(0.073)	(0.048)	(0.059)
Last 6 periods		1.780		3.883		-3.197
		(5.080)		(2.724)		(4.739)
Endowment $\times$ *Last 6 periods*		-0.046				0.047
		(0.089)				(0.082)
Assigned bonus $\times$ *Last 6 periods*				-0.159		-0.137
				(0.113)		(0.134)
Constant	-4.426	-5.315	32.976***	32.073***	-17.663***	-16.257**
	(7.529)	(7.946)	(1.979)	(2.084)	(6.199)	(6.557)
ll	-1582.90	-1582.61	-1601.32	-1600.20	-1742.91	-1737.58
$Wald - \chi^2$	34.180	34.750	28.420	30.810	135.760	148.310
$p > \chi^2$	0.000	0.000	0.000	0.000	0.000	0.000
Obs.	384	384	384	384	432	432
N. groups	8	8	8	8	9	9

Notes. This table reports coefficient estimates (standard errors in parentheses) from two-way linear random effects models accounting for both potential individual dependency over periods and dependency within the group. The dependent variable is the total contribution made by the subject in a HC group to the eight collective accounts in the period. *Endowment* is the endowment in tokens of the subject. *Assigned bonus* is the bonus assigned to the subject by the funded public good. *Last 6 periods* is a dummy that takes a value of 1 in the last six periods of the experiment and 0 o/w. *Endowment* $\times$ *Last 6 periods* and *Assigned bonus* $\times$ *Last 6 periods* are interaction terms. Significance levels are denoted as follows: * $p < 0.1$, **$p < 0.05$, and *** $p < 0.01$.

For each treatment, we consider two different specifications. The first specification straightly tests the empirical validity of the ability-to-pay and the willingness-to-pay by including, respectively, subject's endowment and the bonus assigned to her by the funded public good. The second specification checks the robustness of the results over time by separately assessing the effect of the two contribution drivers in the first six and in the last six periods.

Columns (1) and (2) provide evidence in favor of the ability-to-pay hypothesis in *E_Diff*, as a higher endowment corresponds to a higher willingness to contribute. Specifically, the coefficient of *Endowment* is positive and highly significant in both columns ($p < 0.001$), just as it is the linear combination between *Endowment* and *Endowment* $\times$ *Last 6 periods* in the second column ($p < 0.001$). Therefore, the ability-to-pay is a strong determinant of individual contributions in *E_Diff*, and its effect is stable across the first and the second part of the experiment.

Similarly, columns (3) and (4) support the empirical validity of the willingness-to-pay hypothesis in *P_Diff*, suggesting that the subject is more willing to contribute when the funded public good is the alternative assigning her the higher bonus. The coefficient of *Assigned bonus* is positive and highly significant in both columns ($p < 0.001$). Again, the fact that also the linear combination between *Assigned bonus* and *Assigned bonus* $\times$ *Last 6 periods* in the fourth column is significant ($p = 0.061$) suggests that the effect of the willingness-to-pay persists, though at a lower extent, in the second part of the experiment. The loss of statistical significance in the last 6 periods can be ascribed to the fact that, once reached coordination, the subject benefiting the most from the funded public good no longer needs to signal it through her over-contribution.

P&E_Diff includes both sources of heterogeneity. Therefore, results reported in columns (5) and (6) allow us to separately identify the role played by the two drivers in determining subjects' contributions. Results confirm that both the willingness-to-pay and the ability-to-pay strongly determine individual contributions. In column (5), both the coefficients of *Endowment* and *Assigned bonus* are positive and highly significant (in both cases, $p < 0.001$). In line with the previous results, column (6) confirms that the effects of the two contribution drivers is highly significant in the first six periods (in both cases, $p < 0.001$), and remain so in the last six periods of the experiment ($p < 0.001$ for the linear combination between *Endowment* and *Endowment* $\times$ *Last 6 periods*, $p = 0.006$ for the linear combination between *Assigned bonus* and *Assigned bonus* $\times$ *Last 6 periods*).

These results suggest that successful groups divide costs in a highly progressive way. Specifically, those disposing of higher endowments makes substantially larger contributions, largely offsetting their endowment advantage. For instance, compared to a follow group member, an individual who has an extra 10 tokens of endowment tends to contribute 8.8 more tokens in *P&E_Diff* and 7.7 more tokens in *E_Diff*, respectively.

Additionally, the contribution patterns also largely offset differences in benefits received.

When a group converges to fund a public good that offers one subject a bonus of 39 and the other group members a bonus of 27 tokens, the subject with the 12 point bonus advantage tends to contribute, in each period, an extra 4.4 tokens from her original endowment relative to the other group members, again largely offsetting the bonus advantage.

We summarize the previous evidence in the following result, which in turn provides empirical support in favor of Hypotheses 2 and 3.

Result 2. *Both ability-to-pay willingness-to-pay determine subjects' contributions. The higher the endowment of the subject, the more she is willing to contribute. Similarly, the higher the bonus assigned to the subject by the funded public good, the more she is willing contribute.*

Figure 1 further confirms the positive relationship between subject's contribution and her endowment documented in the two treatments with endowment heterogeneity, *E_Diff* and *P&E_Diff*. In particular, the figure reports, for each treatment, the average contribution of each type of player in the HC groups across the 12 periods of the experiment.[15]

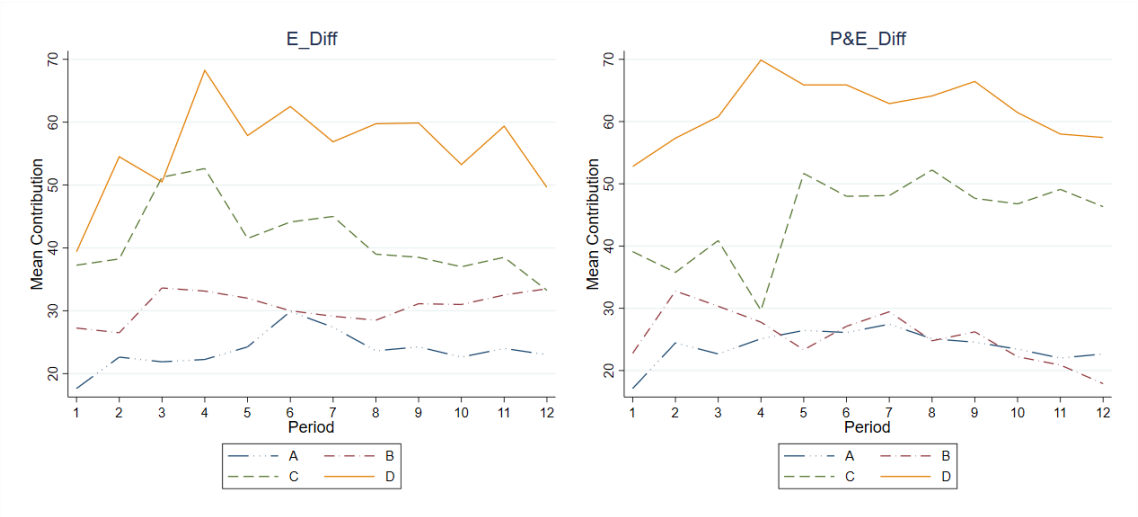

Figure 1: Total contributions in HC groups by subject-types in *E_Diff* and *P&E_Diff*.

There is a positive relationship between contributions and endowments in *E_Diff* and *P&E_Diff*, whereby the wealthiest subject, *D*, makes the largest contribution (61.907 in *P&E_Diff* and 55.979 in *E_Diff*), followed by *C* (44.611 in *P&E_Diff* and 41.354 in *E_Diff*), *B* (25.462 in *P&E_Diff* and 30.687 in *E_Diff*) and *A*, the poorest subject in the group (23.925 in *P&E_Diff* and 23.614 in *E_Diff*).

[15] In the appendix, we include two additional figures. Figure A.1 adds the corresponding graphs for the two treatments with no endowment heterogeneity, *Homogeneous* and *P_Diff*. No remarkable association between subject-types and contributions is documented in these two treatments. Interestingly, only in *Homogeneous* we observe a tendency of subject A to make larger contributions than the other group members. In figure A.2, we replicate the graphical representation by focusing on LC groups. In this case, the relationship between contributions and endowments in *E_Diff* and *P&E_Diff* appears much weaker than before.

In Table A.4 included in the appendix, we report parametric results confirming these descriptive evidence. Our estimates show that, in both treatments with endowment heterogeneity, the wealthiest subject D in HC groups makes significantly higher contributions than the other group members (for any pairwise comparison between D and the other subject-types, $p < 0.01$).[16]

Finally, in line with existing studies that analyze the effects of endowment heterogeneity in threshold public good settings [see for instance, Rappoport and Suleiman, 1993], the differences in individual contributions in *P&E_Diff* and *E_Diff* are associated with the fact that subject-types tend to contribute the same fraction of their endowment. Indeed, when considering individual contributions relative to the level of the endowment, differences across subject-types disappear in both *E_Diff* and *P&E_Diff*. The relative contributions in the HC groups are included between 0.530 (subject B) and 0.815 (subject D) in *P&E_Diff*, and between 0.639 (subject B) and 0.737 (subject D) in *E_Diff*, respectively. The only remarkable observation is that *B* in *P&E_Diff* contributes less than any other subject-type ($p < 0.10$ with respect to A; $p < 0.05$ with respect to C; $p = 0.002$ with respect to D). Any other pairwise comparison between subject-types does not yield significant results.

4.3 Welfare considerations in treatments with endowment heterogeneity

Together, Results 1 and 2 have important welfare implications for group members in the two treatments characterized by endowment heterogeneity. In *E_Diff*, the wealthiest subject contributes more than any other group member to successfully fund one public good. The higher propensity of the wealthiest subject to contribute, together with the fact that, in *E_Diff*, every group member receives the same payoff from the funded public good, imply that reaching the threshold on one alternative is not only beneficial for all group members, but also reduces within-group welfare inequality.

In *P&E_Diff*, the wealthiest subject potentially contributes more than the other group members not only because she has a higher endowment, but also because the contributions fund her preferred public good. This implies that the alternative preferred by the wealthiest agent becomes an effective coordination device for the other group members. Therefore, redirecting contributions to the public good preferred by the wealthiest agent gives the possibility to all group members, especially those endowed with limited resources, to benefit of the returns of a public good they would not have gained otherwise. In addition, the combination between the ability-to-pay and the willingness-to-pay of the wealthiest agent exacerbates the effects on welfare distribution

[16] Instead, estimates in Table A.4 show that there are no remarkable differences between the amount contributed by *D* and what contributed by the other subject-types in LC groups (only for the difference between *D* and *A* in *P&E_Diff*, $p = 0.066$; for any other pairwise difference, $p > 0.10$). For completeness, the table also reports estimates for the other two treatments with no endowment heterogeneity, *Homogeneous* and *P_Diff*.

within the group. Indeed, while the ability-to-pay moves in the direction of levelling out differences in welfare that are due to endowment heterogeneity, the willingness-to-pay mitigates the differences in welfare that are due to the fact that the wealthiest agent receives a higher bonus from the funded public good.

Table 4 parametrically studies the welfare distribution across group members in the two treatments with endowment heterogeneity, *E_Diff* and *P&E_Diff*. We consider a series of specifications that highlight how the welfare distribution changes when comparing HC groups with LC groups.

Table 4: Profits of the subject-types in *P&E_Diff* and *E_Diff*: parametric results

Profit	*P&E_Diff*	*E_Diff*
B	6.005	1.831
	(13.332)	(13.091)
C	19.405	10.386
	(13.332)	(13.091)
D	51.038***	54.525***
	(13.332)	(13.091)
HC	69.779***	61.976***
	(13.087)	(11.713)
$B \times HC$	15.359	16.301
	(15.954)	(16.191)
$C \times HC$	-6.708	19.319
	(15.954)	(16.191)
$D \times HC$	-32.924**	-31.338*
	(15.954)	(16.191)
Constant	93.621***	97.096***
	(10.593)	(9.278)
ll	-4151.09	-4164.84
$Wald - \chi^2$	59.79	82.22
$p > \chi^2$	0.000	0.000
Observations	720	720
Number of groups	15	15

Notes. This table reports coefficient estimates (standard errors in parentheses) from two-way linear random effects models accounting for both potential individual dependency over periods and dependency within the group. The dependent variable is the profit obtained by the subject in the period. *B*, *C*, and *D* are subject-types dummies. *HC* is a dummy that takes a value of 1 if the subject belongs to a *HC* group and 0 o/w. $B \times HC$, $C \times HC$, and $D \times HC$ are interaction terms. Significance levels are denoted as follows: * $p < 0.1$, **$p < 0.05$, and *** $p < 0.01$.

Estimates document three important results. First, in both *E_Diff* and *P&E_Diff*, and for every subject-type, profits are higher in HC groups than in LC groups (for *A*, *B*, and *C*, in both treatments, $p < 0.001$; for *D*, in both treatments, $p < 0.05$), thus confirming the positive effect on

welfare of successfully funding a public good.[17]

Second, in both treatments, every subject-type in HC groups obtains a higher profit than they would in the zero-contribution equilibrium (in all cases, $p < 0.001$). Instead, when focusing on LC groups, only *A* obtains significantly higher profits than what implied by the zero-contribution equilibrium ($p = 0.016$ in *P&E_Diff* and $p = 0.002$ in *E_Diff*).[18]

Third, as discussed above, reaching the threshold on the alternative preferred by the wealthiest agent is not only beneficial for all group members, but also reduces welfare inequality within their group. In line with this observation, when focusing on LC groups, in both treatments with heterogeneous endowments the profits of the wealthiest subject *D* turn out to be higher than what obtained by any other group member (in both treatments, $p < 0.001$ for the difference between *A* and *D*, and $p < 0.01$ for the difference between *B* and *D*; $p < 0.05$ for the difference between *C* and *D*). Instead, in HC groups, the only significant difference in profits is between *D* and the poorest subject *A*, while all the remaining pairwise comparisons between *D* and the other group members yield non significant results (in all cases, $p > 0.1$).[19]

Result 3. *In the two treatments with endowment heterogeneity, E_Diff and P&E_Diff, all group members benefit from successful coordination. Moreover, welfare inequality across members is much lower in groups experiencing strong coordination than in groups that perform poorly.*

The results on the welfare distribution is further confirmed when considering standard measures on income inequality. Specifically, we use data on subjects' profits to compute the Gini index for each group and in each period of the experiment. We find that, in both treatments with endowment heterogeneity, the Gini index is substantially lower in HC groups than in LC groups, suggesting that groups experiencing strong coordination tend to exhibit lower payoff inequality than groups performing poorly. Indeed, when focusing on *P&E_Diff*, the mean of the index decreases from 0.233 in LC groups to 0.131 in HC groups. Similarly, in *E_Diff*, the mean of the index passes from 0.242 in LC groups to 0.154 in HC groups.[20]

[17] According to a two-sided Mann-Whitney rank-sum test, $p < 0.01$ in all cases but for *D* in *E_Diff* for which $p < 0.05$.

[18] According to a two-sided Wilcoxon signed-rank, when focusing on HC groups: $p < 0.01$ for all subject types in *P&E_Diff*; $p < 0.05$ for all subject-types in *E_Diff*. When considering LC groups, $p > 0.1$ in all cases except for *A* ($p = 0.074$ in *P&E_Diff* and $p = 0.063$ in *E_Diff*).

[19] According to a two-sided Wilcoxon signed-rank, when focusing on HC groups, the payoff of *A* is significantly lower than the one of *D* ($p = 0.086$ in *P&E_Diff* and $p = 0.050$ in *E_Diff*), while $p > 0.1$ for all pairwise differences between *D* and the other subject-types in both *P&E_Diff* and *E_Diff*. When considering LC groups, in *P&E_Diff*, $p < 0.05$ for the differences between *D* and *A*, and between *D* and *B*, $p < 0.10$; for the difference between *D* and *C*. In *E_Diff*, for the difference between *D* and *A*, and between *D* and *B*, $p < 0.05$.

[20] According to a two-sided Mann-Whitney rank-sum test, $p < 0.01$ for the difference in *P&E_Diff* and $p < 0.05$ in *E_Diff*.

4.4 Coordination, contributions, and profits: differences across treatments

As a final step, we look at differences in contributions, coordination, and profits (defined as the overall final earnings obtained by each subject at the end of each period) across the four treatments. The first aim of the analysis is to test whether, as stated in Hypothesis 4, preference heterogeneity, when not combined with endowment heterogeneity, adds to the complexity of the environment and discourages coordination and cooperation.

Figure 2 shows the mean total contributions to the public goods, the proportion of successful coordination, and the mean profits in the four treatments over periods.

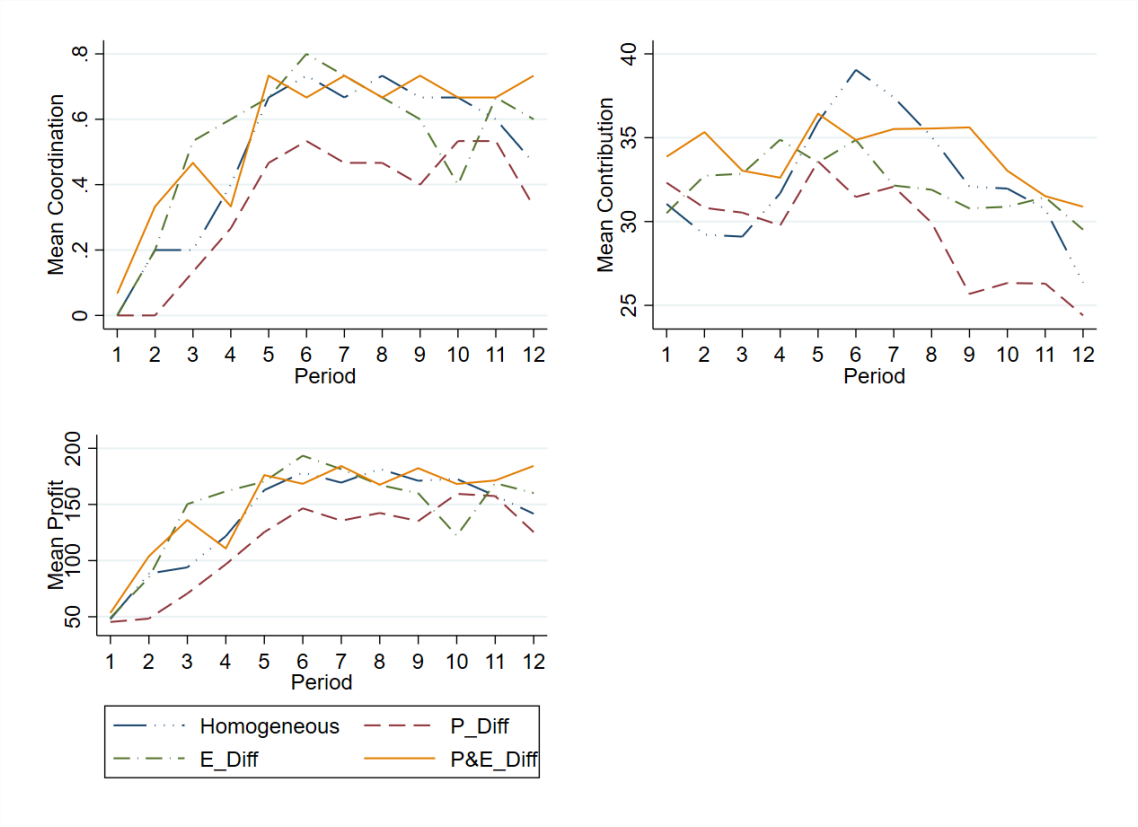

Figure 2: Coordination, contributions, and profits in the four treatments.

Apart from the low performance of *P_Diff*, we do not observe any remarkable difference in the three dimensions across treatments. Table 5 parametrically investigates the empirical validity of these preliminary observations.

Table 5: Coordination, contribution and profits in the four treatments: parametric results.

	Coord	*Coord*	*Total contribution*	*Total contribution*	*Profit*	*Profit*
	(1)	(2)	(3)	(4)	(5)	(6)
P_Diff	-0.157	-0.337***	-3.039	-6.707*	-24.928*	-30.515***
	(0.104)	(0.088)	(3.572)	(3.438)	(13.810)	(9.484)
E_Diff	0.039	-0.006	-0.304	-3.012	6.836	3.572
	(0.097)	(0.112)	(3.572)	(3.885)	(13.810)	(10.719)
P&E_Diff	0.067	-0.023	1.549	-4.929	9.914	4.890
	(0.099)	(0.115)	(3.572)	(4.102)	(13.810)	(11.316)
HC		0.384***		8.588***		55.969***
		(0.063)		(2.879)		(7.942)
P_Diff $\times$ *HC*		0.320***		9.086**		19.968
		(0.089)		(4.500)		(12.414)
E_Diff $\times$ *HC*		0.134		5.466		11.660
		(0.105)		(4.579)		(12.632)
P&E_Diff $\times$ *HC*		0.149		9.716**		7.536
		(0.112)		(4.720)		(13.023)
Constant			32.474***	27.321***	140.642***	107.060***
			(2.526)	(2.538)	(9.765)	(7.003)
ll	-488.06	-397.04	-12303.93	-12280.92	-16661.27	-16622.67
$Wald - \chi^2$	4.900	121.720	1.710	63.330	7.860	185.700
$p > \chi^2$	0.179	0.000	0.634	0.000	0.049	0.000
Obs.	720	720	2,880	2,880	2,880	2,880
N. groups	60	60	60	60	60	60

Notes. Columns (1) and (2) report the marginal effects from a probit regression (standard errors clustered at the group level in parentheses). The dependent variable is *coord*, a dummy that takes a value of 1 if the group reaches the threshold and 0 otherwise. Columns (3) - (6) 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 the group. The dependent variable in column (2) is the total contributions made by the subject to the eight collective accounts in the period. The dependent variable in columns (3) and (4) is the total contribution made by the subject to the eight public goods in a period. The dependent variable in columns (5) and (6) is the profit obtained by the subject in a period. *P_Diff*, *E_Diff* and *P&E_Diff* are treatment dummies. *HC* is a dummy that takes a value of 1 if the subject belongs to a *HC* group and 0 o/w. *P_Diff* $\times$ *HC*, *E_Diff* $\times$ *HC*, and *P&E_Diff* $\times$ *HC* are interaction terms. Significance levels are denoted as follows: * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

We use estimates in column (1) to perform pairwise comparisons between treatments in the ability to coordinate contributions on the same public good. We detect no significant differences between *Homogeneous* and any other treatment, or between *E_Diff* and *P&E_Diff* (in all cases, $p > 0.1$). The only significant differences are between *P_Diff* and *E_Diff* ($p = 0.065$), and between *P_Diff* and *P&E_Diff* ($p = 0.038$).[21]

In column (2) we add the dummy HC and the corresponding interactions with the treatment dummies to assess differences across treatments in HC and LC groups. When focusing on HC groups, we find that, relative to *Homogeneous*, subjects coordinate more in *E_Diff* ($p = 0.029$) and in *P&E_Diff* ($p = 0.06$), though in the second case the difference is only marginally significant. More importantly, we find that subjects in *P_Diff* exhibit a significantly lower attitude to coordinate with respect to *E_Diff* ($p = 0.019$) and *P&E_Diff* ($p = 0.041$). All the remainin pairwise comparisons yield non significant results ($p > 0.1$). Moving to LC groups, subjects in *P_Diff* coordinate significantly less than in any other treatment (in all cases, $p < 0.01$), thus confirming that combining heterogeneity in preferences with homogeneous endowment makes coordination more difficult to reach. We do not detect any other significant pairwise comparison.[22]

In column (3), we parametrically assess differences in contributions across treatments. We detect negligible differences as any pairwise comparison yields no significant results ($p > 0.1$ for the differences between *Homogeneous* the other treatments, between *P_Diff* and *E_Diff*, between *P_Diff* and *P&E_Diff*, and between *E_Diff* and *P&E_Diff*). When separately considering HC and LC groups in column (4), any pairwise comparison between treatments yields non significant results, with the only exception being represented by the marginal significant difference between *P_Diff* and *Homogeneous* ($p = 0.051$).

Finally, estimates reported in column (5) are used to compare treatments in the per period profits obtained by group members. In line with the conjecture that preference heterogeneity complicates coordination, we find that profits in *P_Diff* are lower than in any other treatment (with respect to *Homogeneous*, $p = 0.071$; to *E_Diff*, $p = 0.021$; to *P&E_Diff*, $p = 0.012$).[23] When focusing on *Homogeneous*, *E_Diff*, and *P&E_Diff* only, we document no significant pairwise differences (in all cases, $p > 0.1$).

In the last column of the table, we analyze differences in earnings across treatments by sep-

[21] According to a two-sided Mann-Whitney rank-sum test, the difference between *P_Diff* and *P&E_Diff* ($p = 0.054$) and between *P_Diff* and *E_Diff* ($p = 0.083$) remain marginally significant.

[22] According to a two-sided Mann-Whitney rank-sum test, the difference in HC groups between *P_Diff* and *E_Diff* ($p = 0.043$) and between *P_Diff* and *P&E_Diff* ($p = 0.057$) remain marginally significant. Instead, the coordination in LC groups is still significantly lower ($p < 0.05$) in *P_Diff* than both in *E_Diff* and in *P&E_Diff*.

[23] According to a two-sided Mann-Whitney rank-sum test, these differences remain significant: for the difference between *P_Diff* and *Homogeneous*, $p = 0.085$; for the difference between *P_Diff* and *E_Diff*, $p = 0.065$; for the difference between *P_Diff* and *P&E_Diff*, $p = 0.027$.

arately considering HC and LC groups. Starting from HC groups, we find significantly higher profits in *P&E_Diff* and *E_Diff* than in *P_Diff* (respectively, $p = 0.019$ and $p < 0.01$ in the two cases). We also detect marginally higher profits in *E_Diff* than in *Homogeneous* ($p = 0.08$). Results in LC groups better highlight the coordination problems associated with preferences heterogeneity. Indeed, we find that profits in *P_Diff* are significantly lower than in any other treatment ($p < 0.01$ for all pairwise differences). We do not find any other significant difference between treatments.[24] We summarize the previous results in the following statement.

Result 4. *Total contributions do not remarkably change across treatments. Relative to the other treatments, we detect lower coordination and lower profits in P_Diff, with this result being particularly evident in LC groups.*

As shown by the previous analysis, we do not detect remarkable differences in cooperation and coordination between *Homogeneous* and *P&E_Diff*. This evidence does not support the conjecture in Hypothesis 4, suggesting that the coordination benefits associated with the presence of a potential focal point may not dominate the challenges associated with increased complexity, or that the dynamics of coordination in *Homogeneous* did not provide much room for observable improvements in the frequency of coordination even with the addition of a focal point in *P&E_Diff*. If first period contributions themselves serve as a focal point for later period observations, then coordination after the first period may be just as likely in both *Homogeneous* and *P&E_Diff*, in which case the presence of a salient option in the first period primarily determines which public good succeeds, rather than a group's ability to achieve coordination.

5 Discussion

5.1 Philanthropic Giving

The preferences of the wealthy serve as a focal point enabling the broader donor base to consolidate their support on options where they expect their contributions are less-likely to be wasted.[25] Even though most donors would prefer the focus to be on a different opportunity, they recognize

[24] According to a two-sided Mann-Whitney rank-sum test, the difference in profits in HC groups between *P_Diff* and *E_Diff* ($p = 0.074$) and between *P_Diff* and *P&E_Diff* ($p = 0.043$) remain marginally significant. Instead, profits in LC groups are still significantly lower ($p < 0.01$) in *P_Diff* than both in *E_Diff* and in *P&E_Diff*.

[25] In this respect, our study is also related to the literature studying competition between charities for donations [e.g., Meer, 2017, Filiz-Ozbay and Uler, 2019, Perroni et al., 2019, Aldashev et al., 2020, Schmitz, 2021, Deryugina and Marx, 2021] and crowdfunding public goods and charitable projects [e.g., Hudik and Chovanculiak, 2018, Cason and Zubrickas, 2019, Petruzzelli et al., 2019, Argo et al., 2020, Cason et al., 2021, Foerster and van der Weele, 2021]. Nownes and Neeley [1996] shows how such considerations extend to political causes and how wealthier individuals may influence the political agenda through the formation of interest groups.

that their individual contributions will not unilaterally effect change unless coordinated with others.

In international development and global health, for example, the largest funders, such as the Gates Foundations with its roughly $47 billion endowment (or other large private foundations and western country donor organizations such as USAID), directly control which causes, projects, or approaches to support with their own funding. But, in doing so, they also indirectly steer the funds and efforts of other smaller foundations, organizations, or local governments who recognize that their own initiatives are more likely to succeed when they are aligned with the funding priorities of the larger donors. As McCoy and McGoey [2011] explain, "other donors look to the Gates Foundation in order to decide whether to fund a particular project or programme."[26] Our experiment shows how the tendency of groups to follow the preferences or actions of a the wealthiest donor may not only occur on the global scale, but also applies in more-localized or smaller-scale giving.

Although we see no evidence in our experiment that the effect makes any donors worse off, it does reduce the variety of public goods that receive contributions and successfully reach their funding thresholds. In real world donation environments, this reduction in variety could have important implications for social welfare, if for example the preferences of the wealthiest donors are not representative of the broader needs of society. For example, this could be the case if donor preferences are driven by visibility or financial interests (or potentially national strategic interests in the case of USAID) rather than the needs of society as a whole, including non-donors and marginalized groups. Such possibilities are discussed in surveys of wealthy donors [e.g., Konrath and Clark, 2020, Steuerle et al., 2018, Andrews et al., 2020] and political economy assessments of aid organizations [e.g., Rahman and Giessen, 2017].

5.2 Policy Influence

Substantial research and policy debate has considered how various policies and institutional reforms, from restrictions on campaign contributions to improved oversight, may reduce the policy bias in favor of the rich by reducing their ability to use their wealth to exert influence, rent seek, engage in government capture, or distort public opinion [e.g., Cotton, 2009, 2012, Prat, 2002, Coate, 2004, Hummel et al., 2021, Gulzar et al., 2021]. This raises a question: If we reform institutions to eliminate the channels through which the rich use their financial advantage to exert influence, will this eliminate the policy bias in favour of the wealthy?

[26] Kessler et al. [2019] show how rich donors give more when they have more control over how the money will be used. See also Orbinski [2009], Rushton and Williams [2011], Faubion et al. [2011], Marquis et al. [2013], Birn [2014], Martens and Seitz [2015] and Smith et al. [2015].

Our experiment eliminates the opportunities for corruption, rent seeking, and institutional capture, and shows how groups still implement policy that favours the wealthiest group members. This has several implications for the broader literature. It suggests that an observed bias in favour of the richest interests is not necessarily an indicator of corruption or government capture. Rather, the policy bias in favour of the rich may emerge naturally in groups attempting to work together to support the social good, as groups look to the wealthiest members for an indication of the policies or public goods to collectively pursue. Such a focal point tends to emerge, even when the rich do not have an information advantage or the ability to make a first move in pledging funds. The result additionally suggests that eliminating the bias in favour of the wealthiest interests requires more than just eliminating channels of corruption and capture, but also requires establishing other mechanisms through which other members of society may coordinate their efforts and move policy forward.

5.3 Public Finance

Our experiment gives insight into how groups converge to divide collective costs across heterogeneous individuals. The distribution of contributions we observe in the experiment may loosely be interpreted as a distribution of tax payments adopted as groups work together to select and fund a public good. But unlike a typical tax system, the payments in our experiment are fully voluntary, requiring no government enforcement and rather maintained through the incentives individuals have to do their part and ensure collective success.

Our experimental framework allows us to effectively observe the (voluntary) tax policy that emerges within heterogeneous groups working to collectively fund the social good. We observe the emergence of a tax system in a simple environment, absent of politics or institutions. This work complements an extensive literature in public finance that has focused on the optimal design or relative merits of alternative tax policies [e.g. Musgrave, 1959, Lindahl, 1919, Mirrlees, 1971, Saez, 2011], on how context and institutions may affect the implementation of alternative systems [e.g. Feldstein, 1976, Ito and Krueger, 1992], or on efforts to measure individual preferences over alternative types of policies [e.g. Weinzierl, 2017, Kittel et al., 2017].

We show that successful groups converge to contribution patters consistent with highly progressive tax schedules. Higher income individuals tend to contribute enough extra to the public goods to offset their initial income advantage. Such progressive divisions of costs are not driven by formal tax commitments or equity politics. Rather, the progressive system emerges under a collective expectation that higher income individuals will contribute relatively more than others to ensure collective success. Our results highlight a natural proclivity towards highly progressive

(voluntary) tax systems in our experiment, suggesting that such progressive divisions of costs are consistent with how groups expect to divide costs in successful systems.

Additionally, our experimental design allows us to formally consider the degree to which differences in individual contributions reflect differences in their *ability to pay* (i.e., endowed income) versus differences in their *willingness to pay* for (i.e., benefits received from) the public good. We show that successful groups tend to divide costs in ways that reflect both individual differences in ability to pay and individual differences in benefits received. Consideration of ability to pay and willingness to pay features of tax policies has been ubiquitous in economics since Adam Smith's first Canon of taxation argued that individual tax burdens should be set "as nearly as possible in proportion to their respective abilities" Smith [1776]. Empirically distinguishing ability-to-pay and willingness-to-pay features of tax systems is difficult because one's income (and thus their ability to pay) is affected by the economic benefits they receive from the system of government those taxes fund. In our experiment, higher income individuals contribute more to the public goods in a way that offsets their endowed income advantage, but which does not offset the extra benefits they receive from the implemented public good.[27] This suggests that groups collectively contribute in ways that offset initially salient inequalities, while the funded system may perpetuate other inequalities through the choice of policy. The results are generally consistent with Exley and Kessler [2022], who show that equity concerns in preferences for redistribution are often narrowly framed, with people "applying fairness preferences to single component of payoffs."

Weinzierl [2017] reports results from a survey showing that large portions of people prefer classical benefit based tax systems where contributions reflect relative gains from the system, and that equally large portions of people do not support highly progressive tax systems that equate after-tax income, even when the income differences are the result of luck. In other words, people widely report preferences that are in conflict with the highly progressive, ability-to-pay based payments that emerge within our experiment. Our results are not, however, inconsistent with Weinzierl [2017]. Rather, it reflects that fact that the outcomes in our experiment do not reflect individual preferences [which were the focus of Weinzierl, 2017], but rather reflect the collective expectation that emerges within groups regarding what a successful (voluntary) contribution system looks like. Even people who do not prefer highly progressive contributions may contribute in highly progressive ways if they believe such contributions are expected of them by the broader group.

The analysis contributes to a growing literature applying laboratory experiments to study of policy choice and macroeconomics [see Duffy, 2016, for a survey]. In our framework, policy (public good selection and the effective tax schedule) emerges from the coordinated voluntary efforts

[27] See Musgrave [1959] and Weinzierl [2018].

of individuals in support of alternation options, rather than through an explicit election or voting process integrated into the experimental design [e.g., Agranov and Palfrey, 2015, Jiménez-Jiménez et al., 2020, Frohlich and Oppenheimer, 1990, Riedl and van Winden, 2001, 2007, Cabrales et al., 2012, Sausgruber and Tyran, 2011, Blinder and Morgan, 2005, 2008, Feige et al., 2018, Grober and Reuben, 2013]. While others [e.g., Offerman et al., 2001, van der Heijden et al., 1998] also consider voluntary contributions, support for progressive and redistributive policies in these other frameworks are typically supported through the repeated nature of the policy environment, where, for example, young generations support transfers to older generations, not wanting to shut down such a system before they become old. In our framework, the incorporation of thresholds into the voluntary contribution environment ensures that even without repetition, wealthy individuals have an incentive to do their part to ensure success of (even highly-progressive) policies.

The voluntary contribution environment with multiple threshold public goods offers several advantages over past experimental settings for the study of how groups choose policy and how to divide the costs of such policies. The framework may be extended to allow for alternative processes of selection (e.g., proposals and voting), replace endowments with earned income, or incorporate communication, alternative timing, or different aspects of heterogeneity.

6 Conclusion

The paper introduces heterogeneity into a multiple threshold public goods framework to study the selection and financing of mutually beneficial policy alternatives when individuals differ in their income and preferences. Our lab experiment identifies a bias in favor of the public goods preferred by the wealthiest individual, suggesting that the perceived policy bias in favour of the wealthy persists even in the absence of corruption, government capture, or information asymmetries.

At the same time, we observe highly-progressive contribution patterns, with wealthier individuals tending to contribute larger shares of their income to help fund public goods, even when they do not receive extra benefits from that good and even through contributions are fully voluntary.

The framework is a coordination game in which individuals have an incentive to contribute consistently with the expectations of the group. They have an incentive to play what they perceive to be their expected part to ensure public good success. Because of this, the observed behavior reflects people's expectations about which public good will be implemented and how much each person is expected to contribute, and it does not reflect their individual preferences over alternative outcomes. Group attention is drawn to the public good preferred by the wealthiest individual

because people expect others will also focus on that good. And, in a similar way, individual contributions reflect an expectation that others will also contribute according to a highly-progressive contribution schedule. This suggests a natural proclivity towards policies supported by the rich and funding schedules that subsidize the poor.

The multiple threshold public goods experiment we introduce offers several opportunities for extension to consider various questions regarding policy selection, tax schedules, and the emergence of redistribution and inequality. Further work may relax some of the simplifying assumptions in our framework. For example, in our experiment, incomes are exogenous, endowed to each individual at the beginning of each period. We know from past work [e.g., Alesina and Angeletos, 2005, Gee et al., 2017], however, that attitudes towards redistribution can depend on whether income is due to luck or effort. Future work may endogenize some aspects of income by compensating subjects for real effort on a task. Similarly, we suspect that incorporating communications or sequential contributions into the game could influence the selection and longevity of alternative outcomes.

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A Additional Tables and Figures

Table A.1: Determinants of total contributions in *E_Diff*, *P_Diff*, and *P&E_Diff*: parametric results.

	E_Diff		*P_Diff*		*P&E_Diff*	
Total Contribution	(1)	(2)	(3)	(4)	(5)	(6)
Endowment	0.580***	0.590***			0.695***	0.717***
	(0.110)	(0.116)			(0.092)	(0.097)
Assigned bonus			0.314***	0.240***	0.486***	0.512***
			(0.050)	(0.068)	(0.041)	(0.054)
Last 6 periods		-1.046		-9.663***		-2.901
		(4.206)		(1.461)		(3.927)
Endowment $\times$ *Last 6 Periods*		-0.019				-0.066
		(0.074)				(0.068)
Assigned bonus $\times$ *Last 6 Periods*				0.300***		0.083
				(0.084)		(0.078)
Constant	0.256	0.779	26.192***	29.735***	-12.457**	-11.762**
	(6.451)	(6.785)	(2.396)	(2.236)	(5.368)	(5.655)
ll	-3064.23	-3062.52	-3066.76	-3045.58	-3001.99	-2990.89
$Wald - \chi^2$	28.050	31.480	38.720	86.370	207.250	235.720
$p > \chi^2$	0.000	0.000	0.000	0.000	0.000	0.000
Obs.	720	720	720	720	720	720
N. groups	15	15	15	15	15	15

Notes. This table reports coefficient estimates (standard errors in parentheses) from two-way linear random effects models accounting for both potential individual dependency over periods and dependency within the group. The dependent variable is the total contribution made by a subject to the eight collective accounts in the period. The analysis is conducted by pooling data from HC and LC groups. The other remarks of Table 3 apply.

Table A.2: Determinants of the contributions made to the funded public goods in HC groups in *E_Diff*, *P_Diff* and in *P&E_Diff*: parametric results.

	E_Diff		*P_Diff*		*P&E_Diff*	
Contribution to funded public goods	(1)	(2)	(3)	(4)	(5)	(6)
Endowment	0.659***	0.591***			0.538***	0.452***
	(0.122)	(0.139)			(0.116)	(0.120)
Assigned bonus			1.282***	1.284***	1.391***	1.447***
			(0.038)	(0.055)	(0.039)	(0.049)
Last 6 periods		-0.600		4.569**		-7.527*
		(7.668)		(2.024)		(3.853)
Endowment $\times$ *Last 6 periods*		0.136				0.194***
		(0.134)				(0.067)
Assigned bonus $\times$ *Last 6 periods*				-0.105		-0.177
				(0.084)		(0.109)
Constant	-6.188	-5.888	0.765	-0.272	-30.405***	-25.982***
	(6.981)	(7.965)	(1.583)	(1.641)	(6.622)	(6.846)
ll	-1730.88	-1725.11	-1491.24	-1488.33	-1663.16	-1657.79
$Wald - \chi^2$	29.100	40.820	1112.660	1135.890	1311.480	1356.660
$p > \chi^2$	0.000	0.000	0.000	0.000	0.000	0.000
Obs.	384	384	384	384	432	432
N. groups	8	8	8	8	9	9

Notes. This table reports coefficient estimates (standard errors in parentheses) from two-way linear random effects models accounting for both potential individual dependency over periods and dependency within the group. The dependent variable is the amount contributed by a subject in a HC group to the funded public good in the period. The other remarks of Table 3 apply.

Table A.3: Determinants of the contributions made to the funded public goods in *E_Diff*, *P_Diff* and in *P&E_Diff*: parametric results.

	E_Diff		*P_Diff*		*P&E_Diff*	
Contribution to funded public goods	(1)	(2)	(3)	(4)	(5)	(6)
Endowment	0.470***	0.423***			0.423***	0.372***
	(0.079)	(0.093)			(0.076)	(0.080)
Assigned bonus			1.266***	1.238***	1.363***	1.417***
			(0.027)	(0.038)	(0.030)	(0.040)
Last 6 periods		-1.025		1.266		-4.087
		(5.581)		(0.816)		(2.853)
Endowment $\times$ *Last 6 periods*		0.094				0.106**
		(0.098)				(0.050)
Assigned bonus $\times$ *Last 6 periods*				0.019		-0.120**
				(0.047)		(0.056)
Constant	-4.418	-3.906	0.484	0.003	-23.524***	-21.279***
	(5.161)	(5.867)	(0.828)	(0.883)	(4.343)	(4.567)
ll	-3241.41	-3237.32	-2622.70	-2620.19	-2769.91	-2765.90
$Wald - \chi^2$	35.250	43.480	2238.860	2259.220	2173.860	2206.630
$p > \chi^2$	0.000	0.000	0.000	0.000	0.000	0.000
Obs.	720	720	720	720	720	720
N. groups	15	15	15	15	15	15

Notes. This table replicates the analysis presented in Table A.2 pooling data from HC and LC groups. The other remarks of Table 3 apply.

Table A.4: Contributions of the subject-types in the four treatments: parametric results.

	Homogeneous		*P_Diff*		*E_Diff*		*P&E_Diff*	
Total contribution	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
B	-9.106**	-21.096***	0.089	-3.581	8.194*	7.987	5.778	4.180
	(3.912)	(6.263)	(4.221)	(5.378)	(4.847)	(6.325)	(4.120)	(5.900)
C	-8.306**	-11.346*	-2.078	-1.925	17.011***	17.709***	20.467***	11.480*
	(3.912)	(6.263)	(4.221)	(5.378)	(4.847)	(6.325)	(4.120)	(5.900)
D	-4.294	-4.554	0.172	1.502	24.139***	9.640	30.622***	10.863*
	(3.912)	(6.263)	(4.221)	(5.378)	(4.847)	(6.325)	(4.120)	(5.900)
HC		8.842**		17.039***		7.296		2.904
		(3.823)		(5.120)		(4.821)		(4.635)
$B \times HC$		16.350**		7.864		0.345		2.396
		(6.835)		(7.357)		(7.625)		(6.909)
$C \times HC$		4.146		-0.328		-1.164		13.480*
		(6.835)		(7.357)		(7.625)		(6.909)
$D \times HC$		0.354		-2.850		24.165***		29.638***
		(6.835)		(7.357)		(7.625)		(6.909)
Constant	37.900***	32.595***	29.889***	20.802***	19.833***	15.942***	19.806***	18.063***
	(3.260)	(3.563)	(3.912)	(4.131)	(3.758)	(4.036)	(3.613)	(3.927)
ll	-3047.93	-3039.93	-3084.70	-3076.35	-3064.21	-3053.94	-3063.02	-3050.91
$Wald - \chi^2$	6.870	30.420	0.400	27.820	28.130	61.620	68.530	120.460
$p > \chi^2$	0.076	0.000	0.941	0.000	0.000	0.000	0.000	0.000
Obs.	720	720	720	720	720	720	720	720
N. groups	15	15	15	15	15	15	15	15

Notes. This table reports coefficient estimates (standard errors in parentheses) from two-way linear random effects models accounting for both potential individual dependency over periods and dependency within the group. The dependent variable is the total contribution made by the subject to the eight collective accounts in the period. *B*, *C*, and *D* are subject-types dummies. *HC* is a dummy that takes a value of 1 if the subject belongs to a *HC* group and 0 o/w. $B \times HC$, $C \times HC$, and $D \times HC$ are interaction terms. Significance levels are denoted as follows: * $p < 0.1$, **$p < 0.05$, and *** $p < 0.01$.

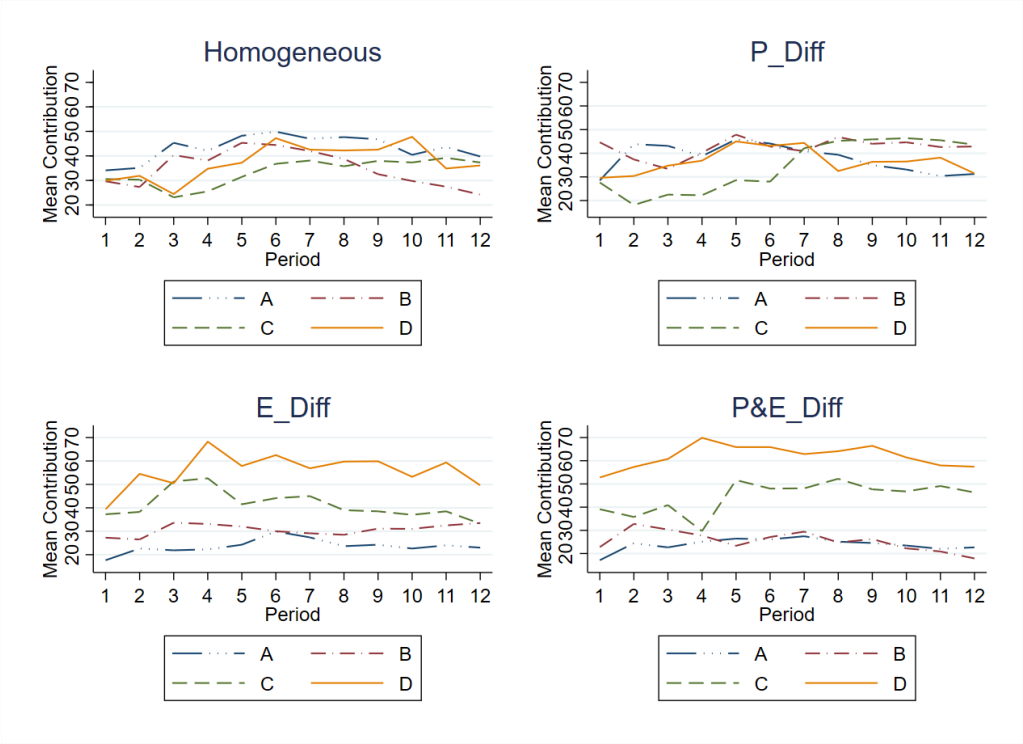

Figure A.1: Total contributions in HC groups by subject-type in the four treatments.

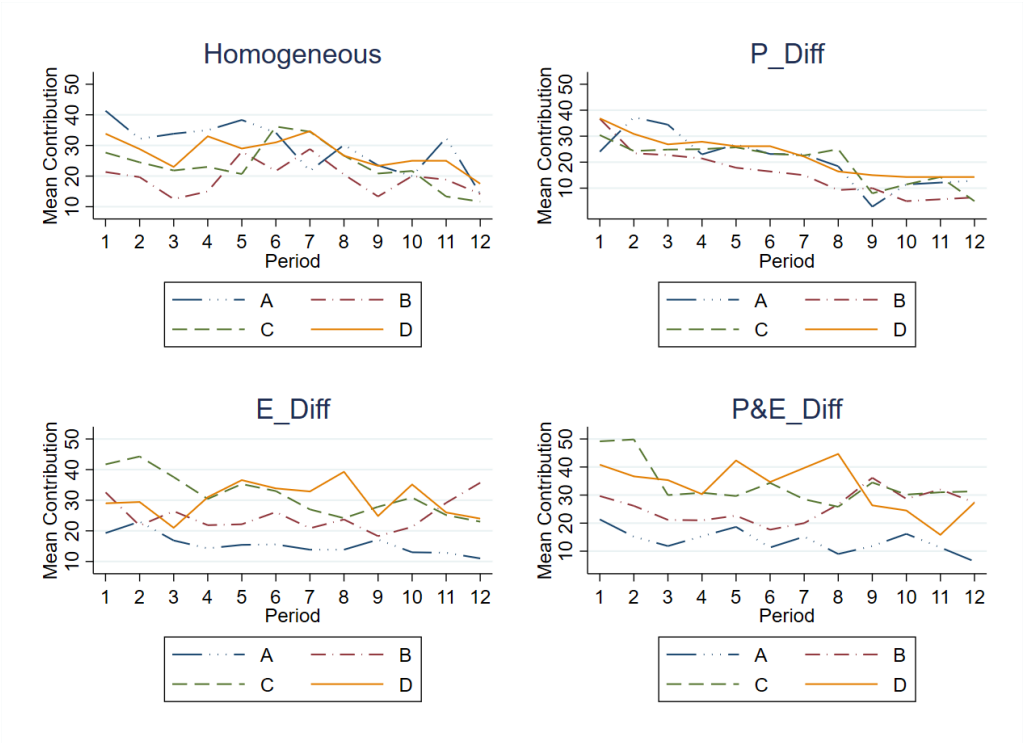

Figure A.2: Total contributions in LC groups by subject-type in the four treatments.

B Experimental instructions

[Instructions were originally written in Italian. The difference in the instructions between P&E_Diff and treatments with homogeneous endowments (Homogeneous and P_Diff) concerns the fact that, in the latter, all group members were endowed with 55 tokens. The difference in the instructions between P&E_Diff and treatments with homogeneous preferences (Homogeneous and E_Diff) concerns the fact that, in the latter, the bonus assigned to the selected public goods was equal to 30 points for all group members.]

Instructions

Welcome. Thanks for participating in this experiment. By following the instructions carefully, you can earn, based on your choices, an amount that will be paid to you in cash at the end of the experiment. During the experiment it is not allowed to speak or communicate in any way with the other participants. If you have any questions, do not hesitate to contact the researcher through the chat. The following rules are the same for all participants.

General rules

At the beginning of the experiment you will be assigned randomly and anonymously to a group of 4 people respectively indicated with the letters A, B, C, and D. Of each of the other three members of your group you will not know either the earnings. The composition of your group and the initial assignment of the letters will remain the same throughout the entire experiment. The experiment consists of 12 periods, in each of which you will interact exclusively with the subjects of your group. At the start of the experiment, you and every other subject in your group will be given one of four possible sets of tokens so that subject A will receive 34 tokens, B will receive 48 tokens, C will receive 62 tokens, and finally D will receive 76 tokens. This means that, overall, your group will therefore have a total of 220 tokens in each period.

How earnings are determined in each period of the experiment?

Given your token allocation, you must decide how to divide it between an INDIVIDUAL ACCOUNT and eight COLLECTIVE ACCOUNTS called respectively ”WHITE”, ”YELLOW”, ”GREEN”, ”RED”, ”BLUE”, ”PURPLE”, ”BLACK” and ”ORANGE”.

The nine ACCOUNTS generate a return expressed in points based on the following rules:

INDIVIDUAL ACCOUNT. You receive points from the INDIVIDUAL ACCOUNT every time you pour tokens into it. In particular, for each token you paid into the INDIVIDUAL ACCOUNT you

will receive 2 points. “WHITE”, “YELLOW”, “GREEN”, “RED”, “BLUE”, “PURPLE”, “BLACK” and “ORANGE”

COLLECTIVE ACCOUNT. Receive points from a COLLECTIVE ACCOUNT if and only if the total number of tokens paid into it by the subjects of your group is greater than or equal to a ”threshold” of 132 tokens.

In particular:

- If the number of tokens paid by your group into a COLLECTIVE ACCOUNT is below the threshold of 132 tokens, then you do not receive any points either from the tokens you paid or from those paid by your group to that COLLECTIVE ACCOUNT.
- If the number of tokens paid by your group into a COLLECTIVE ACCOUNT is greater than or equal to the 132 chip threshold, then for each token paid by you or any other person in your group into that COLLECTIVE ACCOUNT you receive 1 point; in addition, you are awarded a ”bonus” in points whose size depends on the COLLECTIVE ACCOUNT to which the tokens were paid.

What is the size of the bonus?

In period 1, the computer will select four of the eight COLLECTIVE ACCOUNTS at random. The four COLLECTIVE ACCOUNTS selected by the computer will be called ”SELECTED”, while the remaining four will be called ”NOT SELECTED”. The bonus awarded to each person in the group by the four “NOT SELECTED” COLLECTIVE ACCOUNTS will be equal to 20 points. The bonus recognized by a ”SELECTED” COLLECTIVE ACCOUNT depends on whether the subject considers that COLLECTIVE ACCOUNT as ”FAVORITE” or ”NOT FAVORITE”: if for the subject that COLLECTIVE ACCOUNT is ”FAVORITE”, then the bonus awarded to the subject is of 39 points; if instead for the subject that COLLECTIVE ACCOUNT is “NOT FAVORITE”, then the bonus awarded to the subject is 27 points. At the beginning of the first period, the computer will assign each participant a ”FAVORITE” COLLECTIVE ACCOUNT from the four ”SELECTED” so that each ”SELECTED” COLLECTIVE ACCOUNT is preferred by only one person in the group.

How do you make your choices?

- The computer will show you your token allocation and nine fields where you can enter your choices, one for the INDIVIDUAL ACCOUNT and one for each of the eight COLLECTIVE ACCOUNTS.

- In each of the eight fields, the computer will also show you the size of the bonus, 20, 27 or 39 points, awarded in the period to that COLLECTIVE ACCOUNT.
- A table will also show you which COLLECTIVE ACCOUNTS are PREFERRED by the other parties in the group and their token allocations.
- For each member of your group, the order in which the fields of the eight COLLECTIVE ACCOUNTS will appear on the screen will be determined randomly by the computer.
- The sum of the payments made by you in the nine ACCOUNTS must always be equal to your endowment of tokens; this means that in each period you will have to use the full amount of tokens at your disposal.

At the end of each period, the computer will show you how many tokens you have paid into the INDIVIDUAL ACCOUNT, how many tokens you have paid into each of the eight COLLECTIVE ACCOUNTS, how many tokens your group has paid into each of the eight COLLECTIVE ACCOUNTS, how many points you have obtained from the ACCOUNT INDIVIDUAL, how many points you have obtained from each of the eight COLLECTIVE ACCOUNTS and how many points you have gained in the period. At the end of the experiment, the points gained over the 12 periods will be converted into Euros at the exchange rate of 150 points = 1 EUR.

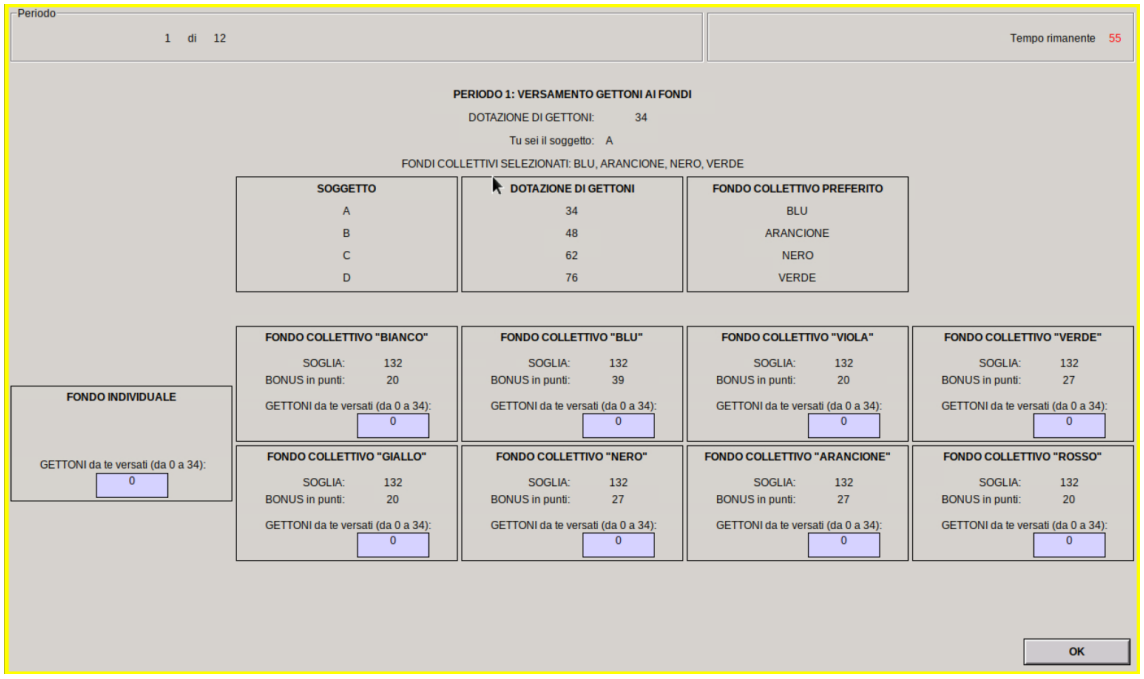

Figure B.1: Choice Screen in *P&E_Diff*.