

# **Those Outsiders: How Downstream Externalities Affect Public Good Provision**

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January 2012

## **Abstract:**

Some policy problems pit the interests of one group against those of another group. One group may, for example, determine the provision of a project (such as a power plant or a dam) that benefits group members but has downstream externalities that hurt people outside the group. We introduce a model of projects with such asymmetries. In-group members may contribute to a common fund that benefits them as a public good. In the model, benefits from the project may or may not vary within the group. Project provision has negative downstream externalities: common fund contributions hurt agents outside the in-group (“Outsiders”) rendering common fund contributions anti-social overall. Many models of social preferences predict that such externalities should reduce or eliminate project provision, although conditional cooperation or a preference for in-group members may counteract this effect. We test this model with a lab experiment. With homogeneous in-group benefits, the presence of negative downstream externalities reduces contribution levels by nearly half. We introduce a rotating high-return position that allows subjects to trade favors. Contributions diminish only slightly with the introduction of the negative externality and reciprocal giving occurs whether or not Outsiders are present.

**JEL codes:** C91, D01, D62, D71, H41, Q50

**Keywords:** public bad, public good, social preferences, reciprocity, externalities, in-group-out-group, parochial altruism

## Introduction

Public goods present a classic social dilemma: the social optimum is not individually rational. The classic public goods problem is relatively simple, however, because agents choose between a selfish action and one that benefits a larger body. Many policy problems, particularly environmental problems, are more ethically and behaviorally complicated because some actions create both winners and losers. Moreover, the power to decide on these policies may rest wholly or partly in the hands of the winners. A dam (Duflo and Pande, 2007) benefits locals but deprives downstream villagers; a biomass plant (Foley, 2010) provides local stimulus but pollutes downwind towns; an inefficient ethanol subsidy (Holland et al., 2011) benefits corn state politicians who draft the measure but wastes taxpayer money. In the most troubling cases, the loss to losers outweighs the gain to winners. Given the power to decide on such a project, will its beneficiaries be sensitive to the harm they cause to others and society as a whole? Does the incentive structure of the in-group affect people's decision to support project provision?<sup>1</sup>

We develop a novel model of this scenario and implement that model in a laboratory experiment to study how people react when common project provision creates a negative externality borne by others. We find that the presence of this negative externality imposes some restraint on contributions, but that restraint is quite incomplete and depends on the group incentive structure.

This research question cannot be answered by existing work in the public goods literature (useful surveys of which include Chaudhuri, 2011; Ledyard, 1995). That literature shows that subjects cooperate more than the model of perfectly forward-looking and self-interested agents

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<sup>1</sup> Another analogy is to valuation studies. If some survey respondents value an environmental asset more than others and they know their high values could cause a tax or fee to be levied on neighbors who value it less, will those respondents shade their reported values down or even state a value of zero to protect their friends?

would suggest, and these results have been used to demonstrate the presence of pro-social preferences such as altruism (e.g., Marwell and Ames, 1981) or conditional cooperation (Gächter, 2007), although other motives have been advanced, such as confusion (e.g., Andreoni, 1995a; Ferraro et al., 2003; Houser and Kurzban, 2002). Settings with heterogeneous returns within the group have further demonstrated the strength of reciprocity as it is leveraged in public goods settings when in-group benefits vary as in some of our scenarios of interest (Jacobson and Petrie, 2011). These results do not demonstrate how subjects' cooperation changes, however, when in-group cooperation is anti-social.

Research on public bads is comparatively limited. A public bad is often treated as the mirror image of a public good: reducing the public bad of pollution, for example, is modeled as providing the public good of pollution abatement. However, the two differ. The Nash equilibrium for selfish actors in a typical public good game is to give nothing, whereas for a public bad game it may involve unboundedly large provision (Shitovitz and Spiegel, 2003). Experimental evidence suggests another difference. The change of a frame from public good provision to public bad prevention causes behavior to be less pro-social (e.g., Andreoni, 1995b; Schwartz-Shea, 1983; Sonnemans et al., 1998). Thus, although this has not been tested before, if agents decide on provision of a project that is a local public good but has global costs that make it a public bad, in-group cooperation could be relatively unhindered by concern for those costs.

When costs are incurred by members of the group of deciding agents, but other members of the group benefit, limited evidence shows that people exhibit little restraint. Isaac et al. (2011) use some projects that are overall pro-social and some that are overall anti-social and allow subjects to effectively contribute toward either increasing or decreasing provision; they find that subjects tend to contribute in accordance with their financial interests. Delaney and Jacobson

(2011) use a rotating asymmetry, where one group member benefits each period at the expense of the other group members. They again find that subjects' contributions are mostly driven by their own payoffs and they find favor-trading in support of the public bad. Unlike our present study, however, all those affected are in the same group and have decision-making power.

Our study also relies on relevant lessons from studies of heterogeneous returns within and across groups and studies that mix benefits and costs. The intergroup conflict literature indicates that damage to other groups can actually increase within-group contributions (Bornstein, 2003; Bornstein and Ben-Yossef, 1994), and this has been attributed to an in-group bias or parochial preference (Baron, 2001). This kind of bias for the in-group can also be seen in the social identity literature, although when agents have little reason to identify with their in-group the extent of this bias seems to vary with the game being played (Chen and Li, 2009). Degrees of sensitivity to or willingness to sacrifice the well-being of those outside the in-group can also be observed in experiments that model firm decision-making structure (Ellman and Pezanis-Christou, 2010), oligopoly (Engel, 2007), and corruption (Abbink et al., 2010).

Our study differs from these in that we study the effect on cooperation of costs that this cooperation will impose on people outside the in-group. The most relevant literature is the small but growing body of experimental work on downstream externalities. Schwartz-Shea and Simmons (1990, 1991) find that when playing a Prisoner's Dilemma game in which cooperation reduces contributions to a charity, subjects cooperate with each other more when they can communicate (which may increase in-group identification) and when the downstream charity is considered less deserving. However, they do not measure the effect of the presence of the outside entity and we feel the use of other ordinary subjects as outside entities is more appropriate for our research question. In very related research, Engel and Rockenbach (2011) implement a game

in which subjects contribute to a local public good in the presence of “bystanders.” They use treatments in which the common project has positive, negative, and zero downstream externality on the bystanders, but in all cases the project is overall pro-social. They find that the presence of bystanders reduces contributions in all cases, even when bystanders are unaffected by provision, and interpret this as evidence of inequity aversion. Our study differs in that we focus on projects that are overall anti-social, inequity aversion would play out rather differently in our setting, and we also study heterogeneous values within the in-group. Our results are rather different as well.

The remainder of the paper proceeds as follows. In the next section, we lay out a model of projects with this kind of heterogeneous benefit. We then present our experimental design. The following section presents our results. The final section concludes.

## Projects with Heterogeneous Benefits and Costs

We model a scenario in which some number  $N_D$  of agents with deciding power (“in-group members”) choose how much to contribute to a common fund. The common fund acts as a linear public good for in-group members. In each round  $t$ , each in-group member  $i$  has endowment  $z$  tokens and chooses amount  $g_{it}$  to contribute to the common fund. Each token he contributes earns him  $b_{it}$ . This rate may vary across subjects and rounds. The rest of his endowment yields him a private return of  $a$ . Thus in-group members earn in each round:

$$\pi_{it} = a(z - g_{it}) + b_{it} \sum_{j=1 \dots N_D} g_{jt}$$

Since this is a public good within the group, the social optimum is for everyone to contribute fully (  $\sum_{j=1 \dots N_D} b_{jt} > a$  ) but there is an individual incentive to free ride for at least some agents (  $a < b_{it}$  ).

In addition to the in-group members, other agents are affected by the project. Some number  $N_o$  are “Outsiders:” agents who are not members of the in-group and therefore have no deciding power, but who are hurt an amount  $c < 0$  for every unit of project provision. An agent  $i$  who is an Outsider in round  $t$  earns profit:

$$\pi_{it} = c \sum_{j=1 \dots N_D} g_{jt}$$

Notice that since  $c$  is negative, the Outsider earns a negative return from common fund contributions. In fact, in the scenario of interest, project provision is overall anti-social:

$\sum_{j=1 \dots N_D} b_{jt} + N_o c < 0$ . The Outsiders’ losses outweigh the gains of the in-group members so that the social optimum is for there to be no project provision.

For some projects, all in-group members may have the same returns from the common project:  $b_{it} = b \ \forall i = 1 \dots N_D$ . In this case, the payoff to in-group member  $i$  in round  $t$  is:

$$\pi_{it} = a(z - g_{it}) + b \sum_{j=1 \dots N_D} g_{jt}$$

In this homogeneous return case, the Nash equilibrium for in-group members when each is only interested in his own payoff (that is, agents for whom  $\frac{\partial u_i}{\partial \pi_j} = 0, \forall j \neq i$ ) and who have

perfect knowledge of rationality is to contribute nothing to the common fund. If in-group members have some altruistic feelings, the prediction is less clear. If that altruism is parochial in

that it privileges in-group members over Outsiders ( $\frac{\partial u_i}{\partial \pi_j} > \frac{\partial u_i}{\partial \pi_k}$  and  $\frac{\partial u_i}{\partial \pi_j} > 0$  for agents  $j$  in the

in-group and Outsiders  $k$ ), in-group members may contribute a positive amount. This is

particularly true if they actively dislike Outsiders ( $\frac{\partial u_i}{\partial \pi_k} < 0$ ). If in-group members’ altruistic

feelings are egalitarian in that they are equally concerned with all other agents affected by their actions ( $\frac{\partial u_i}{\partial \pi_j} = \frac{\partial u_i}{\partial \pi_k} > 0$ ), they should contribute nothing. This game thus aligns the actions of free-riders and egalitarian altruists, but not parochial altruists.

Agents may also engage in conditional cooperation: they may contribute positive amounts in response to other agents' past contributions. This group-level reciprocation is unfocused since agents cannot directly reward specific in-group members for past cooperation. However, conditional cooperation has been shown to be important in public good games (Gächter, 2007). Importantly, Outsiders can do no act to earn an in-group member's reciprocal kindness, nor can they reciprocate any kindness. That is, conditional cooperation can work to increase contributions at the expense of Outsiders.

What other types of preferences could affect contributions? First, if in-group members are inequity-averse, their decisions depend on their belief about Outsiders' baseline payoff. If inequity-averse in-group members believe that Outsiders have baseline payoffs less than or equal to what an in-group member would earn with no contribution, they should contribute nothing. If they believe that Outsiders' have baseline payoffs that are greater, this could induce them to contribute up to the point at which payoffs would be equalized. Second, in-group members who have moderate preferences for efficiency may be sensitive to the overall group payoff. That is, the more negative the overall group payoff, the more restraint will be shown by in-group members who have altruistic feelings toward Outsiders.

For some projects, there are members of the in-group who have a greater stake in provision than others. For example, a farmer may particularly benefit from a local dam. We model this with a higher return from the common fund. We refer to these agents as

“Stakeholders,” and they are identified by index  $Stake_t \in \{1, \dots, N_D\}$ . The Stakeholder position may be held by different in-group members in different rounds as different projects have different beneficiaries. A case of interest is the case of a “privileged group” (following Olson, 1965) where the Stakeholder’s return from the common fund is higher than his return from not contributing:  $b_{Stake} > a$ . All other subjects earn a lower return  $b_{it} = b < a$ . In this case, Stakeholders have a dominant strategy to contribute all tokens and Non-Stakeholders have an incentive to free ride, but within the in-group the social optimum is full contributions by all group members. In-group member  $i$  earns in round  $t$ :

$$\pi_{it} = \begin{cases} a(z - g_{it}) + b \sum_{j=1 \dots N_D} g_{jt} & \text{if } Stake_t \neq i \\ a(z - g_{it}) + b_{Stake} \sum_{j=1 \dots N_D} g_{jt} & \text{if } Stake_t = i \end{cases}$$

In this heterogeneous return case, the behavioral predictions made for the homogeneous case continue to apply. In addition, however, in-group members have a more precise way of practicing reciprocity. Rather than simply engaging in group-level conditional cooperation, in-group members can choose to target each other with rewards for past “generous” behavior. Imagine that Joe and Fred are in a group together and they have no preference with regard to Outsiders’ payoffs. If Joe is the Stakeholder in round 1, he will contribute fully to the common fund and he will want Fred to contribute as well. If Fred contributes in round 1, then when Fred is Stakeholder in round 2, Joe may reward Fred by contributing a large amount, since this will increase Fred’s earnings. If Fred gave little in round 1, Joe may withhold that reward.

This favor-trading could happen because in-group members are reciprocators (i.e. if their preferences over others’ outcomes depend on others’ past actions). However, selfish agents may strategically mimic reciprocators if they believe they are facing reciprocators or if rationality or



foresight is limited. Per Sobel's (2005) terminology, this would be instrumental reciprocity, whereas intrinsic reciprocity depends on other-regarding preferences. Both may be important in this setting. Again, Outsiders can do nothing to inspire either a reciprocation or a strategic conditional contribution; so in the heterogeneous return case, conditional cooperation in response to group-level contributions, intrinsic reciprocity, and instrumental reciprocity may all drive positive in-group contributions in the presence of Outsiders.

In what other ways should a heterogeneous in-group behave differently from a homogeneous in-group? This higher reward associated with the Stakeholder position may make in-group members richer than they would be in the homogeneous return case. If marginal utility diminishes in wealth, agents in a heterogeneous return setting may be more willing to sacrifice their own payoff to benefit others inside or outside the group. This could increase or decrease contributions. Alternately, the promise of a large reward from in-group cooperation could cause agents to contribute more since the costs of restraint (the benefits of cooperation) are higher.

## Experiment Design

The experiment design is based on the model described above. In each treatment, subjects make decisions in each of eight rounds: how many tokens to contribute to a Group Fund which represents a linear local public good. We implement four treatments: Homogeneous Return, Homogeneous Return with Outsiders, Heterogeneous Return, and Heterogeneous Return with Outsiders. All four treatments use in-group sizes of  $N_D = 4$ , and, where applicable, use  $N_O = 2$  Outsiders per in-group. In each, in-group members have an endowment of  $z = 20$  tokens per round. In each round each must allocate his tokens between his private fund, which has a per-token return of  $a = 2$  cents to him only, and the common fund with returns described below.

In the Homogeneous Return treatments, the common fund return is  $b = 1$  cent per token for all in-group members. The common fund acts as a public good for the in-group. Each token contributed to the common fund creates four cents of in-group profit, whereas it would only generate two cents if it were invested privately, for a net social benefit of two cents. Each in-group member has an incentive to free-ride because he earns more from a token in his private fund as compared to the common fund. When Outsiders are present, their returns from common fund contributions are  $d = -3$  cents per token. In this case, the common fund acts as a public bad overall: each token invested in the common fund generates two cents of net profit for the in-group and six cents of loss for the Outsiders, for a net social cost of four cents.

In the Heterogeneous Return treatments, a Stakeholder position rotates through members of the in-group in an observable and predictable fashion so that each decider is Stakeholder twice. The Stakeholder's common fund return is  $b_{stake} = 3$  and the return for Non-Stakeholder in-group members is  $b = 1$ . In this case, a token contributed to the common fund earns six cents for the group at an opportunity cost of two cents, for a net social benefit of four cents. With Outsiders, who again earn  $c = -3$  from the common fund, the in-group social benefit of four cents is again reduced by the six cents of loss to Outsiders for a net social loss of two cents.

The net social cost of a contribution is always two cents greater in the Homogeneous Return treatments than in the Heterogeneous Return case; put another way, the social cost of contribution in both treatments is reduced by the same absolute amount (six cents per token) when Outsiders are added, but this means the relative change in social cost differs<sup>2</sup> and so does the total social value of a token contributed. To implement heterogeneous returns, it was

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<sup>2</sup> The same absolute change in social cost corresponds to a smaller relative change in social cost in the Heterogeneous Returns treatment as compared to the Homogeneous Returns treatment. If agents respond to relative rather than absolute change in social cost, the reduction in contributions when Outsiders are added may be smaller in the Heterogeneous than the Homogeneous Returns case.

necessary to change either the social return to Non-Stakeholders or the private return from the private fund or both. Were the private return reduced to hold constant the net social return, it is likely that altruists, reciprocators, and inequity-averse people would react in complex ways. Instead, the private return is held constant, and the social return changes across treatments. This change in the distribution of payoffs complicates direct comparisons of contribution levels across Homogeneous and Heterogeneous Return treatments. We address this complication in our analysis: we use a difference-in-difference analysis to look at subjects' responsiveness to same absolute change in the social costs of contributions in the two cases.

In the Outsider treatments, Outsiders for each in-group are randomly selected from other in-groups. No subject knows whether he has been chosen as an Outsider until after the experiment is over and total experimental earnings are revealed. This has an element of realism, because in many downstream-externality settings outside the lab a group is simultaneously “upstream” from one perspective and “downstream” from another. Still, the potential for role reversal may induce restraint on the part of deciders. On the other hand, since Outsiders belong to other groups, subjects could see the situation as one of intra-group competition, although we do not frame the scenario this way. This could increase in-group cooperation.

The subject interface is computerized and was programmed in z-Tree (Fischbacher, 2007). At the start of the experiment, subjects read general instructions.<sup>3</sup> They are told that they will make decisions in two sets of eight rounds each (i.e., two treatments) and that they will be randomly assigned into groups which will remain fixed for each set of rounds, but that groups will be different for the first and second sets of rounds. Subjects are not told the exact nature of the decisions they will make in each treatment until the treatment-specific instructions are read.

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<sup>3</sup> All instructions are available on the corresponding author's website: <http://econ.williams.edu/people/saj2>

Each subject participates in either the two Homogeneous Return treatments (with and without Outsiders) or the two Heterogeneous Return treatments.<sup>4</sup>

The first treatment begins with instructions that explain the payoff structure for that treatment. The subjects play through all of the rounds for the treatment. When the first treatment is over, the groups are randomly re-matched. The second treatment proceeds similarly, with treatment-specific instructions read first. After both treatments, subjects complete a questionnaire and are paid anonymously. Subjects' total earnings are the sum of their earnings in each treatment, which in turn are the sum of earnings in each round. The experiment is "double-anonymous" in the sense that subjects do not know which other subjects they are interacting with and the experimenters do not know which subject made which set of decisions.

In addition to the payment for their decisions, all subjects receive a fixed payment of \$16. This increases subjects' worst-case earnings so no subject can earn a negative amount even with large losses for Outsiders.

In the software for each treatment, subjects see a decision screen and then, after making a decision, a review screen for each round. In both the decision and review screens, the central feature is the contribution table. This table contains a row for each round in the treatment. Columns contain information on the subject's contribution and the contributions of others in his group, the group's total contributions, and the subject's own earnings. Information is filled into this table after the decision stage of each round and remains visible for the rest of the treatment. In the Outsider treatments, the presence of Outsiders (referred to in the software and instructions as "Outside People") and the return to Outsiders from the common fund are indicated in the header and at the footer of the screen.

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<sup>4</sup> As explained in the next section, while the design is within-subject, our analysis only uses data from subjects' first treatments.

Figure 1 shows the decision screen for the Heterogeneous Return treatment with Outsiders. In the Heterogeneous Return treatments, Stakeholder assignments are common knowledge. This feature lets subjects, if they so choose, target a benefactor for a reward in the form of high contribution when that benefactor is Stakeholder. To return to our example, if Joe is subject A and Frank is B, Joe can see how much Frank contributed in Round 1 when Joe was the Stakeholder. Joe can reward Frank with a large contribution when Frank is Stakeholder in Round 2, or Joe may withhold that reward if he deems Frank's contribution stingy.<sup>5</sup>

## Results

The experiment was run at the Experimental Economics Center (ExCEN) at Georgia State University in March 2011. Overall, 156 subjects participated in eight sessions: four sessions each of the Homogeneous Return case (with 20 subjects per session, for 80 subjects total) and the Heterogeneous Return case (three sessions with 20 subjects and one with 16 subjects, for 76 subjects total). All subjects experienced a treatment with Outsiders and a treatment without Outsiders. Half of the sessions of each type ran the Outsider treatment first and half second. However, due to order effects in the data<sup>6</sup> we report results for each subject for only the first treatment that subject experienced.

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<sup>5</sup> While targeted reciprocity is made possible by the payoff structure, the instructions and software do not explicitly state this. Thus any reciprocity we see requires subjects to independently discover this possibility.

<sup>6</sup> A subject's contributions to the common fund were less in the subject's second treatment for several treatments and roles, so second-treatment data may be contaminated. Results with the pooled-order sample are the same as the results reported here except: the "Outsider effect" for Non-Stakeholders in the Heterogeneous Return treatment (Table 1) is not significant; and favor-trading in Table 2 is significant for the Outsider treatment.

## **Descriptive Results**

Of the 156 subjects, 91 (58.33%) were female and the average age was 20.82. On average, subjects earned \$22.34 in Homogeneous Return sessions (payments ranged from \$14.38 to \$26.88) and \$24.25 in Heterogeneous Return sessions (with a range of \$13.48 to \$31.57).

Figure 2 shows the trend of average contributions by treatment and by role. Figure 2a shows that in the Homogeneous Return treatment, contributions when Outsiders are not present compare well with other public good games. In Ledyard's (1995) survey of public goods game results, first period contributions range from 31%-68% of endowment and final period contributions range from 9%-19% of endowment. In the Homogeneous Return treatment, first period contributions average 50% of endowment and final period contributions average 36.25% of endowment. The addition of Outsiders reduces first period average contributions to 41.13% and final period contributions to 20.38%. The average within-period contribution when Outsiders are present is everywhere below the average within-period contribution without Outsiders.

Figure 2b shows that in the Heterogeneous Return treatment, Stakeholder contributions are high—nearly 100% of endowment—whether Outsiders are present or not. Figure 2c shows that Non-Stakeholder contributions are similar in level to contributions in the Homogeneous Return treatment. Under both roles, contributions are lower when Outsiders are present than when they are not, but by only a small amount. In Jacobson and Petrie (2011), with a similar asymmetric payoff setup, Stakeholders contributed approximately the same amount they do here in the No-Outsiders case (95-97% of endowment), while Non-Stakeholders gave slightly less than they do here (33-38%), and both roles show trends similar to the trends shown here.

## The Outsider Effect

In Table 1, we verify these trends and differences by comparing mean contributions across treatments and roles. The addition of Outsiders *does* restrain contributions to the common fund quite significantly in all cases in all treatments, but it does not drive them to zero. In the Homogeneous Return treatment, subjects give 52.156% when there are no Outsiders present as compared to 29.125% when Outsiders are present, for a reduction of 44%. In the Heterogeneous Return treatment, the reductions in contribution appear much smaller. Stakeholders reduce contributions by 15% when Outsiders are added. Non-Stakeholders reduce contributions by 24%.

We find it remarkable that even though we made no effort at in-group identification, subjects continue to contribute at significant levels to a common project that is now actually anti-social because of how much it hurts those outside the in-group. This could be explained by a parochial altruism that favors in-group members and perhaps the fact that kindness to an Outsider is effectively thankless while kindness to in-group members may be reciprocated.

Is the Outsider-induced reduction in contributions meaningfully smaller in the Heterogeneous than in the Homogeneous Return case? This is a nontrivial question to answer since the incentive structures differ across the treatments: in both cases introducing Outsiders increases the social cost of contributions by 6 cents, but in-group returns in the Heterogeneous Return treatment are larger than in the Homogeneous Return treatment because of the Stakeholder's high return. As we argue in the Experiment Design section, this difference was better than allowing other returns to change. We perform a difference-in-difference test of absolute<sup>7</sup> changes in contributions when Outsiders are added. Let  $g_i$  be the average contribution level for individual  $i$  and let the superscripts *NO* indicate No-Outsider and *O* indicate the

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<sup>7</sup> Since the magnitude of Heterogeneous Return Non-Stakeholder No-Outsider contributions is slightly (but not significantly) smaller than Homogeneous Return No-Outsider contributions, a relative drop in contributions would cause the Heterogeneous Return drop to look slightly larger than it would look using the absolute drop.

presence of an Outsider, and the superscripts *Hetero* and *Homo* refer to Heterogeneous and Homogeneous Returns, respectively. We are seeking to test the following null hypothesis:

$$[E(g_i^{NO,Hetero}) - E(g_i^{O,Hetero})] = [E(g_i^{NO,Homo}) - E(g_i^{O,Homo})]$$

Because we are only using first-treatment data, we do not have repeated observations for individuals. Since treatments are exogenously imposed, we can regress contributions on treatment dummies to test for a difference in differences without fear of omitted-variable bias. Defining dummies for each treatment (leaving the Outsider, Heterogeneous Return as the omitted category), we can set up the following model:

$$g = \beta_0 + \beta_1 d^{NO,Hetero} + \beta_2 d^{NO,Homo} + \beta_3 d^{O,Homo} + \epsilon$$

If there is no difference in the contribution reduction that comes when Outsiders are added to the Homogeneous as compared to the Heterogeneous Return treatment, it should be true that  $\beta_1 = \beta_2 - \beta_3$ . Since Stakeholders have an incentive to contribute fully and generally do so, we compare the drop in within-subject average Non-Stakeholder contributions in the Heterogeneous Return case (which averages 10.898% of endowment) to the drop in within-subject average contribution in the Homogeneous Return case (which averages 23.031% of endowment). This difference is marginally significant (*F*-test with robust standard errors *p*-value 0.079).<sup>8</sup> Thus we conclude that the presence of Outsiders causes a greater drop in contributions in the Homogeneous Return treatment than in the Heterogeneous Return treatment.

Does this difference arise from lower Outsider condition contributions or from higher No-Outsider condition contributions in the Heterogeneous Return condition? Contributions in the Homogeneous Return case do not differ significantly from those by Non-Stakeholders in the

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<sup>8</sup> Comparing the difference in averages across both roles in the Heterogeneous Returns treatments (rather than only Non-Stakeholder contributions) produces a similar result ( $p = 0.067$ ). Using the full data set allows the more traditional within-subject difference-in-difference test, and the exogenous order-switching means that order effects should not affect this particular result. The associated Mann-Whitney test recommends rejection of the null ( $p < 0.001$ ), indicating that the difference in difference is significant.



Heterogeneous Return case for either the No-Outsider ( $p = 0.156$ ) or Outsider ( $p = 0.551$ ) treatments, so it is difficult to say. (If we consider instead the within-individual average of Non-Stakeholder and Stakeholder contributions for the Heterogeneous Return treatments, the difference in contribution levels across Return treatments is not significant in the No-Outsider treatments ( $p = 0.165$ ) but is highly significant in the Outsider treatment ( $p < 0.001$ ).)

### **Reciprocal Behavior**

In-group members' tendency to continue contributing to the local public good even when Outsiders' pain makes the project overall anti-social may relate, among other things, to some form of reciprocal behavior with in-group members. This is particularly compelling since the reduction in in-group contributions is smaller in the Heterogeneous Return case than in the Homogeneous Return case. In fact, we can look more closely for reciprocal giving because the Heterogeneous Return treatment is designed specifically to allow subjects to selectively reward other subjects if they so choose. The rotating role of the Stakeholder yields a very high return from the common fund, and all contributions and Stakeholder timing are common knowledge. If subject Joe wants to reward subject Fred for past generosity, then Joe can choose to make a large contribution to the common fund when Fred is a Stakeholder. This is a costly sacrifice for Joe, since when Joe is Non-Stakeholder he has an incentive to contribute nothing.

Thus, evidence of favor-trading can be found in Non-Stakeholder contributions in the Heterogeneous Return treatment. For each subject, we generate two measures of his Non-Stakeholder contributions. First, we see how much he contributed to the common fund in rounds in which the current Stakeholder had previously been nice to him; then we see how much he contributed in rounds in which the current Stakeholder had previously been mean to him. We measure "niceness" for this purpose by looking at the current Stakeholder's past contributions.

Any given subject will naturally be particularly concerned with contributions made in past rounds in which he himself was Stakeholder. A current Stakeholder may therefore be considered nice if he contributed a large amount when this subject was previously Stakeholder. A current Stakeholder is mean if he did not contribute much when this subject was previously Stakeholder. A subject is behaving reciprocally—trading favors—if he gives more when the current Stakeholder is a previous benefactor than when it is a previous malefactor.

Table 2 presents the analysis of these measures, using a threshold of 50% of endowment to differentiate between a nice and a mean Stakeholder.<sup>9</sup> In both the No-Outsider and Outsider treatments, subjects give more to a previously kind Stakeholder than to a previously unkind Stakeholder, but this is only significant (at the 5% level) for the No-Outsider treatment. In the Outsider treatment, contributions are more compressed so subjects' discrimination between nice and mean Stakeholders is not statistically significant. If we define the level of reciprocity as the difference between what a subject gives to a nice versus a mean Stakeholder, the level of reciprocity does not differ detectably between the No-Outsider and Outsider treatments (Wilcoxon rank-sum  $p = 0.331$ ). This test greatly reduces the sample being analyzed, however, and thus the power of the test. We can only look at the rounds in which a subject is Non-Stakeholder after he has been Stakeholder at least once (which will be 3-6 rounds). In those remaining rounds few subjects face both a nice and a mean Stakeholder.

The non-parametric tests reported in Table 2 only address unconditional mean levels of contribution, and then only for a small sub-sample of our observations. To further study favor-trading, we consider a parametric model of Non-Stakeholder contributions in the Heterogeneous Returns treatment as a function of Stakeholder past generosity with appropriate controls.

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<sup>9</sup> Results are qualitatively similar with other thresholds.

We let  $g_{it}^{NS}$  be the Non-Stakeholder contribution for subject  $i$  in period  $t$ , and we index the round  $t$  Stakeholder as subject  $j$ . We define a sequence of favor contributions to  $i$  from  $j$  ( $f_{ijs}$ ) as only those Non-Stakeholder contributions of  $j$  in past rounds  $s$  in which  $i$  was Stakeholder. Then we can define  $j$ 's average favor contribution to  $i$  (cumulative as of round  $t$ ) as  $\bar{f}_{ijt}$ , the average of all of  $j$ 's contributions in  $i$ 's past Stakeholder rounds. The coefficient on this variable can be interpreted as subjects' responsiveness to past generosity of in-group members.

Since group contributions may be correlated, we control for past contributions by the rest of the group. For subject  $i$  in round  $t$ , we define  $\bar{g}_{-it}^{NS}$  as the cumulative-to-round- $t$  average of Non-Stakeholder contributions in past rounds (excluding subject  $i$ 's contributions). Dummy  $d_o$  indicates whether the current treatment is an Outsider treatment, and we control for a linear time trend  $t$  (i.e., the round number). Finally, we allow for unobserved individual fixed effects  $c_i$ .

We present parameter estimates for a panel fixed-effects regression in Table 3. We consider two primary regression models. Specification I allows for full interaction effects across treatments:

$$g_{it}^{NS} = \beta_0 + \beta_1 \bar{f}_{ijt} + \beta_2 \bar{g}_{-it}^{NS} + \beta_3 t + \beta_4 (d_o \times \bar{f}_{ijt}) + \beta_5 (d_o \times \bar{g}_{-it}^{NS}) + \beta_6 (d_o \times t) + c_i + \varepsilon$$

A test for reciprocity in the No-Outsider treatment is a test of whether  $\beta_1 = 0$ . We cannot reject this null with this model. However, a test for reciprocity in the Outsider treatment is a test that  $\beta_1 + \beta_4 = 0$ ; we can reject this null with  $p = 0.040$ , indicating significant favor-trading. This is the opposite of the significance in the Table 2 results, which found significant favor-trading in the No-Outsider but not the Outsider treatment.

What is the effect of adding Outsiders to a group? Since we use individual fixed effects and each subject is either wholly in or wholly not in the Outsider treatment, there is no within-

subject variation in the dummies. Thus if the Outsider effect is primarily a level effect, it will be absorbed by the individual fixed effects. Testing the hypothesis that  $\beta_4 = \beta_5 = \beta_6 = 0$  (i.e. that the interaction terms are not important), we cannot reject the null. This recommends a reduced model without treatment interaction terms.

Specification II in Table 3 therefore omits the interaction terms. The reduced model allows for more precise estimation of the effects of previous Stakeholder contributions. The results show that a Stakeholder receives, on average, 0.627 tokens for every token he has contributed to others (this is significantly different from zero:  $p = 0.011$ ). The net private cost of contributing a token when Non-Stakeholder is 1 cent, while Stakeholders earn 3 cents from each token donated other subjects. The reciprocity-fueled net return to a token contributed by a Non-Stakeholder is thus  $(3 * 0.627) - 1 = 1.881 - 1 = 0.881$  cents—that is, reciprocity makes a Non-Stakeholder contribution profitable on average.

## **Conclusion**

Many policy directives and innovative institutional designs seek to address simple public goods problems: pollution that hurts everyone or exploitation of a commonly-owned resource. However, there is less literature studying cases in which a project or resource acts as a public good to one group of people while actively hurting others and ultimately social welfare. Such scenarios are widespread and potentially quite problematic. Downstream externalities can hurt overall efficiency and create dramatic distributional issues.

We present an experiment that investigates the actions of agents with deciding power over provision of projects with just such mixed social benefits and costs. We find that while a

downstream externality does reduce agents' effort at providing a locally-beneficial project, these contributions are not reduced to zero.

This limited restraint is remarkable. Cooperation in public goods settings is often viewed as a pro-social or altruistic act, but in-group members are cooperating here in an anti-social way. This may demonstrate a parochial form of altruism that privileges in-group members over those outside the in-group. In our study, this occurs even in the absence of any effort to lead subjects in our experiment to identify with their in-groups any more than Outsiders.

Further, the distribution of returns matters. When returns from the public project are heterogeneous, this pro-social restraint is less than it is when returns are uniform. Little restraint is shown by those who benefit most from the public project. Stakeholders within our experiment reduce their contributions the least, in both absolute and relative terms. This pattern seems likely to occur outside the lab as well. In addition, we also see that Non-Stakeholders (those with normal returns from the common fund) in our Heterogeneous Returns treatments show less restraint in the presence of negative externalities than do subjects in the Homogeneous Returns case—perhaps because they know they will soon be Stakeholder.

Our results present clear evidence that in-group benefits from a public bad can lead to inefficient outcomes, that favor-trading can reinforce and exacerbate these inefficient outcomes, and that the resulting social costs can be economically significant. Future research is needed to find institutions that encourage more restraint in the presence of harmful downstream externalities.

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## Figures and Tables

You are now: **MAKING YOUR CONTRIBUTION FOR ROUND 2**  
**Your Letter Code: A Stakeholder: B Your Group Has 2 Outside People**

**CONTRIBUTIONS TO THE GROUP FUND**

	<u>YOU</u>	<u>Stakeholder</u>				
	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>TOTAL TOKENS IN GROUP FUND</u>	<u>MY EARNINGS</u>
Round 1	<u>I</u>	1	20	14	42	\$1.52
<b>Round 2</b>		<u>SSSS</u>				
Round 3			<u>SSSS</u>			
Round 4				<u>SSSS</u>		
Round 5	<u>SSSS</u>					
Round 6		<u>SSSS</u>				
Round 7			<u>SSSS</u>			
Round 8				<u>SSSS</u>		

SSSS indicates that this person was/will be Stakeholder in the round indicated

**DECISION PANEL**

How much would you like to put in the **GROUP FUND**? (0-20)

Your **PERSONAL FUND** contribution will be 20 minus your **GROUP FUND** contribution.

**RETURNS:**

Personal fund: **\$0.02 per token to you**

Group fund: **\$0.03 per token to Stakeholder**  
**\$0.01 per token to non-Stakeholders (including YOU)**  
**-\$0.03 per token to each of the 2 Outside People attached to your group**

**CLICK TO SUBMIT**

**SUBMIT**

Figure 1: Heterogeneous Return Treatment with Outsiders Decision Screen

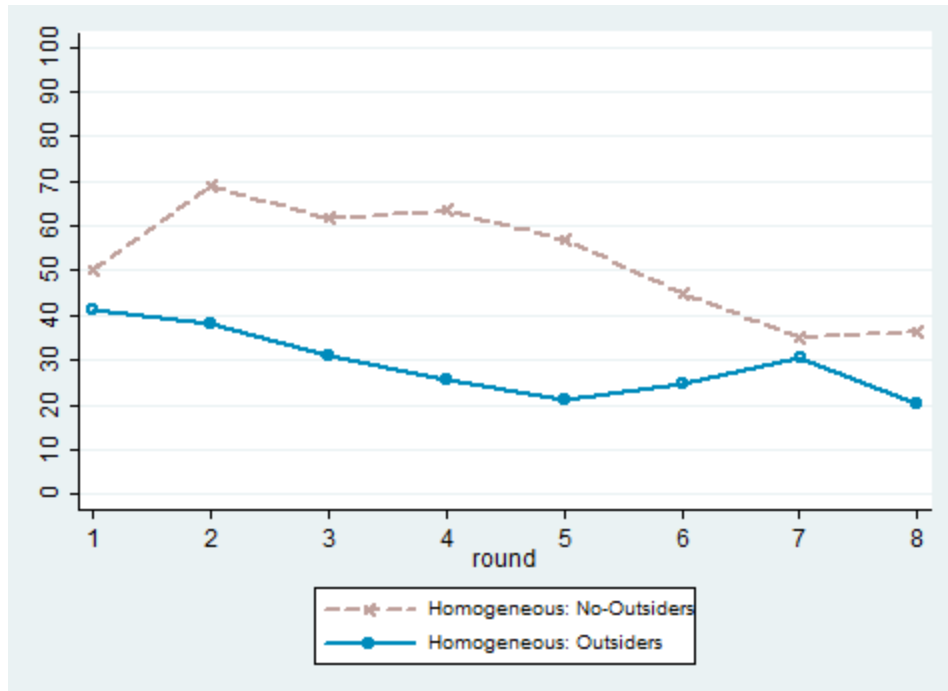


Figure 2a: Common Fund Contributions (in percent of endowment), Homogeneous Returns Treatment

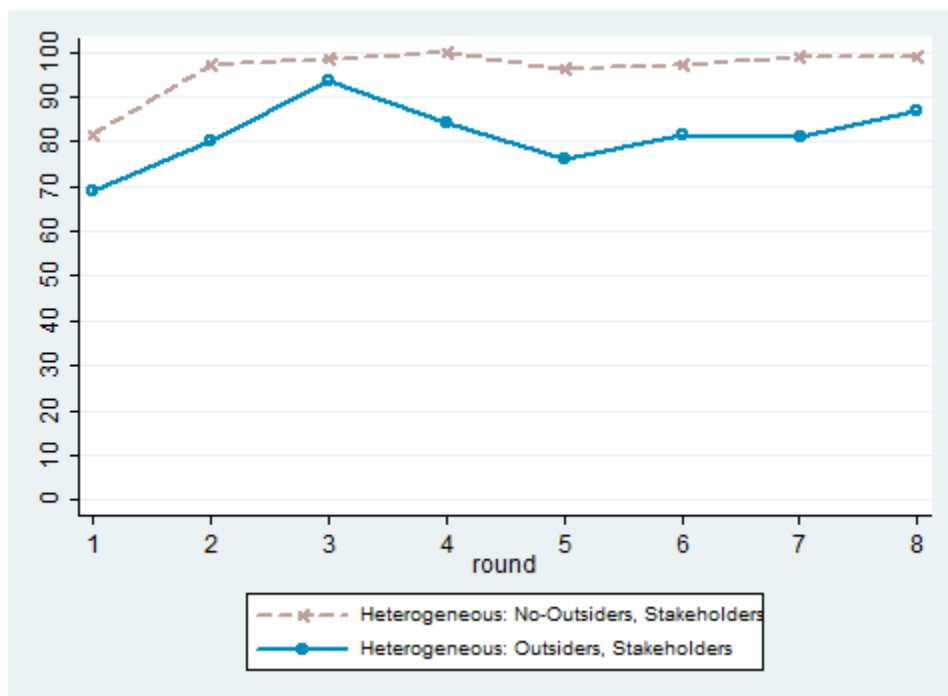


Figure 2b: Common Fund Contributions (in percent of endowment), Heterogeneous Returns Treatment, Stakeholders

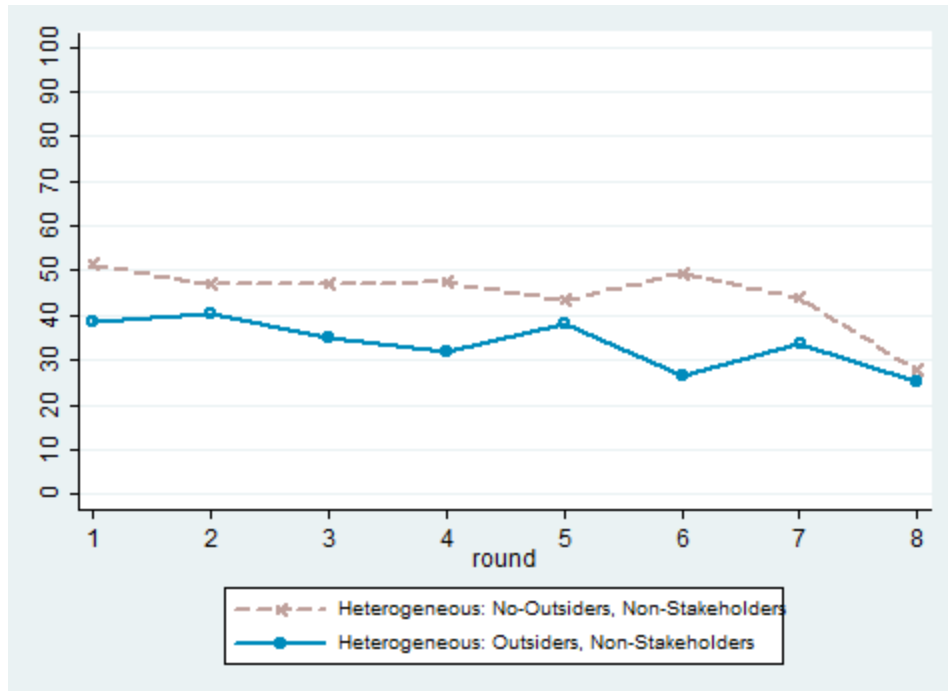


Figure 2c: Common Fund Contributions (in percent of endowment), Heterogeneous Returns Treatment, Non-Stakeholders

Table 1: Common Fund Contributions by Treatment and Role (in Percent of Endowment)

	Homogeneous Return	Heterogeneous Return Stakeholders	Heterogeneous Return Non-Stakeholders
No-Outsider treatment	52.156 (21.042)	96.042 (9.342)	44.606 (21.997)
Outsider treatment	29.125 (18.675)	81.500 (24.526)	33.708 (23.548)
<i>N</i>	80	76	76
Wilcoxon ranksum test <i>p</i> value	0.000	0.001	0.031
Standard deviations in parentheses			

Table 2: Evidence of Reciprocity (in Percent of Endowment)

	No-Outsider treatment	Outsider treatment
How much do I give when current Stakeholder was previously nice to me?	49.635 (24.298)	26.560 (22.902)
How much do I give when current Stakeholder was previously mean to me?	36.026 (27.551)	21.661 (29.268)
<i>N</i>	13	14
Paired Wilcoxon signed-rank test <i>p</i> -value	0.033	0.155

Standard deviations in parentheses. “Previously nice” means current Stakeholder gave at least 50% of endowment when this subject was Stakeholder; “previously mean” means current Stakeholder gave less than 50% of endowment when this subject was Stakeholder.  $N < 40$  because some subjects did not face both a nice and mean Stakeholder by these definitions.

Table 3. Fixed-Effects Panel Regression of Non-Stakeholder Contributions on History

	I	II
Stakeholder average past contributions to me	0.603 (0.420)	0.627** (0.242)
Average past Non-Stakeholder contributions (excluding self)	0.112 (0.203)	0.066 (0.595)
Period	-3.507** (1.483)	-2.689*** (0.903)
Outsider dummy $\times$ Stakeholder average past contributions to me	0.031 (0.518)	
Outsider dummy $\times$ Average past Non-Stakeholder contributions (excluding self)	-0.082 (0.254)	
Outsider dummy $\times$ Period	1.507 (1.852)	
Observations (rounds)	342	342
Number of subjects	76	76
$F$	3.94	7.32
$R^2$ (overall)	0.1087	0.1097

Robust standard errors in parentheses; errors are clustered on groups and all models are individual fixed-effects models.

Significance levels: \*: 10%, \*\*: 5% \*\*\*: 1%