The Good of the Few: Reciprocity in the Provision of a Public Bad

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Abstract:

People trade favors when it is efficiency-enhancing to do so; will they also trade favors when it reduces efficiency? This dilemma may arise, for example, in a series of wasteful public projects where each project benefits an individual. We introduce the "Stakeholder Public Bad" game to study this question. In each round, contributions to a common fund increase the earnings of one person (the "Stakeholder") but reduce the earnings of the rest of the group so much that overall efficiency is reduced. The Stakeholder position rotates through group members and the promise of high Stakeholder rewards provides a lever for reciprocal actions. We hypothesize that some people will help a current Stakeholder by contributing in hopes of being rewarded later with a reciprocal gift. In a lab experiment, we find evidence of such favor trading. In this setting, information provision actually enables efficiency-decreasing reciprocal acts. Favor trading does not increase public bad provision, but it could if the parameters or population were different. We also find that Stakeholders seem quite willing to sacrifice the good of the group to reap their own personal rewards, even when contribution decisions are public.

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1. Introduction

Groups must frequently decide on the provision of projects that have both winners and losers. A defense contract may benefit one constituency while incurring large tax-funded expenses; a factory siting decision brings jobs to one area but may have broad environmental consequences; an appropriations bill may fund wasteful "bridges to nowhere" to the benefit of individual committee members. Further, these groups must often repeat the decision process with different stakeholders for different projects. This structure may give rise to reciprocal behavior: you support my project and I'll support yours. Existing evidence shows that this kind of trading may work in favor of pro-social projects. Does the same dynamic occur when projects are overall anti-social—when the harms they cause are greater than the benefits they generate? More generally, can reciprocity, which has been championed as a force for the greater good in settings from interpersonal interactions to the macroeconomy to evolution, be destructive?

We study this question using a model that allows reciprocal behavior to enter into a group's provision of a common project with heterogeneous costs and benefits. We create a game called the "Stakeholder Public Bad" game. In each round, members of a group decide how much to contribute to a common fund. These contributions determine the provision of an overall efficiency-reducing project in which one member has a stake (i.e., a strong financial interest) while other members' payoffs are reduced by project provision. This Stakeholder role rotates so that each group member will periodically be the beneficiary from the project. In some settings, public information makes reciprocal acts possible, but in others information is hidden so that targeted reciprocal acts are impossible. How people will behave in these settings depends on what types of social preferences they have and whether they expect others to reciprocate.

In a lab experiment, we find that people engage in anti-social reciprocal behavior even though trusting to such reciprocation is on average not profitable. We also find that subjects contribute nearly fully in the role of Stakeholder, even though this is an anti-social act.

2. Favor-Trading in Public Good and Public Bad Provision

Agents' behavior in a public bad game with rotating high return has, to our knowledge, not yet been studied. We take lessons from the extensive literature on public goods (useful surveys of which include Chaudhuri, 2011; Ledyard, 1995), noting particularly that subjects in public goods experiments contribute much more than selfish rational models predict. Suggested motives for this cooperation include fairness (e.g., Marwell and Ames, 1981), altruism (e.g., Dawes, 1980), and conditional cooperation (Gächter, 2007), although some suggest that confusion plays a role (e.g., Andreoni, 1995a; Ferraro et al., 2003; Houser and Kurzban, 2002). Many institutions for project provision have been examined, the most relevant of which is the linear voluntary contributions mechanism game in which individuals' contributions to the common fund have constant returns to each member of the group. This game is the basis for our Stakeholder Public Bad game.

Projects that reduce overall efficiency have received less attention. This is in part because many models treat public bads as dual to public goods. For example, one can argue that preferences against (the public bad of) pollution are the same as preferences for (the public good of) pollution abatement.[2] However, there are systematic differences in the extent of observed cooperation when isomorphic games are framed as public good provision as compared to public bad reduction. Schwartz-Shea (1983), Andreoni (1995b), and Sonnemans et al. (1998)

[2] Shitovitz and Spiegel (2003) show that in a general equilibrium framework, the Nash equilibrium outcome for provision of a public bad is different from the standard outcome for a public good, because they find that provision of a public bad can be unbounded.

demonstrate that people behave more pro-socially under a public goods framing than a public bad framing.[3] The public bad literature reveals some other lessons about behavior: Barr and Serra (2009, 2010) find that culture and the magnitude of social costs affect willingness to contribute to a public bad; work by Moxnes and van der Heijden (Moxnes and van der Heijden, 2003; van der Heijden and Moxnes, 2003) shows the existence of a leader can slightly reduce public bad provision; and Delaney and Jacobson (2013) show that public bad provision increases when social distance to injured parties increases. While Delaney and Jacobson (2013) find that beneficiaries of a project that hurts others will trade favors among themselves, we are aware of no other work on reciprocal behavior in a public bad setting.

Reciprocity is important in social settings. In this study, we do not try to distinguish reciprocal acts rooted in other-regarding preferences from those motivated by strategic self-interest ("intrinsic" versus "instrumental" reciprocity, respectively, in the terminology of Sobel, 2005). Intrinsic reciprocity (as laid out in theories like Cox et al., 2008; and Rabin, 1993) has been shown to drive some pro-social behavior (e.g., Berg et al., 1995; Charness and Rabin, 2002; Cox, 2004; Fehr et al., 1993). Instrumental reciprocity has also been found to be important (e.g., List, 2006).

Reciprocal behavior in the form of conditional cooperation is important in public good games (Gächter, 2007). However, information conditions and payoff asymmetries can provide additional leverage for reciprocity of all types within a group provision setting. Information provision alone may increase giving (e.g., Andreoni and Petrie, 2004; Sell and Wilson, 1991). But information can also enable reciprocity: it is impossible to reciprocate without knowing who has been kind to you (Wilson, 2008). Asymmetric returns have mostly been used to study

[3] The difference between positive and negative framing can also be observed in DeScioli et al. (2011), who find that anti-social acts of omission occur more frequently and receive less punishment than acts of commission.

responsiveness to returns to self and others (e.g., Goeree et al., 2002) or leadership (e.g., Brandts et al., 2007; Glöckner et al., 2011), sometimes in the spirit of Olson's (1965) "privileged groups" (Reuben and Riedl, 2009). Isaac et al. (2013) study common projects that are asymmetric in that they benefit some people and hurt others, but they provide no opportunities for favor trading. Jacobson and Petrie (2013), in a design very similar to our study, use asymmetric returns and information to allow subjects to trade favors in support of a public good. They show that other-regarding preference-based (intrinsic) reciprocity does boost support of a pro-social common project. We ask whether this will also occur in support of an anti-social common project.[4]

We extend the existing literature by examining reciprocal acts in a project provision setting where the common project is anti-social. We do not seek the kind of "negative reciprocity" (i.e. spite) examined in work like Abbink et al. (2000), where reciprocal preferences cause people to reduce one another's payoffs through punishment. In such settings, negative reciprocity can be socially positive because it enforces cooperative norms. In our setting, reciprocal acts are socially harmful.

3. Model

We model a "Stakeholder Public Bad" game. In this game, members of a group make repeated simultaneous individual decisions to contribute to a common pot. These contributions fund a public project with asymmetric returns: some group members benefit from provision while others are hurt, and the socially optimal level of provision is zero. One can interpret contributions in this setting as either public bad provision or common pool resource extraction.

Agents belong to groups of size N. Group membership is fixed and the interaction continues for a finite number of periods. Each member has an endowment of z tokens each

[4] Other work examines behavior when the project affects people with no power to decide on provision of the project, e.g., "bystanders" in Engel and Rockenbach (2011) and "outsiders" in Delaney and Jacobson (2013).

period to allocate between a private fund and a common fund. The private fund represents the opportunity cost of support for the common fund. For each token an agent contributes to his private fund, he alone earns return $a > 0$. Agent *i* earns return b_{it} for every token contributed by any group member to the common fund. This return varies across roles and may be negative for some group members. Each agent also earns a role-specific baseline return G_{it} from the "status quo" (no contributions) level of public project provision.[5]

In each period *t*, agents are exogenously assigned roles. The values of G_{it} and b_{it} vary according to agent *i*'s role in period *t*. Each agent chooses his contribution g_{it} for each round. The simple net return to *i* for any token he contributes to the public fund is $b_{it} - a$.

In each period, one member of the group has the role of Stakeholder (role *S* if $Stakeholder_t = i$). The Stakeholder strongly prefers the common project to the status quo: the Stakeholder return from the common fund is $b_S > a > 0$, thus making this a privileged group (Olson, 1965). The Stakeholder role rotates through all group members from period to period.[6] The remaining $N-1$ group members are Non-Stakeholders (role *NS* if $Stakeholder_t \neq i$). Non-Stakeholders prefer the status quo to project provision; their per-token return from the public fund is $b_{NS} < 0 < a$. Agent *i*'s payoff for period *t* is given by equation 1.

$$\pi_{it} = \begin{cases} G_S + b_S\left(\sum_{j=1\ldots N} g_{jt}\right) + a\left(z - g_{it}\right) & \text{if } Stakeholder_t = i \\ G_{NS} + b_{NS}\left(\sum_{j=1\ldots N} g_{jt}\right) + a\left(z - g_{it}\right) & \text{if } Stakeholder_t \neq i \end{cases} \quad (1)$$

[5] This fixed status quo is similar to the "alternative public project" in Isaac et al. (2013). There, however, agents can contribute to this alternative and such contributions actually reduce provision of the main project.

[6] In some situations, a Stakeholder in a potential project that would be anti-social may be able to (in addition to withholding his own contributions) "bury" his project so that no-one has opportunity to contribute. In other situations, as in our model, a Stakeholder may have no such power.

This project is a public bad if the total return from a token contributed is negative. This happens if the total losses of Non-Stakeholders combined with the opportunity cost of the token are larger than the gains of Stakeholders. Thus, the project is a public bad if $b_S + (N-1)b_{NS} < a$. It would be a public good if $b_S + (N-1)b_{NS} > a$, as in Jacobson and Petrie (2013).

We can make some theoretical predictions based on the bounds we have placed on parameters. Because payoffs are linear in own-contribution, each role has a dominant strategy if all agents are rational and purely self-regarding: each agent contributes fully to the common fund when he is Stakeholder and contributes nothing when he is Non-Stakeholder. Because there is a known end-period, rational agents do not strategically cooperate because they expect unraveling.

Other-regarding agents face a dilemma. Contribution helps one member of the group at others' expense and reduces efficiency. In the paragraphs that follow, we consider the possible effects of altruism, efficiency-seeking, inequity aversion, conditional cooperation, and reciprocity (with consideration also of instrumental reciprocity) on behavior.

Altruistic or efficiency-seeking Stakeholders may reduce their contributions to the common fund. Altruistic Non-Stakeholders should not contribute to the common fund unless they have preferences that privilege the current Stakeholder above other group members, and efficiency-seeking Non-Stakeholders should never contribute.

If agents are inequity-averse, their behavior depends on their expectations of others' actions. Recall that the baseline returns may differ across roles. In our implementation, as we describe in the next section, the Non-Stakeholder return is much greater than the Stakeholder return. If an agent is inequity averse and only considers the current period, he may try to use his contribution to reduce inequity. In this configuration, contributions by Non-Stakeholders always increase disadvantageous inequality with regard to the Stakeholder, and contributions by the

Stakeholder always increase advantageous inequality. Therefore, in the stage game, inequity aversion reduces contributions. However, an agent would have to be extremely myopic to behave this way. The Stakeholder role rotates through all group members across periods. Considering the whole game, if other agents contribute fully as Stakeholder and refrain as Non-Stakeholder, an inequity-averse agent should do the same to ensure equal payoffs. If others deviate from that pattern, an inequity-averse agent should match that deviation.

Untargeted conditional cooperation should have little effect on contributions. Conditional contributions by Non-Stakeholders intended to spur or respond to contributions by the group at large are unlikely because increased contributions would reduce all agents' earnings.

However, group members may use the rotating Stakeholder position to alternately "help" one another in a targeted way. Imagine that in three sequential periods, first Adam is Stakeholder, then Beatrice, then Cynthia. In the first period, Beatrice contributes a large amount while Cynthia contributes nothing. Beatrice's contribution was personally costly in that she sacrificed her own payoff to increase Adam's. Cynthia made no such sacrifice. Adam exhibits reciprocal behavior if, in response to their actions, he contributes a large amount when Beatrice is Stakeholder (rewarding her) and less when Cynthia is Stakeholder (withholding a reward).

With reciprocal other-regarding preferences (intrinsic reciprocity), this discrimination happens because Adam's preferences for Beatrice's and Cynthia's payoffs are changed by their previously kind and unkind, respectively, acts. On the other hand, reciprocation may be instrumental. Adam might seek future rewards by strategically contributing when a likely reciprocator is Stakeholder. If he guesses from her past generosity that Beatrice is reciprocator, Adam may mimic a reciprocating type in hopes she will reward him later. If no-one is a reciprocator (and everyone knows this) and everyone is fully forward-looking, then this kind of

"cooperation" would wholly unravel. If agents are fully self-interested but myopic, unraveling might be incomplete and might generate strategic contributions in early periods of the game.[7]

Like Non-Stakeholder contributions, Stakeholder contributions may be affected by intrinsic or instrumental reciprocity. A Stakeholder who wishes to earn higher contributions in future Stakeholder stints or to reward the kindness of past benefactors may reduce his common fund contributions now since those contributions hurt all of his group members. However, this affects all three of his group members equally, i.e. it does not target any particular individual.

Contributions by Non-Stakeholders to benefit Stakeholders are a form of positive reciprocity (repaying kindness with kindness). The withholding of those contributions is not negative reciprocity (as defined in Cox and Deck, 2005) because it is not a punishment: it is simply the withholding of a reward. Contributions by either Non-Stakeholders or Stakeholders that are made with the intent of hurting Non-Stakeholders could result from negative reciprocity, but, again, such punishments (or refraining therefrom) cannot be targeted at any individual. Any such attempts at punishment by Non-Stakeholders are rendered further unattractive because the punisher would be hurt just as much as the intended punishee.

All kinds of reciprocity require that agents know one another's history of actions and schedule of Stakeholder timing. Without this information, reciprocity in the sense of targeted rewards for individuals' past actions cannot influence contributions. We model two information conditions. In the Public condition, group members know one another's contribution history and roles in each period. In the Private condition, group members know only their own role and

[7] Could some subset of a group form a coalition, the members of which would cooperate with each other for mutual benefit? Such a coalition is only possible if the joint payoff of the members of the coalition can be increased by such an agreement, and that depends on parameter values. With the parameters we use in our experiment, a coalition of two of the four group members could increase joint payoff by cooperating with each other. However, there is no coalition enforcement mechanism. Therefore, as with strategic reciprocal acts in general in this setting, we would expect such coalitions to fail because of unraveling.

history; they learn the individual amounts contributed in past periods but cannot associate them with any particular group member and do not know the timing of others' Stakeholder stints.

To summarize, given either self-interest or other-regarding preferences, we expect Non-Stakeholder contributions in the Private information condition to be at some low baseline level. In the Public condition, Non-Stakeholder contributions might increase because of targeted reciprocity, but they may not: if Non-Stakeholders reduce contributions (relative to the baseline) to previously unkind Stakeholders, this reduction may offset gains from higher contributions to previously kind Stakeholders. That is, the effect on Non-Stakeholder contributions of Public information is ambiguous. Regardless, direct favor-trading can occur only in the Public condition. Additionally, Stakeholder contributions may decrease in the Public as compared to the Private condition because of instrumental or intrinsic reciprocity.

4. Experiment

We implement the Stakeholder Public Bad game in a laboratory experiment based on a linear public bad game with rotating asymmetric payoffs. We use two treatments corresponding to the Private and Public information conditions, which we describe in detail below.

In each treatment, subjects are randomly assigned to fixed four-person groups for eight rounds. In each round, each subject is endowed with $z = 10$ tokens. He must choose an integer number of tokens ($g_{it} \in \{0,\ldots,10\}$) to invest in the Group Fund, while the remaining tokens are kept in the Personal Fund. Each group has one Stakeholder and three Non-Stakeholders in each round. The Stakeholder role rotates through all members of each group so that each subject is Stakeholder twice and Non-Stakeholder six times in each eight-round treatment.

The per-token payoff from the Personal Fund is $a = \$0.02$ for all group members. For Stakeholders, the Group Fund yields no base payment ($G_S = 0$) and the per-token payoff from

the Group Fund is $b_S = \$0.10$. For Non-Stakeholders, the base payment is $G_{NS} = \$2.00$. This ensures that no Non-Stakeholder can ever earn a negative amount in any round; the Stakeholder base payment G_S is zero because this concern does not exist for them. Non-Stakeholder earnings are reduced by $b_{NS} = -\$0.05$ per token in the Group Fund.

With these parameters, the marginal social return to a token put in the Group Fund is $(\$0.10 - \$0.02) - 3*\$0.05 = -\$0.07$. As discussed above, the dominant strategy equilibrium in each round for rational self-interested agents is for Stakeholders to contribute fully and Non-Stakeholders to not contribute. In this case, total group investment is 10, the Stakeholder earns $\pi_S = \$1.00$, and the Non-Stakeholders each earn $\pi_{NS} = \$1.70$. The total group payoff is then \$6.10. The socially optimal outcome is for no tokens to be invested in the Group Fund, in which case $\pi_S = \$0.20$ and $\pi_{NS} = \$2.20$ and total group earnings are \$6.80. If all agents contribute all tokens, the total investment is 40, $\pi_S = \$4.00$, $\pi_{NS} = \$0.00$, and total group earnings are \$4.00.

In the Public information condition, each subject is assigned a letter code. Subjects see a table in which the timing of the Stakeholder position rotation through all group members is reported and in which each group member's contribution history is displayed. In the Private condition, subjects' contributions to the Group Fund are reported in a disaggregated list (it has been noted, e.g., Sell and Wilson, 1991, that disaggregated reporting affects giving). Because contributions are listed in a random order that is reshuffled each round, norms may be established and subjects may follow one another. However, reputations cannot be established and Stakeholder timing is private information, so targeted reciprocity is impossible.

The experimental procedure is outlined in Figure 1. The subject interface is computerized using software written in z-Tree (Fischbacher, 2007). Subjects enter the lab and are given general

instructions.[8] They are told that they will make decisions in two sets of eight rounds with two different groups and that they will then make one unrelated decision, but are not told the exact nature of the decisions they will make in each treatment until directly before the treatment begins. The design is within subject—each subject participates in both the Public and Private information treatments. The final task is a risk preference elicitation in the style of Holt and Laury (2002). The protocol is double anonymous: subjects cannot identify which subjects were in their group, and the experimenters cannot identify which subject made which decisions.

FIGURE 1 GOES HERE.

The first treatment begins with instructions that explain the roles and the information condition for that treatment. The software randomly assigns subjects into four-person groups. The subjects then play through all of the rounds of the treatment. After the first treatment, subjects are randomly assigned into new four-person groups. The second treatment features the complementary information condition and proceeds in much the same way, with treatment-specific instructions read first. After both treatments are complete, subjects receive instructions for and perform the risk task. Finally, subjects complete a questionnaire and receive payment anonymously. Each subject's total earnings are the sum of his earnings in each treatment, which in turn are the sum of his earnings in each round, plus his earnings from the risk task.

5. Results

The experiment was run at the Experimental Economics Center (E*x*CEN) at Georgia State University in March 2010 in four separate 20-subject sessions, for a total of 80 subjects. All subjects played two treatments of eight rounds, one in a Public and one in a Private information condition. Half of the sessions ran the Public treatment first, and half ran the Private treatment

[8] Instructions are available on the corresponding author's website.

first. Some small order effects are detectable, so all analysis includes only data from subjects' first treatment.[9] Of the 80 subjects, 40 (50%) were female, and the average age was 20.1. Each session lasted about 90 minutes, and average earnings were $23.38 (standard deviation $1.85).[10]

Contribution Level Results

Figure 2 shows the path of contribution decisions across the rounds of each treatment. Stakeholder decisions in both treatments are close to the endowment, which is consistent with the selfish dominant strategy of full contribution by Stakeholders. This should be viewed in light of the fact that such contributions are social costly on net because of the harm they cause to Non-Stakeholders. Non-Stakeholder contributions are low but positive in all rounds. Contributions show the downward trend usually seen in public goods games, even though this public investment is actually a public bad.[11]

FIGURE 2 GOES HERE

Table 1 shows summary statistics of the distribution of individual contributions across rounds. The majority of contributions follow the selfish dominant strategy, but many subjects deviate from this, particularly when they are Non-Stakeholders. Recall that Non-Stakeholders may give nonzero amounts because of an altruism that prefers some group members over others, reciprocity, or conditional cooperation, and Stakeholders may give less than their full

[9] The only significant order effects is that Stakeholder contributions are lower in the Public treatment if the Public treatment is first (92.88% of endowment) as compared to if the Private treatment is first (98.00%, Wilcoxon rank-sum p=0.007). Results change little if the full data set is used: Stakeholder contributions are significantly greater in the Public than in the Private treatment (p=0.038); and the difference-in-difference test comparing favor-trading between the Public and Private treatments is significant (unpaired t-test p=0.089).

[10] We do not report results from the risk elicitation task or the questionnaire because they add little value to our analysis, but we discuss some minor points of interest with regard to these in a Reviewer's Appendix. We note that twelve of the 80 subjects incorrectly answered a comprehension question on the questionnaire. The results reported in the body of the text include their choice data, but all results presented are robust to their exclusion.

[11] Interpretation of our results depends on the assumption that subjects understand the game they are playing and in particular understand the public bad nature of the common fund. While comprehension is impossible to prove, we find at least some questionnaire responses to imply they understand; for example, one subject said his/her group members "were very selfish in their decisions. They wanted to make the most money for themselves."

endowment because of altruism, efficiency-seeking, conditional cooperation, or a very myopic inequity aversion (although, as previously argued, we find this last reason less plausible).

TABLE 1 GOES HERE.

We compare mean contributions by role and treatment in Table 2. Both Stakeholders and Non-Stakeholders contribute slightly less in the Public treatment as compared to the Private treatment, but this is not significant. If subjects act reciprocally, it may be the case that subjects' increased contributions to kind Stakeholders are offset by decreased contributions to unkind Stakeholders. In the next sub-section we present evidence that reciprocity does indeed occur in the Public treatment even though average contribution levels do not change.

TABLE 2 GOES HERE.

Total (summed across all group members) group contributions also do not differ between the Public and Private conditions. Figure 3 shows the trend across rounds for the two treatments. Across-round average total contribution is 41.77% of the maximum possible group contribution in the Private treatment as compared to 40% of the maximum in the Public treatment. These numbers are not statistically different (Wilcoxon rank-sum test *p*-value 0.626).

FIGURE 3 GOES HERE.

Because of the novel structure of induced preferences here, it is difficult to compare contributions in this experiment to contributions in other experiments except for Jacobson and Petrie (2013) and Delaney and Jacobson (2013), which have contain similar designs. In Jacobson and Petrie (2013), where the common fund is a public good instead of a public bad, Stakeholders gave slightly more (95-97% of endowment) than they do here and Non-Stakeholders gave much more (33-38%) than they do here, and both roles show trends similar to the trends shown here. In Delaney and Jacobson (2013), in which all group members get positive returns but two people

outside the group get large negative returns to the common fund, subjects gave less as Stakeholders (83-85% of endowment) and much more as Non-Stakeholders (32-36%) than they do here, again showing a similar pattern across rounds.

As in Delaney and Jacobson (2013), therefore, we can say that the public bad nature of the common fund reduces contributions somewhat but does not reduce them to zero, even though in this case many of those contributing to the common fund are hurting themselves with their contributions. While some Non-Stakeholder giving may be driven by social preferences, Stakeholders' willingness to follow self-interest to the detriment of their group appears to be only slightly inhibited by social preferences; in this setting, self-interest and reciprocal behavior appear to overwhelm the positive factors that would diminish public bad provision.

Presence of Reciprocal Behavior

We test for reciprocal acts by studying whether Non-Stakeholders contribute in a way that seems to return a "favor" done by the current Stakeholder.[12] That is, we want to see whether a subject gives more in rounds in which the current Stakeholder is someone who contributed significantly when this subject was Stakeholder in a past round. We do this with non-parametric tests and regressions that study the relationship between Non-Stakeholder contributions and Stakeholder past generosity. We cannot distinguish between intrinsic and instrumental reciprocity because favor trading may be driven by strategic self-interest.[13]

For our non-parametric tests, we classify the Stakeholder in each round as generous or ungenerous with regard to each Non-Stakeholder. We do this by calculating the current

[12] Although it is technically possible for reciprocity to manifest itself in other ways (e.g. a Stakeholder reducing contributions to reward others, a Non-Stakeholder increasing contributions to hurt another Non-Stakeholder), we do not have the power to test for any of these. The patterns that would arise from these relationships would not confound the strong tests of reciprocity that we perform in this section.

[13] Jacobson and Petrie (2013) find evidence of intrinsic reciprocity in late-period cooperation (after a subject's last Stakeholder stint, so that rewards from strategic cooperation are low). In our study, groups are smaller and there are fewer rounds as compared to that study, so there is not sufficient power to perform such a test.

Stakeholder's average contribution in past rounds in which this (currently Non-Stakeholder) subject was Stakeholder. If the current Stakeholder gave more than half of his endowment to this subject on average, we classify him as generous with regard to this subject; if not, we classify him as ungenerous.[14] We perform a within-subject comparison of each subject's average Non-Stakeholder contribution when facing a previously-generous Stakeholder and his average Non-Stakeholder contribution when facing a previously-ungenerous Stakeholder.

Table 3 shows these average Non-Stakeholder contributions by Stakeholder generosity for both the Private and Public treatments. Since targeted reciprocity is impossible in the Private treatment, we do not expect to see a difference between these values for that treatment. The data support this: the difference between what is given to a generous and an ungenerous Stakeholder is not significant. However, in the Public treatment, in which subjects have all of the information they need to discriminate in this way, Non-Stakeholders do respond significantly to the current Stakeholder's past kindness, i.e., they reciprocate: they contribute more when the current Stakeholder was previously generous than when he was previously ungenerous. The within-subject difference is significant even though the sample size is greatly reduced.[15] The difference in this sort of discrimination across the Private and Public treatments is not significant (Wilcoxon rank-sum *p*-value 0.241), although again, the sample size is very low. Still, some subjects' tendency to discriminate seems quite strong when they have the information to do so. We do not detect a significant difference between what subjects give to a previously-generous Stakeholder in the Private as compared to the Public treatment ($p = 0.383$) and what subjects give to a

[14] The results that follow hold for alternative specifications (30% to 90% of endowment) of the threshold for generosity.

[15] Most people do not face both a previously-kind and previously-unkind Stakeholder. Each subject experiences only 3-6 rounds as Non-Stakeholder after his first Stakeholder stint. Since the majority of Non-Stakeholder contributions are zero in both treatments, is it not surprising that fairly few subjects face both types of Stakeholders after their first Stakeholder stint in this small number of rounds.

previously-ungenerous Stakeholder in the Private as compared to the Public treatment (p = 0.787). Therefore, we cannot say whether reciprocity results from additional kindness to past benefactors, reduced kindness to those who previously refused to be kind, or both.

TABLE 3 GOES HERE.

In addition, we regress Non-Stakeholder contributions on Stakeholder past generosity to this subject. The non-parametric tests above are a stricter test, since regressions could be subject to endogeneity because of the unknown ways in which group members affect each other's behavior. However, regressions allow us to see the effects of more factors.

In these panel regressions, the outcome variable is g_{it}^{NS}, subject *i*'s Non-Stakeholder contributions in time *t*. We wish to see the relationship between this variable and cumulative average "favor" contributions by the current Stakeholder *j* in previous periods when subject *i* was Stakeholder, denoted $\overline{f}_{it}$. Since we wish to see the differential responsiveness in the Public and the Private treatments, we define Public treatment indicator variable d_p which we interact with $\overline{f}_{it}$. To limit the effects of the cross-correlations that may cause endogeneity, we also control for the cumulative average Non-Stakeholder contribution of other subjects in this group $\left(\overline{g}_{it}^{NS}\right)$. We also control for a time trend *t*.

We examine a full-interaction model, noting that d_p must be omitted if we include individual fixed effects since each subject is observed in only one treatment. The OLS panel regression model is given in equation 2.

$$g_{it}^{NS} = \beta_0 + \beta_1 \overline{f}_{ijt} + \beta_2 \overline{g}_{it}^{NS} + \beta_3 t + \beta_4 \left(d_p \times \overline{f}_{ijt}\right) + \beta_5 \left(d_p \times \overline{g}_{it}^{NS}\right) + \beta_6 \left(d_p \times t\right) + c_i + \varepsilon \qquad (2)$$

We give parameter estimates from the OLS implementation of this model in specification I in Table 4. Since the dependent variable is limited to the range 0 to 100, we also implement a panel Tobit model, with marginal effects reported in specification II.

TABLE 4 GOES HERE.

In the OLS specification, the coefficient on $\bar{f}_{ijt}$ (the "favor" contribution by the current Stakeholder) is positive and significant, although small. This gives the appearance of reciprocal behavior in the Private treatment. Recall that such regressions can be biased because of spurious correlations within groups; from examining the data, we infer that this spurious correlation occurs because Non-Stakeholders generally have low last-period contributions and some Stakeholders also steadily reduced contributions across rounds. The Tobit specification, however, does not show this correlation.

More importantly, the size and significance of the interaction term coefficient (and marginal effect in the Tobit model) indicates that reciprocal giving is happening in the Public information condition much more than in the Private condition: previous generosity by the current Stakeholder has a large and significant effect on Non-Stakeholder contributions. The results are robust to the exclusion of the last period. Thus we have further evidence of favor-trading in support of a public bad, enabled by the provision of information.

Does trading favors pay, i.e. is the sacrifice of contributing to the Group Fund worthwhile for a Non-Stakeholder? Using the OLS coefficients, for each token that the current Stakeholder contributed in previous rounds, Non-Stakeholders in the Public treatment contribute an additional 2.283 + 0.461 = 2.744 percent of their endowment, or 0.274 tokens (p = 0.012). The net private cost of contributing a token when Non-Stakeholder is -7 cents, while Stakeholders earn 10 cents from each token donated other subjects. The reciprocity-fueled net return to a token

contributed by a Non-Stakeholder is thus $(10 \times 0.274) - 7 = 2.74 - 7 = -4.26$ cents.[16] Even at the upper bound of the confidence interval for any reasonable confidence level, Non-Stakeholder contributions remain unprofitable in expectation even when reciprocation is considered.

Anti-social favor trading, which is clearly a socially harmful activity, is enabled by information on subjects' histories and the timing of their interest in the common fund. In this case, reciprocal behavior and the information that enables it serve as a force for evil. We contrast this with the result in Jacobson and Petrie (2013), who show that providing information that allows reciprocity in a similar game (a "Stakeholder Public Good" rather than a "Stakeholder Public Bad" game) increases efficiency by leveraging pro-social favor trading.

6. Conclusion

In this paper, we examine reciprocal behavior in the provision of a public bad. Individuals may have competing motivations when members of a group must decide on the provision of a common project. We model a sequence of inefficient projects, each of which is nonetheless privately desirable to a booster within the group. Natural analogies include political logrolling or influence peddling. Reciprocity has been shown to be a force for social good in many settings; our results show that it can also cause social harm.

We develop a novel "Stakeholder Public Bad" model in which asymmetric returns create a public bad that is privately beneficial to a single constituent. In our model, we show that intrinsic or instrumental reciprocity could lead to favor-trading in the provision of these projects which, in turn, could increase overall provision. In an experiment implementing this model, we find that some subjects actively engage in this favor trading when information allows. Reciprocal

[16] Using the Tobit marginal effects, each Non-Stakeholder token contributed earns back 2.954% of endowment, or 0.295 tokens, giving a net return of $(10 \times 0.295) - 7 = 2.95 - 7 = -4.05$.

behavior does not increase the level of public bad provision in this case. Given the existence of reciprocity, however, overall public bad provision might increase or decrease because of favor trading, depending on early contributions and the distribution of agent types (e.g., reciprocators, etc.) in the population.

In this way, reciprocal acts—and the information that makes reciprocity possible—may reduce efficiency. This potential for anti-social use of information has been noted in the context of campaign finance reform in the United States. Ackerman and Ayres (2002) argue that all campaign contributions should be anonymous to render political favor trading impossible.

More broadly, our results demonstrate how people behave when they can take privately beneficial actions at others' expense. The effects of self-interest and reciprocal behavior dominate social preferences like altruism and efficiency-seeking. This issue is subtly but fundamentally different from people's failure to provide a public good. When subjects benefit directly from a public bad, as in our Stakeholder role, they contribute nearly fully. Even some subjects who bear a private cost from the public bad (Non-Stakeholders) contribute a positive amount. Our results show that some of this behavior is caused by subjects' hopes of garnering future rewards when it is their "pet project's" turn to be considered (i.e., when they are Stakeholder).

The rewards reaped by a person with a stake in a common project seem to be so tempting that they can counterbalance a person's inherent social preferences. Despite the negative social effects of provision of the public bad, subjects from both roles contribute to the provision of the public bad to their mutual detriment. A vast literature has shown that altruism and pro-social reciprocity are real and powerful. In this setting, however, individuals attempt to harness reciprocity and information as a force for the good of the few but against the good of the many.

Appendix A: Correlates of Behavior

Additional insights into contribution behavior come from subjects' choices in a risk preference elicitation task (in the style of Holt and Laury, 2002) and from subjects' questionnaire responses. Neither of these could have primed subjects, as both occurred after the main experimental tasks were concluded. We investigated correlations between behavior and a number of individual characteristics, including self-identified race, gender, religion, previous experience with economics, and charitable giving behavior, as well as several measures of political affiliation and attachment. The characteristics that vary with contribution decisions are described in Table A-1.

TABLE A-1 GOES HERE

Subjects who identify with the Democratic Party tend to give less as Stakeholders in the Public treatment as compared to subjects who do not identify with that party. In the Private treatment the same pattern exists but is not statistically significant (Democrats give 89.71 as compared to 96.74 percent of endowment, Wilcoxon rank-sum *p*-value 0.122). This accords with the results from other social sciences that Democrats are more oriented than others toward duties to society and a feeling of obligation to help others (Coffé and Bolzendahl, 2011).[17]

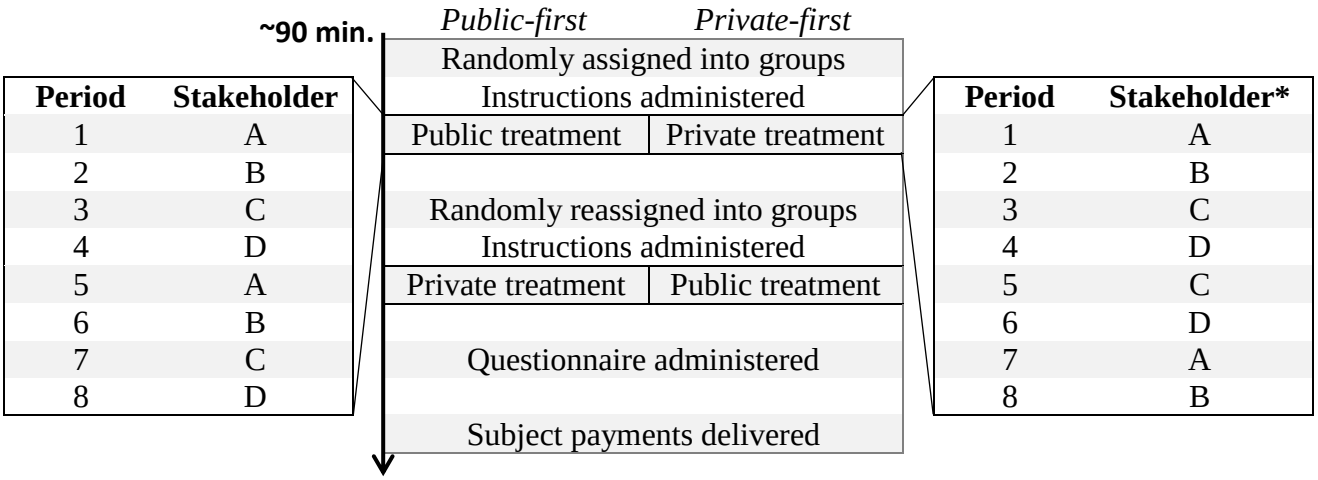
We also look at risk aversion as measured by a subject's lottery switch point. An early switch point indicates that the person is less risk-averse. We consider those who are risk-seeking to mildly risk-averse as one group and compare their contributions to those of the more risk-averse subjects. (This result is robust to other thresholds of the "more risk-averse" classification.) Less risk-averse subjects give more as Non-Stakeholder than do more risk-averse subjects in the Private treatment. This is sensible because giving as Non-Stakeholder in the Private treatment is

[17] Subjects who identify as black are more likely to identify as Democrats, as are subjects who have not taken economics classes. Stakeholder contributions do not vary significantly by whether a subject has taken economics classes. Black subjects do give less as Stakeholder in the Public treatment, but not the Private treatment.

very risky, in the sense that it is extremely unlikely to be reciprocated. In the Private treatment, any "payback" would rely wholly on the weaker force of group-level conditional cooperation, while in the Public treatment targeted reciprocal acts can generate returns.

Finally, we included a simple comprehension test in the questionnaire. This gave a simple scenario with two funds with different returns, and asked the subject how many tokens he should put into the fund with the higher return to maximize his profit. Out of the 80 subjects in the experiment, 68 (85%) answered this question correctly. A tendency to make non-dominant contributions—to contribute high amounts as Non-Stakeholder and to contribute low amounts as Stakeholder—is correlated with tendency to answer this comprehension question incorrectly. Subjects who answered the comprehension question incorrectly were much more likely to have reported taking no economics classes, so this characteristic is also associated with non-dominant contributions. As noted in the text, all of our main results are robust to the exclusion of the subjects who answered this question incorrectly.

Figures



*The Stakeholder position in the Private treatment follows this pattern, but letter codes are not revealed to subjects in this treatment. Half of the sessions began with the Public treatment first, while half began with the Private treatment first.

Figure 1. Experiment design.

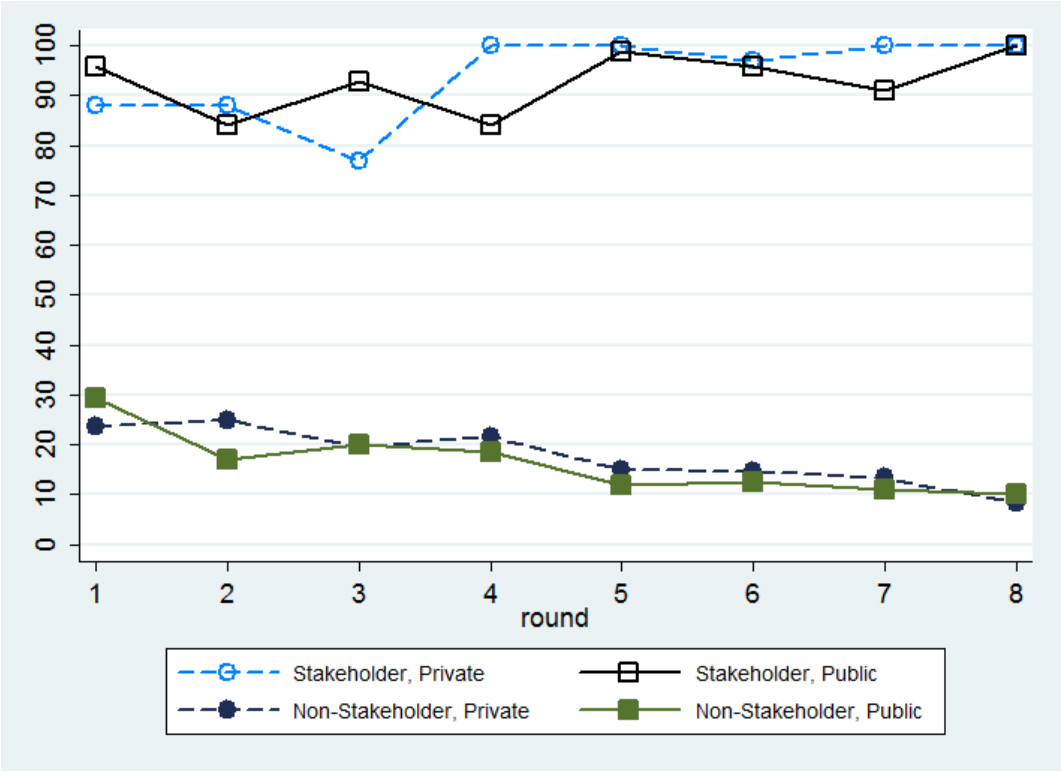


Figure 2: Contributions across rounds by role and treatment (in percent of endowment)

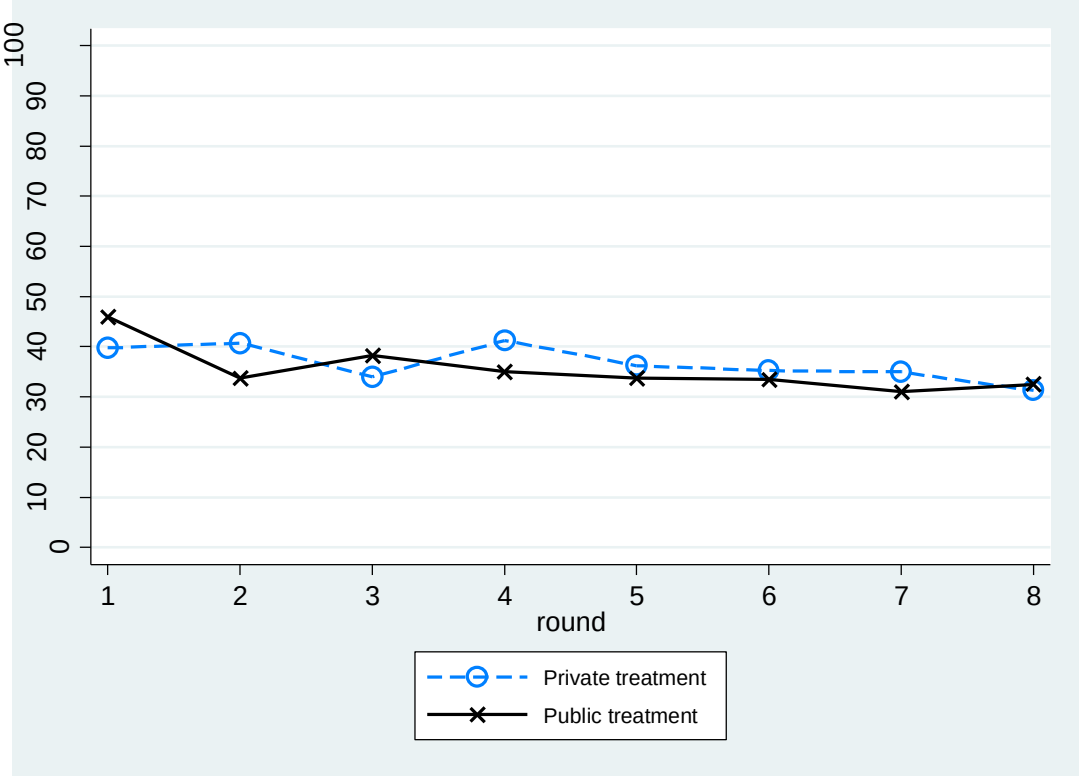


Figure 3: Group average public bad provision by treatment (in percent of total group endowment)

Tables

Table 1: Distribution of contribution amounts by treatment and role

	Non-Stakeholder		Stakeholder	
	Private	**Public**	**Private**	**Public**
Gave 0% of endowment[a]	161 (67.08%)	140 (58.33%)	3 (3.75%)	2 (2.5%)
Gave intermediate amount[a]	60 (25%)	86 (35.83%)	8 (10%)	12 (15%)
Gave 100% of endowment[a]	19 (7.92%)	14 (5.83%)	69 (86.25%)	66 (82.5%)
Median contribution	0	0	Endowment	Endowment
Subjects who always follow selfish dominant strategy[b]	13 (32.5%)	14 (35%)	29 (72.5%)	27 (67.5%)
Number of contributions	240	240	80	80
Number of subjects	40	40	40	40

[a] Cells contain number of contributions with percent of contributions in parentheses.
[b] Selfish dominant strategy is to contribute 0 as Non-Stakeholder and 100% of endowment as Stakeholder.

Table 2: Mean contributions by role and treatment (in percent of endowment)

	Non-Stakeholder	Stakeholder
Private	17.67	93.75
	(24.58)	(13.95)
Public	16.33	92.88
	(21.79)	(15.34)
Wilcoxon rank-sum test *p* value	0.992	0.680

N = 40 in each cell. Standard deviations in parentheses.

Table 3: Evidence of reciprocal contributions

	Private	Public
Stakeholder extracted > 50% when I was Stakeholder in past	25.00	29.32
	(34.76)	(32.24)
Stakeholder extracted ≤ 50% when I was Stakeholder in past	19.23	9.06
	(30.37)	(10.68)
N	13	11
Wilcoxon signed-rank test *p*-value	0.420	0.058

N < 40 in each cell because subjects who did not face both "nice" and "mean" Stakeholder were dropped. Standard deviations in parentheses.

Table 4. Panel Regressions of Non-Stakeholder Contributions on History

	I (OLS)	II (Tobit)
Stakeholder average past contributions to me	0.46***	-0.28
	(0.11)	(0.57)
Average past Non-Stakeholder contributions (excluding self)	-0.03	0.06
	(0.27)	(0.07)
Period	-2.29	-1.07
	(1.96)	(1.19)
Public indicator × Stakeholder average past contributions to me	2.28*	3.24**
	(1.26)	(1.54)
Public indicator × Average past Non-Stakeholder contributions (excluding self)	0.23	0.03
	(0.31)	(0.09)
Public indicator × Period	0.88	-2.55
	(2.18)	(2.11)
Constant	12.25*	65.74***
	(6.89)	(8.81)
Observations (rounds)	360	360
Number of subjects	80	80
Wald chi-squared	4.28e+06	9.24
R^2 (overall) / Log likelihood	0.0304	-46.5199

Standard errors in parentheses. For OLS, errors are clustered on session, individual fixed-effects are used, and errors are bootstrapped. For Tobit, 0 is the lower limit and 100 is the upper limit; random effects are used, and marginal effects are reported.
Significance levels: *: 10%, **: 5% ***: 1%

Table A-1: Correlates of contribution decisions

Characteristic	Subjects with Characteristic	Treatment	Role	Difference
Democrat	21 of 40	Public	Stakeholder	Democrats give less (88.81 vs. 97.37, p=0.009)
Risk averse	17 of 40	Private	Non-Stakeholder	Less risk averse give more (27.94 vs. 10.07, p=0.026)
Risk averse	17 of 40	Private	Stakeholder	Less risk averse give less (87.65 vs. 98.26, p=0.054
Comprehension question wrong	6 of 40	Private	Non-Stakeholder	Wrong answer give more (42.50 vs. 13.28, p=0.022)
Comprehension question wrong	6 of 40	Public	Non-Stakeholder	Wrong answer give more (35.00 vs. 13.04, p=0.008)

Amounts given in percent of endowment. *P*-values are for Wilcoxon rank-sum test

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