# Income Inequality, Reciprocity and Public Good Provision: An Experimental Analysis

Andre Hofmeyr, Justine Burns and Martine Visser

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# Income Inequality, Reciprocity and Public Good Provision: An Experimental Analysis

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**Abstract**

This paper analyses the impact of income inequality on public good provision in an experimental setting. A sample of secondary school students were recruited to participate in a simple linear public goods game where income heterogeneity was introduced by providing participants with unequal token endowments. The results show that endowment heterogeneity does not have any significant impact on contributions to the public good, and that consistent with models of reciprocity, low and high endowment players contribute the same fraction of their endowment to the public pool. Moreover, individuals appear to adjust their contributions in order to maintain a fair share rule.

## 1 Introduction

Economists have become increasingly interested in the impact of heterogeneity on the provision of public goods, but while there is agreement that heterogeneity is likely to affect the provision of public goods, disagreement arises over the direction of such an effect. One school of thought argues that heterogeneity results in the under-provision of public goods, since heterogeneity undermines group cohesion, thereby raising the transactions costs of bargaining. Individuals may be more prone to co-operate when others in their group or community are similar to them, since this fosters a strong group identity (Kramer and Brewer, 1984; Kollock, 1998). Groups characterised by greater heterogeneity, be it extreme wealth inequalities or ethnic diversity, may be less successful in resolving collective action dilemmas, not only because polarised societies may be more prone to competitive rent-seeking by different groups within that society, but also because such diversity may promote polarisation in preferences, thereby making it difficult to reach consensus of the type and quality of public goods and services to be provided (Baland and Platteau 1997a,b; Alesina and Drazen, 1991). An alternative school of thought, however, posits that heterogeneity will result in higher provision of the public good since heterogeneity is associated with a less well-endowed median voter, who "votes" in favour of public good provision. Moreover, if the benefits of public goods are purely localised, and enjoyed by specific groups alone, be they ethnic groups or groups defined in terms of income/wealth status, then a common pool model may well imply the over-provision of public goods in the context of ethnic or income diversity (Alesina and Drazen, 1991).

Alongside this work, there is now a growing body of experimental results that have tackled the same question using public goods games (see for example Anderson, Mellor and Milyo, 2003; Chan et al, 1999; Cherry, Kroll and Shogren, 2003; Rappoport and Suleiman, 1993), and our work forms

*Andre Hofmeyr is a Masters student in the School of Economics at the University of Cape Town. Justine Burns is a senior lecturer in the School of Economics at the University of Cape Town and Research Associate of the Southern Africa Labour and Development Research Unit (SALDRU). Martine Visser is a lecturer in the School of Economics at the University of Cape Town and Research Associate of SALDRU. Financial support for the working paper version of this article gratefully acknowledged from Economic Research Southern Africa (ERSA).

part of this tradition. In this paper, we report the results of linear public goods games that explicitly examine the impact of income heterogeneity, introduced through the random allocation of differing player endowments, on aggregate contributions to the public good at the group level, as well as the differential effect that such heterogeneity has on the contributions of well-endowed individuals relative to less well endowed group members. We find that endowment heterogeneity does not have any significant impact on contributions to the public good, and that consistent with models of reciprocity, low and high endowment players contribute the same fraction of their endowment to the public pool. Moreover, individuals appear to adjust their contributions in order to maintain a fair share rule.

## 2 Public Goods Games and Income Inequality

Since Bohm (1972) first investigated the willingness of individuals to provide public goods in an experimental setting, a multitude of these studies have been undertaken (see Ledyard (1995) for a detailed overview of public goods experiments). Whilst experimental designs may vary, the most common approach is to use the Voluntary Contribution Mechanism (VCM) or Public Goods (PG) game to examine this question.

The details of a simple, linear public goods game are as follows. A group of subjects – usually between 4 and 10 people – take part in the experiment. Each individual is given an endowment of tokens that they can allocate between their private account and a public account or common pool[1]. Any tokens that are placed in the private account are kept by the individual for himself. Those tokens placed in the public account are totalled and then multiplied by some factor, k – where k is greater than 1 but less than the number (n) of participants in the game - and then distributed equally amongst all n players in the group, irrespective of whether the individual contributed to the public account or not. Thus, an individual's payoff is increasing in the number of tokens in the public account but each token invested by a player provides a private return that is less than the value of the token. For example, suppose k=2 and n=4. A token placed in the public account will yield only one half of the value of the token for the contributing player - the marginal per capita return (MPCR) is 0.5. The structure of this game results in a unique Nash equilibrium of zero contributions to the public account because each player has a dominant strategy to free-ride on the contributions of others.

Numerous studies have shown that this prediction is not borne out by the experimental results. In single round ("one shot") public goods games, individuals do not play the Nash Equilibrium but generally contribute between 40 and 60 percent of their endowment to the public account (Dawes & Thaler, 1988: 189). In multiple round ("repeated play") public goods games, contribution rates to the public account tend to decay over the course of the game but remain at between 15 to 25 percent of the endowment by the final round (Ostrom, 2000: 140). Thus, it would appear that individuals are not motivated solely by self-interest as classical economic theory presumes.

Experimenters have used a variety of methods to introduce income heterogeneity into public goods games. These methods include varying participant's show-up fees (Anderson, Mellor & Milyo, 2003), and providing subjects with different endowments[2] (Chan et al., 1999; Cherry, Kroll & Shrogen, 2003; Rappoport & Suleiman, 1993; and Bergstrom et al., 1986). Much like the theoretical and econometric work in this area, the results from these studies are mixed, with some authors finding that income inequality tends to reduce group contributions to the public account (Bergstrom et al., 1986; Isaac and Walker, 1988; Anderson, Mellor and Milyo, 2003), while others report higher

[1] 'Account' and 'pool' are synonymous and will be used interchangeably throughout the text.

[2] The show-up fee is the money paid to participants simply for taking part in the experiment. An individual receives an endowment of tokens in each round of a repeated public goods game. To introduce income inequality to a public goods game one can vary the show-up fees or token endowments of participants. When each participant is allocated the same unequal endowment in all rounds of the game, this introduces continual, as opposed to initial, inequality in incomes.

aggregate contributions (Cherry, Kroll & Shrogen, 2003; Chan et al., 1996; and Cardenas, 2002). In part, these differences may be attributed to differences in the design of public goods games[3]. Relatively fewer studies have focused on how income heterogeneity affects the contributions of the wealthier group members relative to the less wealthy. Again, the evidence is mixed, but while earlier studies suggested that wealthier individuals tended to over-contribute to the provision of public goods (Bergstrom et al, 1986), the weight of more recent studies is in favour of the opposite conclusion, namely that less well endowed players tend to over-contribute to the public pool relative to the wealthier individuals in the group (Chan et al, 1996; Cardenas, 2002; Buckley and Croson, 2004

# 3 Explaining public goods provision when income inequality is present: Altruism, Inequality aversion and reciprocity

Regardless of the method in which inequality is introduced into the game, models of altruism, inequality aversion and reciprocity have been proposed to derive predictions about the impact of inequality on public good provision. These models offer different predictions of individual behaviour, particularly with regards to absolute and relative contributions to the public pool.

In Becker's (1974) model of altruism, an altruist's utility is an increasing function of his own income and the income of other individuals. Thus:

$$U^A = U^A\left(X_A, X_B\right)$$

where $X_A$ and $X_B$ are the payoffs to the altruist and the other members of his group, respectively, and taken together, they constitute "social income". Since an altruist will act to maximise "social income", he will refrain from all actions that lower the income of other individuals by more than they increase his own, because this would lower "social income" and reduce the altruist's utility. Importantly, individuals motivated solely by altruism should contribute their entire token endowment to the public account, because on the margin, the ratio of the altruist's utility to the utility of the other group members equals 1 by definition (Becker, 1976: 819), implying that he will always contribute a token to the public account because by not doing so he necessarily lowers "social income".[4] Consequently, in a public goods game where endowment heterogeneity is introduced, since an altruist should contribute his entire endowment, high-income players should contribute a larger absolute amount to the public account than low-income players, by mere virtue of the fact that they have more tokens to contribute. Note, however, that since contributions in these public goods games rarely approximate 100%[5], altruism does not appear to provide a complete explanation for behaviour in these games.

Models of inequality aversion posit that an individual's utility increases in the equality of payoffs of all the players (Fehr & Schmidt, 1999). Individuals derive utility not only from their payoff

[3] In a linear public goods game, the marginal per capita return (MPCR) is constant throughout the course of the experiment. In a non-linear public goods game, the MPCR varies as the level of contributions change. Consequently, linear and non-linear public goods games have different equilibrium predictions. This is an important factor in explaining the divergent results presented above as some of those studies used a linear public goods game while others used the non-linear variant.

[4] As an example, if the marginal per capita return from the public account is 0.5 and an altruist is deciding whether to contribute a token to the public or private account, he will contribute this token to the public account to maximise "social income". Although contributing this token to the public account lowers his potential payoff by 0.5 tokens, it raises the other participant's payoffs by 0.5 tokens each. In the example above, where n=4, this would raise the combined payoff of the other participants by 1.5 tokens. The 1.5 token gain of the rest of the group offsets the 0.5 token loss of the altruist, and therefore it will always be in the altruist's interest to contribute a token to the public account.

[5] When communication is allowed amongst group members, contributions do increase significantly and may approach 100%. Arguably, in this instance though, contributions are motivated by communication as opposed to altruism.

but also from their position with respect to the other members of their group. Individuals dislike obtaining either a higher or lower payoff than the rest of their group. Thus:

$$U_i = \prod_i - \delta_i \max\left(\prod_{avg} - \prod_i, 0\right) - \alpha_i \max\left(\prod_i - \prod_{avg}, 0\right)$$

where $\pi_i$is the material payoff to player i and $\pi_{avg}$ is the average payoff to the rest of the group. It is assumed that $\delta_i > \alpha_i > 0$. This utility function is increasing in $i's$ payoff and decreasing in his aversion to differences in payoffs, with his aversion to disadvantageous inequality (represented by $\delta_i$) weighted more heavily than his aversion to advantageous inequality (represented by $\alpha_i$). In a public goods game with endowment heterogeneity, these models predict that high-income individuals will contribute a larger fraction of their endowment to the public account than low-income individuals to reduce inequality (thereby equalising earnings) in the group (Buckley & Croson, 2004: 4).

Finally, models of reciprocity have also been advanced to explain voluntary contributions to public goods (Sugden, 1984). The principle of reciprocity requires that if members of the group are voluntarily contributing to a public good from which the individual derives benefits, then that individual is morally obliged to reciprocate their kindness and contribute to the good, even though self-interest would suggest defection as the optimal strategy. Individuals are thus viewed as conditional co-operators, contributing when others in the group contribute, but defecting when others defect as well.

Sugden (1984) suggests that in situations where income heterogeneity exists, reciprocating individuals will contribute their "fair share" to the provision of a public good, provided that others are also contributing. "Fair share", in this context, demands that individuals contribute "effort as relative money contribution: a person's effort is measured by the size of his money contribution as a proportion of his income" (Sugden, 1984: 776). Therefore, individuals reciprocate by contributing the same fraction of their endowment as the other members of their group. For example, they may all try to contribute 25 percent of their endowment to the public good. This model predicts that in public goods with endowment heterogeneity, high and low-income individuals will tend to contribute the same fraction of their endowment to the public account so as to conform to a "fair share" threshold, implying that the absolute contribution of a high-income individual is larger than that of a low-income individual.

To summarise, various models have been proposed to explain contributions to public goods under conditions of income heterogeneity. Models of altruism predict that individuals will contribute their entire endowment to the public account to maximise "social income". Thus, high-income individuals contribute more in absolute terms than low-income individuals because they have larger endowments. Models of inequality aversion predict that high-income individuals will contribute a larger percentage of their endowment (and thus larger absolute amount as well) to the public account than low-income individuals to reduce inequality in the group. On the other hand, models of reciprocity predict that high and low-income individuals will contribute the same fraction of their endowment (but different absolute amounts) to the public account because individuals bring notions of fairness to each interaction. The experimental design used in this paper allows us to explicitly test which of these models appears most consistent with our data.

# 4 Experimental Design

For this study, eighty secondary-school children were recruited from Khayelitsha in the Western Cape of South Africa. Participants were recruited through a non-governmental organisation providing extra tuition in Mathematics, English and Science. Just over 50% of the individuals in this sample were male. On average, the participants were 18 years old, had lived in Khayelitsha for just less than half their lives, and the majority reported Xhosa as their home language.

Participants were randomly assigned to groups of four to take part in a simple linear public goods game - as adapted by Isaac, Walker and Thomas (1984) - which lasted for ten rounds and had a marginal per capita return (MPCR) of 0.5[6]. There were 20 groups in total. Ten groups were assigned to participate in the Equal treatment (where all participants received the same token endowment) and ten in the Unequal treatment (where participants randomly received different token endowments). In the equal treatment, each participant received 40 tokens to divide between the public and private accounts in each round of the game. In the unequal treatment, two participants in the group received 30 tokens and two received 50 tokens to play with in each round. Thus, income heterogeneity was introduced in the unequal treatment by varying participant's endowment levels. Endowment status was randomly allocated, and each token was worth 10c. For the groups in the equal treatment, the experimenter announced that all players had received 40 tokens to play with in each round of the game. For groups in the unequal treatment, the experimenter announced that two players had received 50 tokens and that two had received 30 tokens to play with in each round of the game. However, the actual identity of high and low endowment players was not publicly revealed in the group. Individuals maintained their endowment status for the duration of the experiment. [7]

The games were run at the public library in Khayelitsha. For each experimental session, participants were directed to their groups and then taken into the library. Here, subjects were seated at separate tables which were divided by partitions to ensure that the individual's decisions were private. Each participant was asked to read and sign a consent form before the experiment began. The experimenter then carefully explained the details of the public goods game before working through examples with the participants. Two practice rounds were conducted before the start of the first round to ensure that participants correctly understood the game. At the end of the experiment, participants were asked to fill out a questionnaire that elicited information about their background, their extra-curricular activities and their answers to a range of attitudinal questions. Participants earned R128 on average for participating in the experiments of which R20 was a show-up fee given to each individual for taking part in the

games. Experimental sessions lasted for approximately two and a half hours.

# 5 Results

**Result 1***: Endowment heterogeneity has no significant impact on contributions to the public good.*

Figure 1 below presents a plot of the mean offers per round across Equal and Unequal treatment groups. In Equal treatment groups, the average contribution in round one of the game is 33% , and while there is some variation in mean contributions over rounds, the mean contribution in the final round of the game is also 33%. In contrast, in the Unequal treatment groups, average contributions in round 1 are 46%, and fall to 42% by the final round. Thus, unlike other studies, we do not see the same rate of decline in mean contributions to the public good over rounds. In part, this may have to do with the relative homogeneity of our sample as well as the relatively small group size, which,

[6] This follows the trend in the international literature to set MPCR at 0.5.(Andreoni, 1988a&b; Croson, 1998).

[7] The decision making exercise was described to participants in the following way: You have been given a number of tokens to play with. In each round, you must decide how many tokens to put into a **Private Account**, and how many to put into a **Public Account**. Any tokens you put into the **Private Account, you will keep for yourself.** Keep a record of your decision on your **Personal Record Sheet**. You will also earn tokens from the **Public Account**. At the end of each round, the number of tokens in the **Public Account** will be added up. This number will be DOUBLED, and we will then divide this equally amongst everyone in the group, irrespective of how many tokens you put into the **Public Account**. Your total earnings from the round will be equal to the number of tokens in the Private Account + the tokens you get from the Public Account. We will repeat this 6 times. At the end of the 6 rounds, we will add up all the tokens you have earned during each round of the game, and this will tell us how much to pay you. **Each token you earn is worth ten cents**. For example, if you earn 500 tokens, you will be paid R50. A full copy of the instructions used can be obtained from the authors on request. In addition, participants were taken through a number of numerical examples prior to the commencement of the game, to ensure that everyone understood the game properly.

according to Olson's (1965) logic of collective action, makes it easier for participants to co-ordinate their actions, and makes deviation from the group mean less likely.[8]

While contributions in unequal groups are higher than contributions in equal groups on average, these differences are not significant at the 5% significance level.[9]. This is confirmed by the pooled OLS regression results presented in Columns 1 and 2 of Table 1, which suggest that while offers in equal treatment groups are lower than unequal groups, this difference is not significant (even if one limits the analysis to Round 1 only, where the observed difference in mean offers appears largest).

All regressions include controls for group dummies[10] and age. (not reported) "All" includes both the equal and unequal treatments. Absolute value of t-statistics in brackets. *** = 1% significance; ** = 5% significance; * = 10% significance.

**Result 2:** C*onsistent with models of reciprocity, low and high endowment players contribute the same fraction of their endowment to the public account*

As the results in Columns 3 and 4 of Table 1 suggests, low and high endowment players in the unequal treatment tend to contribute a similar fraction of their endowment to the public account across rounds. Although the coefficient on "Low endowment player (30 tokens)" is positive, this variable is not significant. Thus, there is no statistically significant difference in the contributions of low and high endowment players, as a fraction of their endowment, across the 10 rounds of the game. A regression including observations only from round 1 also finds that there is no significant difference in contributions to the public account between low and high endowment players when controlling for group level differences (Column 4, Table 1).

Since low and high endowment players contribute the same fraction of their endowment to the public account, this means that high endowment players must also contribute a larger absolute amount, on average, to this account. This was confirmed in regression results (not reported here), indicating that high endowment players contribute 6.4 tokens more, on average, than low endowment players and that this value is significant at the 1 percent level. While this result is consistent with models of altruism and reciprocity, we take the view that reciprocity is a more plausible explanation. Since the aggregate contributions to the public pool never approach 100 percent of the groups' token endowment, models of altruism fail to provide a complete account of the results from this study. Moreover, models of inequality aversion assert that high-income individuals will contribute a larger fraction of their endowment to the public account than low-income individuals - our results do not support such a model to explain our results.

**Result 3** *Individuals adjust their contributions to maintain the fair share rule*

In the discussion of Sugden's (1984) model of reciprocity, it was suggested that individuals bring notions of fairness to each interaction which affect their behaviour. In a public goods game, reciprocity requires that individuals contribute the same fraction of their endowment to the public account as the other players in their group, as we have demonstrated above.

Table 3 presents regression results, in which we examine whether *changes* in the fraction of the endowment contributed appears to be responsive to this notion of a fair share threshold. Sugden's notion of a fair share threshold in which all individuals contribute the same fraction of their endowment to the public account was formalised by creating the following variable:

$$D = \left(\frac{tokens\ contributed\ by\ i}{token\ endowment\ of\ i}\right) - \left(\frac{Total\ tokens\ in\ pool - tokens\ contributed\ by\ i}{Maximum\ number\ of\ tokens\ in\ pool - token\ endowment\ of\ i}\right)$$

where D is the deviation from the fair share threshold. The first term in this expression simply represents individual i's contribution to the public pool as a fraction of his endowment, whilst the second term represents the average contribution of others in the group to the public pool (also

[8] We are grateful to an anonymous referee for making this point.

[9] The Mann-Whitney z-statistic is -1.79 (p=0.073).

[10] Since the game is played in groups of 4, individual outcomes within groups is likely to be more correlated than outcomes across groups, particularly since each group will develop a game dynamic of its own. Thus, group dummies are included to control for any group specific effects that might influence the results.

measured as a fraction of endowment status). This variable will take on a positive value when individual i has contributed more as a fraction of his endowment than the rest of his group.

We include this variable as a lagged regressor in our model to determine whether an individual's deviation from the fair share threshold in the previous round will affect the change in his contribution between this round and the next. If individuals are conditional co-operators motivated by reciprocity concerns, then we would expect the coefficient on D to be negative since individuals who contributed more than their fair share in the previous round should adjust their offers downwards. The converse holds true. Our results presented in Table 2 confirm that this is indeed the case.

**Result 4** *Contributions by the majority of players approximate a conditional fair share threshold.*

That players appear to adjust their offers in response to a fair share rule with the result that both high and low endowment players contribute the same fraction of their endowment is quite remarkable, especially when one considers the cognitive demands involved in calculating how much the other players of an individual's group contributed relative to what they could have contributed (particularly in the unequal treatment where endowment heterogeneity exists).

However, even more remarkable is the fact that this choice behaviour effectively implements contributions that approximate what we term a "*conditional fair share threshold*", namely, each player's contribution to the total resources in the public account is in direct proportion to their endowment allocation. More specifically, our data suggests that individuals may have calculated the ratio of their token endowment to the total tokens allocated to the group to construct a fair share threshold that informs their decisions. In equal treatment groups, this amounts to each player contributing 25 percent (40/160) *of the total tokens in the public account.* In unequal groups, low endowment players would have to contribute 19 percent (30/160) and high endowment players 31 percent (50/160) of the total tokens in the public account for their contributions to approximate this fair share threshold.

To illustrate this point, assume that 40 tokens have been allocated to the public account in total in one round of an unequal treatment game. As a high endowment player, a fair share contribution would have been 12.5 tokens (calculated as (5/16)*40). As a low endowment player, a fair share contribution would have been 7.5 tokens (calculated as (3/16)*40). Note that in following this rule, these individuals would both contribute 25% of their token endowment (since $7.5/30 = 12.5/50 = 0.25$), thereby satisfying the reciprocity requirement[11].

Panel B[12] of Table 3 presents compelling evidence that individual contributions to the public account approximate a conditional fair share threshold (conditional on the individual's endowment). On average, participants in the equal treatment groups contribute 25 percent of the total tokens in the public account. In unequal groups, low endowment players contribute 21 percent and high endowment players contribute 29 percent, on average, of the total tokens in the public pool. Although low endowment players contribute slightly more than their fair share and high endowment players slightly less, these differences are not significant. Moreover, Result 2 demonstrated that there is no statistically significant difference in the contributions of low and high endowment players as a fraction of their income, implying that individuals' decisions are motivated by concerns for fairness and reciprocity.

# 6 Discussion

The results from this study suggest that individuals did bring preferences for fairness to the experimental setting. The results suggest that equal and unequal groups contribute the same fraction of

[11] Forty tokens was an arbitrary value used for illustrative purposes. This result holds for any group contribution to the public account. Importantly, this result hinges on making a distinction between the *fraction of the individual endowment contributed* (e.g. 25% of token endowment), and the *fraction of the total resources in the public pool* accounted for by the individual's contribution (In this case, 19% for low endowment players).

[12] Panel A provides data on the average fraction of the endowment contributed in each round for comparison. Panel B presents data on the fraction of the total tokens in the public pool accounted for by the individual's contriburion.

their endowment to the public account across the ten rounds of the game, and that high and low endowment players contribute the same fraction of their endowment to the public account. Individuals' contributions to the public account approximate a fair share threshold, even in the presence of endowment heterogeneity, and deviations from this threshold prompt correcting behaviour. If an individual has contributed less than his fair share in a particular round he will increase his contribution between this round and the next, and vice-versa. Thus, a strong concern for reciprocity is evident in the results.

Such reciprocal behaviour may also provide at least a partial explanation for why our data do not demonstrate the same rate of decline in contributions across rounds as in some other studies. Individuals appear to make numerous adjustments to their contributions in order to maintain their fair share. This, combined with the fact that these participants knew one another well and had participated in numerous study sessions together, would serve to maintain co-operation in this setting.

An interesting question that arises is why participants in these games do not appear to be concerned with minimising inequality in token endowments. One possibility is simply that the extent of the inequality (30 tokens versus 50 tokens) was not large enough to induce a strong behavioural response in this regard. Another possibility is that the cognitive requirements involved in calculating the differences in payoffs to high and low endowment players in a particular round, thereby adjustments in contributions in the following rounds so as to equalise earnings in the group may have been too high. This would have been particularly difficult given the limited information that individuals received at the end of each round – how many tokens were contributed to the public account in total and how much each player therefore earned from the public account. Thus, although individuals may be averse to inequality per se, they may struggle to determine whether inequality is in fact being reduced (or increased) throughout the course of the game. Both of these possibilities suggest interesting avenues for future research studies to pursue.

# References


[1] Alesina, A. & Drazen, A. 1991: "Why are Stabilisations Delayed?", *American Economic Review*, LXXXI, pp 1170-1188.

[2] Alesina, A. and D. Rodrik, 1994, "Distributive Politics and Economic Growth", *The Quarterly Journal of Economics,* 109: 465-489.

[3] Anderson, L., Mellor, J., & Milyo, J. 2003. "Inequality, Group Cohesion and Public Good Provision: An Experimental Analysis". *Working Paper*, Department of Economics, University of Missouri.

[4] Andreoni, J. 1988a. "Privately Provided Public Goods in a Large Economy: The Limits of Altruism." *Journal of Public Economics,* 35: 57–73.

[5] Andreoni, J. 1988b. "Why Free Ride? Strategies and Learning in Public Goods Experiments. *Journal of Public Economics 37*, 291–304.

[6] Baland, J.M. & J.P. Platteau 1997a: "Coordination problems in local level resource management," *Journal of Development Economics* , 53, 197-210.

[7] Becker, Gary. 1974. "A Theory of Social Interactions." *Journal of Political Economy.* 82(6): 1063-1093.

[8] Becker, G. 1976. "Altruism, Egoism and Genetic Fitness: Economics and Sociobiology". *Journal of Economic Literature*, 14(3): 817-826.

[9] Bergstrom, T., Blume, L., & Varian, H. 1986. "On the Private Provision of Public Goods." *Journal of Public Economics*. 29: 25-49.

[10] Bohm, P. 1972. "Estimating demand for Public goods: An experiment." *European Economic Review.* 3: 111-130.

[11] Buckley, E. & Croson, R. 2004. "Income and Wealth Heterogeneity in the Voluntary Provision of Linear Public Goods" *Working Paper*, The Wharton School, University of Pennsylvania.

[12] Cardenas, Juan-Camillo. 2002 "Real Wealth and Experimental Cooperation: Experiments in the Field Lab." *Journal of Development Economics*: 70(2), 263-289.

[13] Chan, K., Mestelman, S., Moir, R. & Muller, R. 1996. "The Voluntary Provision of Public Goods under Varying Income Distributions." *Canadian Journal of Economics.* 96: 54-69.

[14] Chan, K., Mestelman, S., Moir, R. & Muller, R. 1999. "Heterogeneity and the Voluntary Provision of Public Goods." *Experimental Economics.* 2(1): 5-30.

[15] Cherry, T., Kroll, S., & Shrogen, J. 2003. "The Impact of Endowment Heterogeneity and Origin on Public Good Contributions: Evidence from the Lab." *Journal of Economic Behaviour and Organisation.* 57(3): 357-365.

[16] Croson, R. 1998. "Differentiating Altrusim and Reciprocity." *Working Paper*, The Wharton School, University of Pennsylvania.

[17] Dawes, R. & Thaler, R. 1988. "Cooperation". *Journal of Economic Perspectives.* 2(3): 187-197.

[18] Fehr, E. & Schmidt, K. 1999. "The Theory of Fairness, Competition and Co-operation" *The Quarterly Journal of Economics*, August.

[19] Isaac, M., Walker, J. & Thomas, S. 1984. "Divergent Evidence on Free Riding: An Experimental Examination of Possible Explanations." *Public Choice*, 43: 113-149.

[20] Isaac, R.M. and Walker, J.M. (1988) "Group size effects in public goods provision: the?voluntary contributions mechanism", in *Quarterly Journal of Economics*, pp 179-200.

[21] Kramer, R. & Brewer, M.B. 1994: "Effect of Group Identity on Resource Use in a Simulated Commons Dilemma," *Journal of Personality and Social Psychology*, 46, 1044,Äî1057.

[22] Kollock, P. 1994: "The Emergence of Exchange Structures: An Experimental Study of Uncertainty, Committment, and Trust," *American Journal of Sociology*, 100, 313,Äî345.

[23] Ledyard, John. 1995. "Public goods: A survey of experimental research," in Kagel and Roth, eds, *Handbook of Experimental Economics*, Princeton, NJ: Princeton University Press: 111-194.

[24] Olson, Mancur. 1965. *The Logic of Collective Action: Public goods and the Theory of Groups.* Cambridge, MA: Harvard University Press

[25] Ostrom, E. 2000. "Collective Action and the Evolution of Social Norms". *The Journal of Economic Perspectives.* 14(3): 137-158.

[26] Rappoport, A. & Suleiman, R. 1993. "Incremental Contribution in Step Level Public Goods Games with Asymmetric Players". *Organizational Behavior and Human Decision Processes*, 55: 171-194.

[27] Sugden, R. 1984. "Is Fairness Good? A Critique of Varian's Theory of Fairness." *Nous*, 18: 505-511.

[28] Visser, M. & Burns, J. 2005. "Inequality and the Provision of Public Goods: Experimental Evidence from non-university Students in South Africa." *Working Paper*, Department of Economics, University of Cape Town.

*Figure 1: Mean Fraction of Endowment Contributed to Public Account by Treatment*

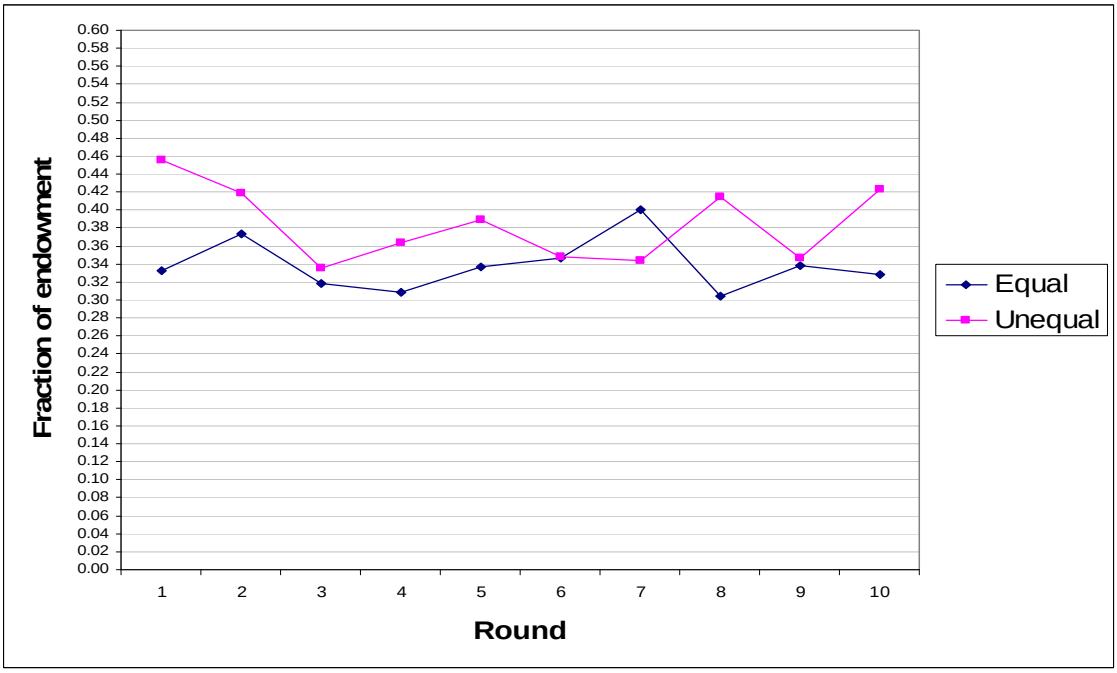


*Table 1: Fraction of endowment contributed to public account by treatment*

| Dep var: Fraction of endowment contributed to public pool | | | | |
|---|---|---|---|---|
| | All | All (Round 1) | Unequal treatment | Unequal treatment (Round 1) |
| | (1) | (2) | (3) | (4) |
| Round | -0.001 | | -0.002 | |
| | (-0.66) | | (-0.83) | |
| Equal Treatment | -0.044 | -0.089 | | |
| | (-0.72) | (-0.45) | | |
| Low endowment player (30 tokens) | | | 0.033 | 0.084 |
| | | | (1.2) | (0.92) |
| Constant | 0.78 *** | 0.85 * | 1.18 *** | 0.88 |
| | (5.48) | (1.88) | (6.05) | (1.36) |
| Adj. R2 | 0.18 | 0.13 | 0.25 | 0.07 |
| n | 800 | 80 | 400 | 40 |

*Table 2: Adjustments in contributions to maintain a fair share*

| Dep var: Change in fraction of endowment contributed to public pool | | | | |
|---|---|---|---|---|
| | All | | Unequal treatment only | |
| | (1) | | (2) | |
| Round | 0.000 | | 0.001 | |
| | (-0.016) | | (0.233) | |
| Equal Treatment | -0.032 | | | |
| | (-0.51) | | | |
| Low endowment player (30 tokens) | | | 0.015 | |
| | | | (0.54) | |
| Deviation from fair share in previous round | -0.760 | *** | -0.788 | *** |
| | (-20.35) | | (-14.79) | |
| Constant | 0.660 | *** | 0.960 | *** |
| | (4.37) | | (4.5) | |
| Adj. R2 | 0.360 | | 0.370 | |
| n | 720 | | 360 | |

All regressions include controls for group dummies, age and the combined contributions by others in the group in the previous round (not shown) .
"All" includes both the equal and unequal treatments. Absolute value of t-statistics in brackets.
*** = 1% significance; ** = 5% significance; * = 10% significance.

*Table 3: Mean contributions by round*

| | | Panel A: Number of tokens contributed as fraction of endowment | | | | Panel B: Number of tokens contributed as fraction of tokens in pool | | | |
|---|---|---|---|---|---|---|---|---|---|
| Round | | Player allocated 30 tokens | Player allocated 40 tokens | Player allocated 50 tokens | All Players | Player allocated 30 tokens | Player allocated 40 tokens | Player allocated 50 tokens | All Players |
| Round 1 | Mean | 0.51 | 0.33 | 0.43 | 0.40 | 0.20 | 0.25 | 0.30 | 0.25 |
| | Std. Dev | 0.33 | 0.28 | 0.27 | 0.30 | 0.14 | 0.20 | 0.17 | 0.18 |
| Round 2 | Mean | 0.39 | 0.37 | 0.44 | 0.39 | 0.17 | 0.25 | 0.33 | 0.25 |
| | Std. Dev | 0.29 | 0.28 | 0.26 | 0.27 | 0.12 | 0.19 | 0.17 | 0.18 |
| Round 3 | Mean | 0.41 | 0.32 | 0.29 | 0.33 | 0.25 | 0.25 | 0.25 | 0.25 |
| | Std. Dev | 0.31 | 0.26 | 0.21 | 0.26 | 0.16 | 0.21 | 0.18 | 0.19 |
| Round 4 | Mean | 0.32 | 0.31 | 0.39 | 0.33 | 0.19 | 0.25 | 0.31 | 0.25 |
| | Std. Dev | 0.31 | 0.30 | 0.30 | 0.30 | 0.21 | 0.23 | 0.24 | 0.23 |
| Round 5 | Mean | 0.40 | 0.34 | 0.39 | 0.36 | 0.19 | 0.25 | 0.31 | 0.25 |
| | Std. Dev | 0.36 | 0.29 | 0.28 | 0.30 | 0.20 | 0.19 | 0.23 | 0.21 |
| Round 6 | Mean | 0.45 | 0.35 | 0.29 | 0.36 | 0.25 | 0.25 | 0.25 | 0.25 |
| | Std. Dev | 0.31 | 0.30 | 0.26 | 0.30 | 0.17 | 0.23 | 0.22 | 0.21 |
| Round 7 | Mean | 0.40 | 0.40 | 0.31 | 0.38 | 0.22 | 0.25 | 0.28 | 0.25 |
| | Std. Dev | 0.37 | 0.28 | 0.26 | 0.30 | 0.19 | 0.15 | 0.20 | 0.17 |
| Round 8 | Mean | 0.40 | 0.30 | 0.42 | 0.36 | 0.23 | 0.25 | 0.27 | 0.25 |
| | Std. Dev | 0.33 | 0.31 | 0.37 | 0.33 | 0.25 | 0.25 | 0.26 | 0.25 |
| Round 9 | Mean | 0.33 | 0.34 | 0.36 | 0.34 | 0.18 | 0.25 | 0.32 | 0.25 |
| | Std. Dev | 0.37 | 0.30 | 0.34 | 0.32 | 0.19 | 0.20 | 0.23 | 0.21 |
| Round 10 | Mean | 0.39 | 0.33 | 0.45 | 0.37 | 0.20 | 0.25 | 0.30 | 0.25 |
| | Std. Dev | 0.41 | 0.29 | 0.34 | 0.34 | 0.25 | 0.20 | 0.25 | 0.22 |
| **Average across rounds** | | **0.40** | **0.34** | **0.38** | **0.36** | **0.21** | **0.25** | **0.29** | **0.25** |