What Motivates Common Pool Resource Users? Experimental Evidence from the Field

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Keywords: common pool resources, experiments, altruism, reciprocity, conformism

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Abstract: This paper develops and tests several models of pure Nash strategies of individuals who extract from a common pool resource when they are motivated by a combination of self-interest and other motivations such as altruism, reciprocity, inequity aversion and conformism. We test whether an econometric summary of subjects' strategies is consistent with one of these motivations using data from a series of common pool resource experiments conducted in three regions of Colombia. As expected, average extraction levels are less than that predicted by a model of pure self-interest, but are nevertheless sub-optimal. Moreover, we find that a model of conformism with monotonically increasing best response functions best describes average strategies. Our empirical results are inconsistent with models of altruism, reciprocity and inequity aversion.

1. Introduction

There is substantial evidence that models of purely self-interested Nash behavior usually fail to explain individual behavior in situations in which private and social interests diverge, such as public good provision or common pool resource extraction. Several theories have emerged in an attempt to explain why individual choices differ from those predicted by self-interested Nash behavior. Many of these explanations are based on the assumption that individuals are motivated by a combination of both pure self- interest and other motivations such as altruism, reciprocity, inequality aversion, or conformism. Although there is a significant theoretical and experimental literature on theories explaining non-selfish behavior, to date there has been no study that develops a unified theoretical framework to discriminate among these competing models. Moreover, much of the literature focuses on models of reciprocity and altruism, but conformism has been given little attention.

This paper develops and tests several models of pure Nash strategies of individuals who extract from a common pool resource when they are motivated by a mix of self-interest and other motivations. In addition to a model of purely self-interested behavior, the other motivations that we consider are:

1. Altruism. Individuals have utility functions that include a positive weight on the payoffs of others.

2. Reciprocity that is conditioned on the expected resource extraction of others. In this model individuals place a positive weight on the payoffs of others when they expect others' extraction choices to not exceed their own, and a negative weight on the payoffs of others when they expect others' extraction choices to exceed their own.

3. Inequity aversion is similar to reciprocity, but individuals condition their choices on how their payoffs compare to the payoffs of others. Individuals place a positive value on the payoffs of others when they do not exceed their own, but they place a negative value on the payoffs of others when they do exceed their own.

4. Conformism. Individuals bear an internal penalty when their own choices deviate from the average choices of the others.

Using data from a series of common pool resource experiments conducted in rural Colombia, we test whether an econometric summary of subjects' strategies is consistent with one of these motivations.

Our models of altruism and reciprocity are adapted from the models developed by Levine (1998) and Bowles (2003). Our model of reciprocity generates a similar Nash best response function to that generated by Falk et al. (2002), who adapted Fehr and Schmidt's (1999) notion of inequity aversion to the common pool resource problem. We model conformism in a way that is similar to Luzzati (1999) and Bowles (2003), although Bowles calls this motivation 'guilt'. Each of these motivations, when combined with pure self-interest, generates a unique Nash best response function. We estimate individual extraction choices as a function of the individuals' expectation about the choices of the other group members. This yields a summary of individual best response functions that we then use to determine which motivation best explains average choices in our subject pool.

The common pool resource experiments were framed as an extraction decision from a community-owned natural resource. The experiments were conducted in three regions of Colombia in communities that are highly dependent on the extraction of a shared natural resource. Thus, the participants regularly face a social dilemma in their everyday lives similar to that presented in the experiment. Therefore, it is likely that participants' prior experiences with common pool resources and similar social dilemmas may influence their preferences and choices in a way that is not controlled by the experiment (Cardenas and Ostrom, 2004).

During an experiment, groups of five participants played 10 rounds of an open access

game.[1] Individuals payoffs were derived from a conventional model of common pool resource exploitation. Each round, subjects were asked to decide how much to extract from a shared resource. In addition, participants were also asked to provide their expectation of the aggregate level of extraction they anticipated that the others would choose in the current round. With data on both individual choices and the expectations about the aggregate choices of others, we estimate best response functions that are conditioned on an individual's expectation of the choices of the other four group members.[2]

As expected, we find that average extraction levels lie between that predicted by a model of purely self-interested behavior and that which would maximize group earnings. This result is consistent with individual strategies that balance self-interest and other factors. Our theoretical model suggests that the best response functions for individuals motivated by reciprocity or inequity aversion are not necessarily monotonic and will have segments that are downward-sloping. Altruistic preferences yield a monotonically decreasing best response function, and conformism suggests that the best response function will be monotonically increasing if conformism dominates pure self-interest.

Because the best response functions may be non-monotonic, we estimate a spline regression of individual extraction choices as a function of the expectations of what the others in their group will extract. Our estimation results indicate that the best response function is non-decreasing for relatively low levels of others' extraction, and is strictly increasing for mid to high levels of others' extraction. This suggests that a model of conformism best characterizes average strategies. We emphasize that our results do not suggest that all individuals are solely motivated by conformism, and not by altruism, reciprocity, or inequity aversion; only that an empirical summary of individual strategies reveals that conformism is dominant.

Our approach and results differ from similar studies in significant ways. Fischbacher, Gachter and Fehr (2001) analyze individuals' contribution schedules given the average contribution level of the other group members in a public good experiment. They graph the individual strategies of 44 participants and show that about half of the subjects are 'conditional cooperators', which they define as individuals who are willing to cooperate the more others

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[1] Each group played 10 additional rounds with different treatments involving combinations of communication and regulatory control. These additional data are not included in the present analysis.
[2] We should note an important caveat at this point. Strictly speaking, the models of Nash strategies that we develop apply to static common pool games, while our experiments clearly placed subjects in a dynamic environment. Thus, our results should be interpreted with this qualification in mind.

cooperate. Kurzban and Houser (2005) use a statistical-type classification algorithm to empirically assign individuals to one of three types in a public good experiment. Their algorithm identifies 20% of their subjects as free-riders, 13% as cooperators (altruists) and 63% as reciprocators or conditional cooperators.

Here, we focus on an econometric estimate of individuals' strategies and the summary it provides. Moreover, we have been able to distinguish between reciprocity and conformism as possible causes for conditional cooperation as previously identified by Frey and Meir (2004). Interestingly, Bardsley (2000) argues for the need to also distinguish between these alternative motivations in public goods provisions, which is exactly what we have accomplished in the context of a common pool resource experiment.

Fehr and Fischbacher (2002) survey the experimental evidence of ultimatum, dictator, public goods, and gift exchange games (among others) and argue that many experimental results can be explained by individual preferences for fairness and reciprocity. Our results suggest otherwise. Moreover, this literature fails to discriminate among other possible models, particularly conformism. In general, economists have been less interested in conformism as a motive driving individual behavior, although some have considered conformism in the context of public goods games. Luzzati (1999) provides a theoretical model of conformism in these situations. Carpenter (2004) provides experimental evidence that conformism could actually increase free-riding in public goods games. In contrast, our experiments suggest that conformism leads to more conservative exploitation of common resources.

The evidence explaining individual choices in common pool resource games is quite limited. Cardenas, Stranlund, and Willis (2000) reported results of common pool resource experiments conducted in rural villages of Colombia that are not consistent with the conventional Nash equilibrium levels of extraction. However, they did not attempt to attribute individual behavior to alternative preferences. Casari and Plott (2003) formulate a model of other regarding preferences that includes altruism or spite as alternatives to pure self-interest. From a pool of 32 subjects they found that about one third are other regarding, and these are predominantly spiteful. Falk, Fehr, and Fischbacher (2002) developed a theoretical explanation of behavior in common pool resource games by using Fehr and Schmidt's (1999) model of inequity aversion and the empirical regularities reported in Walker, Garden and Ostrom (1990) and Ostrom, Walker and Garden (1992). Our results challenge Falk et al's focus on inequity aversion and Casari and

Plott's focus on spite by suggesting that conformism is a better summary of individual behavior in open access problems.

Our results have profound implications for the understanding of individual behavior in the commons, and for the design and evaluation of government interventions to promote more efficient use of common pool resources. We stress the importance of the conformism motive and the role that it plays in producing outcomes that are more efficient than conventional Nash equilibria. Moreover, our results make it clear that policies based on conventional individual self-interests will not be appropriate when conformism is a more important motive.

The rest of this paper is organized as follows: The next section develops the theoretical models of pure Nash strategies under alternative sets of preferences. The third section focuses on the experimental design and the fourth section presents our econometric results. The last section concludes.

2. Models of Self-Interest, Altruism, Reciprocity (Inequity Aversion), and Conformism

In this section we present models of pure Nash strategies when individuals are motivated by self-interest, and self-interest combined with altruism, reciprocity, inequity aversion and conformism. Each of these alternatives generates best response function with distinct characteristics. Our experiment design and econometric estimations allows us to test for these characteristics.

2.1 Self-Interested Nash Strategies

The benchmark model for our study is the standard problem of individual extraction from a common pool resource by n individuals. The model is static and is similar to models presented by Ostrom et al. (1994), Falk et al. (2002), and an earlier model developed by Cornes and Sandler (1983).

Individual i extracts x_i units up to a capacity constraint x_i^{max}. Units of extraction sell at a constant price p. The individual's extraction costs are $c \sum_{i=1}^{n} x_i + dx_i \sum_{i=1}^{n} x_i$, where c and d are positive constants. Define $x_{-i} = \sum_{j \neq i} x_j$, and write i's extraction costs more compactly as $c(x_i + x_{-i}) + dx_i(x_i + x_{-i})$. These components of the cost function capture the social dilemma of the model in which $dx_i(x_i + x_{-i})$ captures the cost externality that is typical of common pool

resource problems, while $c(x_i + x_{-i})$ captures negative externalities that reduce individual existence or non-use values. The individual has an endowment e_i.

Given the extraction of others, the individual's self-interested extraction choice is determined by maximizing:

[1] $\pi_i = e_i + px_i - c(x_i + x_{-i}) - dx_i(x_i + x_{-i})$, subject to $x_i \le x_i^{max}$.

Throughout we will let π_i denote individual i's monetary payoff. Since π_i is strictly concave in x_i, the following Kuhn-Tucker condition is necessary and sufficient to identify a solution to [1]:

[2] $p - c - 2dx_i - dx_{-i} \ge 0$, if > 0, $x_i = x_i^{max}$.

Letting [2] hold with equality and solving for x_i yields the unconstrained best response function:

[3] $\hat{x}_i^s(x_{-i}) = (p - c - dx_{-i}) / 2d$.

The superscript s denotes the strategy of a purely self-interested individual. Incorporating the capacity constraint gives us the individual's best response function:

[4] $x_i^s(x_{-i}) = \min[\hat{x}_i^s(x_{-i}), x_i^{max}]$.

Each subject received the same payoff table generated from [1] with parameters $p = 116.875$, $c = 17.875$, $d = 2.75$ $e_i = 900$ and $x_i^{max} = 8$. Figure 1 graphs $\hat{x}_i^s(x_{-i})$ and $x_i^s(x_{-i})$ using these parameters. Let $\overline{x}_{-i} = \sum_{j \ne i} x_j / (n-1)$ represent the average extraction choices of the other group members, where $n = 5$. The function $x_i = \overline{x}_{-i}$ defines the set of choices in which individual i's extraction choice equals the average extraction of the others up to the group and individual capacity constraint (32,8). The intersection of $x_i = \overline{x}_{-i}$ and $x_i^s(x_{-i})$ at (24,6) is the standard symmetric Nash equilibrium. It is easy to show that if all individuals extract a single unit, then joint payoffs are maximized.

2.2 Other Regarding Preferences: Altruism, Reciprocity and Inequity Aversion

Models of altruism, reciprocity and inequity aversion reflect a balance between self-regarding and other regarding preferences. In that case, individual i places a value on the payoffs of others. Suppose individual i's utility is given by:

[5] $$u_i = \pi_i + \beta_i \sum_{j \neq i} \pi_j.$$

Following Levine (1998) and Bowles (2003), β_i can be specified to capture both altruism and reciprocity motives as follows:

[6] $$\beta_i = \beta_i(x_i - \overline{x}_{-i}) = \begin{cases} \alpha_i + \rho_i^+, & \text{if } x_i \geq \overline{x}_{-i} \\ \alpha_i - \rho_i^-, & \text{if } x_i < \overline{x}_{-i}, \end{cases}$$

where α_i, ρ_i^+, and ρ_i^- are positive constants. We construct β_i in this way to guarantee that all best response functions are piecewise linear. The value α_i is the altruism parameter; it is the marginal value that i places on the utility of the other players and is independent of their choices. In contrast, the reciprocity motive implies that the weight that the individual places on the payoffs of others is conditioned on their choices. An individual places a positive value, ρ_i^+, on the payoffs of others when she expects that their average extraction will not exceed her own, and a negative weight, $-\rho_i^-$, on their payoffs when she expect their average extraction to exceed her own.

Upon substitution of [1] for each individual into [5] we have:

[7] $$\begin{aligned} u_i &= e_i + px_i - c(x_i + x_{-i}) - dx_i(x_i + x_{-i}) \\ &\quad + \beta_i \left(\sum_{j \neq i} e_j + px_{-i} - (n-1)c(x_i + x_{-i}) - dx_{-i}(x_i + x_{-i}) \right). \end{aligned}$$

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Maximizing u_i with respect to $x_i \leq x_i^{max}$ requires:

[8] $\partial u_i / \partial x_i = p - c - 2dx_i - dx_{-i} - \beta_i [dx_{-i} + (n-1)c] \geq 0$, if > 0, $x_i = x_i^{max}$.

Note that $\partial^2 u_i / \partial x_i^2 = -2d < 0$, which indicates that u_i is strictly concave in x_i; thus, [8] is necessary and sufficient to identify a best response to x_{-i}. The solution to [8] with a non-binding capacity constraint is:

[9]
$$\hat{x}_i^{\beta}(x_{-i}) = (p - c - dx_{-i} - \beta_i[dx_{-i} + (n-1)c]) / 2d$$
$$= \hat{x}_i^{s}(x_{-i}) - \beta_i[dx_{-i} + (n-1)c] / 2d,$$

where $\hat{x}_i^{s}(x_{-i})$ is defined by [3]. Upon substitution of [6] we have:

[10] $\hat{x}_i^{\beta}(x_{-i}) = \begin{cases} \hat{x}_i^{\beta+}(x_{-i}) = \hat{x}_i^{s}(x_{-i}) - (\alpha_i + \rho_i^{+})[dx_{-i} + (n-1)c] / 2d, & \text{for } x_i \geq \overline{x}_{-i} \\ \hat{x}_i^{\beta-}(x_{-i}) = \hat{x}_i^{s}(x_{-i}) - (\alpha_i - \rho_i^{-})[dx_{-i} + (n-1)c] / 2d, & \text{for } x_i < \overline{x}_{-i}. \end{cases}$

Incorporating the capacity constraint yields the individual's best response when she is motivated by a combination of altruism, reciprocity, and pure self-interest:

[11] $x_i^{\beta}(x_{-i}) = \min[\hat{x}_i^{\beta}(x_{-i}), x_i^{max}]$.

2.2.1 Altruism

We first consider an individual that balances altruism and self-interest when choosing her extraction, and does not engage in reciprocal behavior. Ignoring the capacity constraint for a moment, set $\rho_i^{+} = \rho_i^{-} = 0$ in [10] to obtain $\hat{x}_i^{\beta}(x_{-i}) = \hat{x}_i^{\alpha}(x_{-i}) = \hat{x}_i^{s}(x_{-i}) - \alpha_i[dx_{-i} + (n-1)c] / 2d$. Incorporating the capacity constraint ($x_i^{max} = 8$) gives us the best response function for this individual, $x_i^{\alpha}(x_{-i}) = \min[\hat{x}_i^{\alpha}(x_{-i}), x_i^{max}]$. Note that $\hat{x}_i^{\alpha}(0) = \hat{x}_i^{s}(0) - \alpha_i(n-1)c / 2d < \hat{x}_i^{s}(0)$

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and $\partial\hat{x}_i^\alpha(x_{-i})/\partial x_{-i} = \partial\hat{x}_i^s(x_{-i})/\partial x_{-i} - \alpha_i d/2 < \partial\hat{x}_i^s(x_{-i})/\partial x_{-i}$.[3] These relationships reveal that when an individual balances altruism and pure self-interest, her unconstrained best response function lies below and is more steeply downward-sloping than her unconstrained best response function if she were purely self-regarding.

In Figure 2 we have used $\hat{x}_i^\alpha(x_{-i})$ and the capacity constraint to graph a representative best response function, $x_i^\alpha(x_{-i})$, for an individual that balances an altruism and pure self-interest. We assume that the capacity constraint is binding in this case for relatively low levels of extraction by the other individuals, but this need not be the case if the altruism motive is strong enough. Except for the capacity constraint, the individual will always choose lower levels of extraction than if she was purely self-interested. Moreover, if she does not extract up to the capacity constraint, then her extraction will be declining in her expectation of what others will extract. Therefore, if altruism is a dominant motive, an econometric analysis of individual extraction choices should generate a best response function that is non-increasing and that has a strictly decreasing segment.

2.2.2 Reciprocity

Now consider an individual that is not motivated by altruism, but rather by a combination of reciprocity and self-interest. Again, ignoring the capacity constraint for the time being, substitute $\alpha_i = 0$ into [10] to obtain

$$[12] \quad \hat{x}_i^\rho(x_{-i}) = \begin{cases} \hat{x}_i^{\rho+}(x_{-i}) = \hat{x}_i^s(x_{-i}) - \rho_i^+[dx_{-i} + (n-1)c]/2d, \ \text{for } x_i \geq \overline{x}_{-i}; \\ \hat{x}_i^{\rho-}(x_{-i}) = \hat{x}_i^s(x_{-i}) + \rho_i^-[dx_{-i} + (n-1)c]/2d, \ \text{for } x_i < \overline{x}_{-i}. \end{cases}$$

With the capacity constraint the individual's best response is $x_i^\rho(x_{-i}) = \min[\hat{x}_i^\rho(x_{-i}), x_i^{max}]$.

To derive the characteristics of $x_i^\rho(x_{-i})$ we need to examine how $\hat{x}_i^{\rho+}(x_{-i})$, $\hat{x}_i^{\rho-}(x_{-i})$, and $\hat{x}_i^s(x_{-i})$ are related. From [12] we have:

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[3] It is possible that the altruism motive is so strong that $\hat{x}_i^\beta(0) = 0$, but we ignore this possibility, because it implies that $\hat{x}_i^\beta(0) = 0$ for all x_{-i}.

[13.a] $\quad \hat{x}_i^{\rho+}(0) = \hat{x}_i^s(0) - \rho_i^+(n-1)c/2d < \hat{x}_i^s(0);$

[13.b] $\quad \hat{x}_i^{\rho-}(0) = \hat{x}_i^s(0) + \rho_i^-(n-1)c/2d > \hat{x}_i^s(0);$

[13.c] $\quad \partial \hat{x}_i^{\rho+}(x_{-i})/\partial x_{-i} < \partial \hat{x}_i^s(x_{-i})/\partial x_{-i} < \partial \hat{x}_i^{\rho-}(x_{-i})/\partial x_{-i}.$

These relationships indicate that $\hat{x}_i^{\rho+}(x_{-i})$ lies below and is more steeply sloping downward than $\hat{x}_i^s(x_{-i})$, while $\hat{x}_i^{\rho-}(x_{-i})$ lies above and has a greater slope than $\hat{x}_i^s(x_{-i})$. In fact $\hat{x}_i^{\rho-}(x_{-i})$ may have a positive slope if the negative reciprocity motive is strong enough. Figure 3 graphs $\hat{x}_i^s(x_{-i})$, and possible $\hat{x}_i^{\rho+}(x_{-i})$ and $\hat{x}_i^{\rho-}(x_{-i})$. The heavy dashed line is the individual's best response function, $x_i^\rho(x_{-i})$, when she is motivated by a combination of pure self interest and reciprocity. This function combines $\hat{x}_i^{\rho+}(x_{-i})$ for $x_i \geq \overline{x}_{-i}$, $\hat{x}_i^{\rho-}(x_{-i})$ for $x_i < \overline{x}_{-i}$, and the capacity constraint.[4]

Like the model of altruism, the best response function for a reciprocator may lie along the capacity constraint for relatively low levels of the expected extraction of others, but there must also be a strictly decreasing segment. In this segment, the individual's extraction exceeds her expectation of what others will extract. In a sense, she rewards the others for their restraint by extracting less than if she were purely self-interested. After this declining segment of the function her best response function is monotonically increasing along $x_i = \overline{x}_{-i}$, indicating that her extraction exactly equals the average of what she expects others to extract. For significantly higher levels of extraction by the others, the individual 'punishes' the others by extracting more than if she were purely self-interested. Although our graph indicates a declining segment of the best response function for very high extraction levels of the others, if the punishment motive is

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[4] To show that $x_i^\rho(x_{-i}) = \overline{x}_{-i}$ in its third segment from the left, consider a pair (x_i^0, x_{-i}^0) in this segment, where $x_i^0 = x_{-i}^0/(n-1)$. To show that x_i^0 is a best response to x_{-i}^0, suppose instead that some $x_i^1 < x_i^0$ is a best response to x_{-i}^0. Note that $x_i^1 < x_{-i}^0/(n-1)$. However, using [12] $\min[\hat{x}_i^{\rho-}(x_{-i}), x_i^{max}]$ is the best response for all $x_i < x_{-i}/(n-1)$. Since at a point like (x_i^0, x_{-i}^0), $\min[\hat{x}_i^{\rho-}(x_{-i}), x_i^{max}] > x_i^0 > x_i^1$, some $x_i^1 < x_i^0$ cannot be a best response to x_{-i}^0. Now suppose that some $x_i^2 > x_i^0$ is a best response to x_{-i}^0. Note that $x_i^2 > x_{-i}^0/(n-1)$, but for all $x_i \geq x_{-i}/(n-1)$, $\min[\hat{x}_i^{\rho+}(x_{-i}), x_i^{max}]$ is the best response as long as $\hat{x}_i^{\rho+}(x_{-i}^0) \geq 0$. In Figure 3 note that at a point like (x_i^0, x_{-i}^0), $\min[\hat{x}_i^{\rho+}(x_{-i}), x_i^{max}] < x_i^0 < x_i^2$, which indicates that $x_i^2 > x_i^0$ cannot be a best response to x_{-i}^0. Since higher or lower extraction levels than $x_i^0 = x_{-i}^0/(n-1)$ cannot be a best response to x_{-i}^0, x_i^0 must be.

strong enough, then this will not occur and the best response function will continue along $x_i = \bar{x}_{-i}$ up to the group and individual capacity constraint (32,8).

If reciprocity is a dominant motive in our subject pool, then our estimation results should yield a non-monotonic regression that may lie along the capacity constraint for relatively low levels of expected extraction by others, but is strictly decreasing and lies above $x_i = \bar{x}_{-i}$ for somewhat higher levels of others' extraction, and then follows $x_i = \bar{x}_{-i}$ for mid to higher levels of the expectation of others' extraction. The strictly increasing segment and the level of extraction for very high extraction levels of others are the characteristics that distinguish the reciprocity from altruism motives.

2.2.3 Altruism and Reciprocity

Deriving an individual's best response function when she is motivated by a combination of altruism, reciprocity and self-interest is more involved, but nevertheless has a similar structure as the best response function in Figure 3. In this case the best response function lies below $x_i^\rho(x_{-i})$, due to the inclusion of the altruism parameter α_i, except when it lies on the $x_i = \bar{x}_{-i}$ locus, and possibly at the capacity constraint for low expected levels of others' extraction. This implies that, except when the capacity constraint binds, the best response function has a strictly declining segment at first and then a strictly increasing segment along $x_i = \bar{x}_{-i}$. How the function behaves for higher expected extraction of others depends on the relative importance of negative reciprocity and altruism.

2.2.3 Inequity Aversion

Our model of reciprocity and pure self-interest generates a best response function that is similar to that generated by the model of inequity aversion presented by Falk et al. (2002). They adapted Fehr and Schmidt's (1999) notion of inequity aversion to the common pool resource problem. An individual's utility function is assumed to be

[14] $u_i = \pi_i - \dfrac{\rho_i^+}{n-1}\sum_{j \neq i}\max\{\pi_i - \pi_j, 0\} - \dfrac{\rho_i^-}{n-1}\sum_{j \neq i}\max\{\pi_j - \pi_i, 0\},$

where as before ρ_i^+ and ρ_i^- are positive constants. In this model subjects are averse to differences in payoffs among individuals, with disadvantageous differences being more heavily weighted than advantageous differences ($\rho_i^- > \rho_i^+$). Falk et al. (2002) demonstrate that this model produces a best response function that has similar characteristics to our model of reciprocity.

2.4 Conformism

If individuals are motivated by conformism, then they prefer not to deviate much from others' choices. We model conformism as an internal penalty an individual faces when her choices deviate from the average expected choices of others. This is very similar to the approach Luzzati (1999) used to adopt the conformism concept to explain voluntary contributions to public goods. It is also similar to Bowles' (2003) concept of "guilt" that an individual experiences when he of she deviates from the choices of others. A key difference between conformism and reciprocity is that when individuals are motivated by conformism, their actions are conditioned on the expected choices of others; they are not evaluating the payoffs of others. Suppose individual i's utility is given by:

$$[15] \quad u_i = \pi_i - \gamma_i (x_i - \bar{x}_{-i})^2 / 2.$$

Maximizing [15] without the capacity constraint, $x_i \le x_i^{max}$, yields the individual's unconstrained best response function:

$$[16] \quad \hat{x}_i^{\gamma}(x_{-i}) = \frac{p - c - d x_{-i}}{2d + \gamma_i} + \frac{\gamma_i x_{-i} / (n-1)}{2d + \gamma_i}.$$

Incorporating the capacity constraint yields the individual's best response when she has a preference for conformance, $x_i^{\gamma}(x_{-i}) = \min[\hat{x}_i^{\gamma}(x_{-i}), x_i^{max}]$.

To compare an individuals' best response when she balances conformism and simple self-interest to her best response when she is motivated solely by self-interest, note from [3] that $2d\hat{x}_i^s(x_{-i}) = p - c - dx_{-i}$. Therefore, we can rewrite [16] as

[17] $\hat{x}_i^{\gamma}(x_{-i}) = \hat{x}_i^s(x_{-i})\dfrac{2d}{2d+\gamma_i} + \dfrac{\gamma_i x_{-i}/(n-1)}{2d+\gamma_i}.$

From [17] we have

$$\hat{x}_i^{\gamma}(0) = \hat{x}_i^s(0)\frac{2d}{2d+\gamma_i} < \hat{x}_i^s(0),$$

and $\partial\hat{x}_i^{\gamma}(x_{-i})/\partial x_{-i} = \left(\partial\hat{x}_i^s(x_{-i})/\partial x_{-i}\right)\dfrac{2d}{2d+\gamma_i} + \dfrac{\gamma_i/(n-1)}{2d+\gamma_i} > \partial\hat{x}_i^s(x_{-i})/\partial x_{-i}.$

Thus, $\hat{x}_i^{\gamma}(x_{-i})$ has a lower intercept than $\hat{x}_i^s(x_{-i})$, but a greater slope. In fact, if the conformism motive is strong enough, $\hat{x}_i^{\gamma}(x_{-i})$ may be upward sloping.[5] In general, the conformism motive can produce several best response functions with different characteristics. However, all such best response functions are monotonic except when the capacity constraint is binding. This distinguishes the conformism motive from reciprocity, mixed altruism and reciprocity, and inequity aversion.

4. Experiment Design

Our experimental design is similar to that of Cardenas, Stranlund and Willis (2000). Subjects were placed into groups of five and participated in a ten-period common pool resource game.[6] Subjects sat facing away from each other and were not allowed to communicate. Payoffs were calculated using [1] with parameters $p = 116.875$, $c = 17.875$, $d = 2.75$ and $e_i = 900$ presented as a table (see the appendix for the experiment instructions, including the payoff table).[7] In each

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[5] This requires $\gamma_i/(n-1) > d$.

[6] Assignment to groups was not completely random. We tried to ensure that relatives were in separate groups.

[7] For the experiments in the field, the participants were asked to choose a level of extraction between 1 and 9 units, instead of between 0 and 8 units. The reason of doing this is that the concept of zero extraction is very difficult to

round, subjects were asked both their extraction choice and their expectation about the extraction choice of the other group members.[8] After all subjects had made their decisions, the monitor collected this information and announced the aggregate level of extraction. With this information, individuals were able to calculate both the actual level of total extraction by the others and their own payoffs given the others' decisions.

The experiments were conducted in three regions of Colombia (Magdalena Region, Pacific Coast and Caribbean Coast) in communities in which the primary activity is artisanal fishing. Table 1 presents some summary statistics of the subject pool. Over three-quarters of the subjects were male fishermen. Subjects also had relatively low levels of education (mean 5.5 years) with an average age approaching 39.

A total of 420 individuals (140 per region) participated in these experiments with average earnings of 15,340 pesos per person (about US$6) during the summer of 2004. Daily wages in these regions averaged 10,000-15,000 pesos. Earnings were paid in cash at the end of each experiment. Each experiment lasted about three hours. Before each experiment began, instructions were read aloud by the monitor and several practice rounds that did not count toward final earnings were played to familiarize the participants with the experiments.

These field experiments were conducted with subjects who face the same kind of social dilemma about the exploitation of local natural resources in their everyday lives as the dilemma modeled in the experiments. Therefore, it is likely that participants' prior experiences with common pool resources may influence their preferences and choices in a way that is not controlled by the experiment (Cardenas and Ostrom, 2004). Moreover, many subjects knew each other from daily interactions. Thus, it is possible that their decisions were affected by these relationships.

5. Experimental Results and Analysis

Table 2 presents some summary statistics of individual extraction and the expected and actual extraction of others. The mean individual level of extraction was 4.6 units, but the purely self-interested Nash equilibrium prediction is that each individual would extract six units. We also

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explain in the field since the participants depend so critically on the extraction of local natural resources. The payoff table they were given was modified to account for this.

[8] Croson (1998) also asked subjects about their expectations about the choices of the other group members and compensated them based on the accuracy of their prediction. In our experiments, earnings were based solely on the individual's extraction choice and were not affected by her prediction of others' choices.

calculated individual differences between their actual choice and their purely self-interested best response given their reported expectations of what others would do. Not surprisingly, on average, subjects did not pursue self-interested Nash strategies as suggested by a two-unit average deviation from their purely self-interested Nash best responses.

Individuals' expected levels of extraction by others in their group were significantly different from others' actual extraction. In fact, as shown in Table 2, individuals tended to be too optimistic about others' extraction[9]. On average, individuals expected that the other four members of the group would extract 15.4 units, 2.9 less units their actual extraction. This difference was greater in the last period, when individual's expectation of the others' extraction was 3.8 units lower than their actual extraction.

Identifying the existence of individual deviations from purely self-interested Nash best responses functions is the first step towards understanding the motivations driving individual behavior. Random effects Tobit models were used to estimate summaries of individual best response functions and test the theoretical models explained in section 3. The use of random effects models responds to the nature of our experimental data in which repeated observations are obtained from each individual. Also, the Tobit models account for the censored nature of our data since individual decisions were constrained to be between 0 and 8 units. Moreover, since our theoretical development yielded piece-wise linear best response functions, we estimated spline functions which allow the slope of the regression to vary in different intervals of the expected extraction of others but imposes continuity on the estimated regression.

Our regression results are reported in Table 3. Model 1 is a spline regression that divides the range of individuals' expectation of the extraction levels of the other group members, denoted x^e_{-i}, into four-unit intervals. Recall that for our models of pure self-interest alone and for self-interest combined with altruism, reciprocity or inequity aversion individual best response functions could exhibit a flat segment at the capacity constraint of eight units for relatively low levels of expected extraction of others, but that each must have a monotonically decreasing segment. In contrast, we estimate a summary best response function that is flat and significantly below the capacity constraint (the estimate of the constant is 2.46) for $x^e_{-i} < 8$, and then is monotonically increasing as the expected extraction of others increases. Thus, we reject the

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[9] Croson (1998) also reports that 33% of her subject pool exhibited over optimism when predicting other's behavior.

hypothesis that pure self-interest, altruism, reciprocity, inequity aversion or combinations of these motives can explain average behavior in our experiments.

Instead it appears that the model of conformism best describes average strategies in our experiments. Our model of linear conformism generates a Nash best response function that is monotonic except possibly at the capacity constraint. Moreover, if the conformism motive is strong enough the function is monotonically increasing. Except for the flat segment for low levels of expected extraction by others, which we will revisit shortly, this is exactly what our empirical results indicate. This result is consistent with the notion of conditional cooperation as an explanatory feature of individual behavior. However, we move forward from that concept by identifying that conformism, instead of reciprocity, is the most important motive driving conditional behavior in our subject pool.

As discussed by Carpenter (2004), the conformism motive could generate less conservative outcomes than predicted by the model of pure self-interests. That is, subjects could conform to similarly high levels of extraction. Recall that in our case, mean levels of individual extraction were well below the conventional Nash prediction (see Table 2). Thus, in our subject pool, it appears that the conformism motive leads to a more conservative (though not efficient) exploitation of the commons.

The spline function estimated in Model 1 was useful to test for any changes in the slope of the regression. However, the coefficients obtained for each interval suggest that the expected extraction of others could be partitioned into fewer intervals. The first two intervals of Model 1 show positive coefficients that are not significantly different from zero. Furthermore, the rest of the intervals have coefficients that are statistically greater than zero, but they are not significantly different from each other. The null hypothesis that the estimated coefficients are equal to each other cannot be rejected (Wald test, $p = 0.59$). This leads us to Model 2 which includes just two intervals, $0 \leq x^e_{-i} < 8$ and $8 \leq x^e_{-i} \leq 32$. The results show statistically positive slope coefficient in both intervals, indicating that the function is monotonically increasing. However, the slope coefficients are statistically different ($p = 0.03$) which may suggest a nonlinearity that our theoretical model of conformism does not explain.

We also investigated whether our fundamental results varied by region. In each model, we included dummy variables to capture regional effects, none of which are statistically significant. Note that in Model 3, we estimated a simple linear relationship between individual

extraction and their expectations of the extraction of others in their group; that is, we did not partition the expected extraction of others into intervals. This allows us to interact the regional dummy variables with the expected extraction of others, but these interactions are also not significant.

In each model we also included the period as an explanatory variable to capture the effect of time on individual choices. In all cases, individual extraction is increasing as the experiment proceeds. This is consistent with results that others have found in games of social dilemmas; namely, high levels of cooperation in the first rounds of these experiments, but declining cooperation rates over time (Fehr et al., 2002)

Finally, we also examined the effects of individual characteristics such as age, gender and years of education.[10] As is evident in Table 3, age and gender are not significant in explaining individual choices. The coefficient for education is positive and highly significant in each of our models. It is possible that the more educated individuals may be better able to identify the purely self-interested Nash strategy and use this to their advantage. This result could suggest that those with lower levels of education who are unsure about what to choose might use the decisions of others as a source of information to guide their decisions (Smith and Bell 1994). Moreover, they may simply try to ensure that their choices roughly conform to what the rest of the group is doing.

6. Conclusions

We have developed and tested several models of pure Nash strategies of individuals who extract from a common pool resource when they are motivated by a mix of self-interest and altruism, reciprocity, inequity aversion, or conformism. Using data generated from common pool experiments conducted in three regions of Colombia, we estimated individual extraction choices as a function of their expectation about the choices of the others in their experiment. An econometric summary of individual strategies strongly suggests that self-interest, altruism, reciprocity and inequity aversion are not the primary motivations in our subject pool. Rather, our results suggest that the conformism motive best explains average strategies in our experiments.

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[10] 420 individuals participated in our experiment. However, by including age, gender and education as explanatory variables we lost the observations of 15 individuals from whom we did not have this information.

Moreover, it appears that conformism works to generate outcomes that are more efficient than that predicted by a model of pure self-interest.

Of course, we do not claim that our results suggest that all the subjects were primarily conformists; only that conformism best explains average strategies. It is quite probable that there are individuals in our subject pool who are better described as self-interested, altruists, or reciprocators. Therefore, the next step in this research project is to characterize individual strategies rather than average strategies. This will allow us to investigate how the composition of individual motivations produces outcomes. This would be similar to the work of others in the context of public goods games (e.g. Fischbacher, Gachter and Fehr 2001, and Kurzban and Houser 2005). Notably, this kind of analysis has been not conducted for common pool games, much less in the field with direct users of common pool resources.

Furthermore, it may be fruitful to formulate dynamic strategies under alternative motivations and analyze our data in light of these strategies.

It is clear that alternative individual motivations will have profound impacts on the design of policies to manage common pool resources. Because of this future research should also consider the effects of different institutions on outcomes in the presence of alternative motives. Indeed, institutions may affect preferences as suggested by several authors including Cardenas, Stranlund and Willis (2000) and Frey and Jegen (2001). Thus, examining the interactions between preferences and institutions appears to be a fruitful area for new research.

Finally, although we found that our main conclusion about the importance of the conformism motive did not vary across the three regions we visited, one should stop short of concluding that this result is likely to be robust to differences in contexts. Additional research in this area is needed to generate comparable results across subjects in different environments. Ultimately, a sufficient number of similar studies would allow us to draw conclusions about what motivates common pool resource users across the developing world.

References

Bardsley, Nicholas (2000). "Interpersonal Interaction and Economic Theory: The Case of Public Goods." *Annals of Public and Cooperative Economics*, 71:2, 191-238.

Bowles, Sam (2003). *Microeconomics: Behavior, Institutions and Evolution*. Princeton University Press.

Cardenas, Juan Camilo; John Stranlund and Cleve Willis (2000). "Local Environmental Control and Institutional Crowding Out." *World Development,* 28: 10, 1719-1733.

Cardenas, Juan Camilo and Elinor Ostrom (2004). "What People Bring Into the Game? Experiments in the field about cooperation in the commons." *Agricultural System,* 82, 307-326.

Carpenter, Jeffrey P. (2004). "When in Rome: Conformity and the Provision of Public Goods." *The Journal of Socio- Economics*, 33:4, 395-408.

Casari, Marco and Charles R. Plott (2003). "Decentralized Management of Common Property Resources: Experiments with a Centuries-old Institution." *Journal of Economic Behavior & Organization*, 51, 217-247.

Cornes, Richard and Todd Sandler (1983). "On Commons and Tragedies." *The American Economic Review*, 73:4, 787-792.

Croson, Rachel T.A (1998). "Theories of Commitment, Altruism and Reciprocity: Evidence from Linear Public Good Games." Working Paper. University of Pennsylvania.

Falk, Armin, Ernst Fehr and Urs Fischbacher (2002). "Appropriating the Commons - A Theoretical Explanation." In *The Drama of the Commons*, ed. by Thomas Dietz, Nives Dolšak, Elinor Ostrom, Paul Stern, Susan Stonich, and Elke Weber, National Academy Press, Washington, DC, 157-192.

Fehr, Ernest and Klaus M. Schmidt (1999). "A Theory of Fairness, Competition and Cooperation." *The Quarterly Journal of Economics*, 114:3, 817- 868.

Fehr, Ernest and Urs Fischbacher (2002). "Why Social Preferences Matter- The Impact of Non-Selfish Motives on Competition, Cooperation and Incentives." *The Economic Journal*, 112:3, C1- C33.

Fischbacher, Uber, Simon Gachter and Ernest Fehr (2001). "Are People Conditionally Cooperative? Evidence from a Public Goods Experiment." *Economics Letters*, 71, 397-404.

Frey, Bruno and Reto Jegen (2001). "Motivation Crowding Theory: A Survey of Empirical Evidence". *Journal of Economics Surveys*, 15:5, 589-611.

Frey, Bruno and Stephan Meier (2004). "Social Comparisons and Pro-social behavior: Testing "Conditional Cooperation" in a Field Experiment". The American Economic Review, 94:5,1717-1722.

Kurzban, R. and Houser, D. (2005). "Experiments investigating cooperative types in humans: A complement to evolutionary theory and simulations." *Proceedings of the National Academy of Sciences*, 102(5):1803-1807.

Levine, David K. (1998). "Modeling Altruism and Spitefulness in Experiments." *Review of Economic Dynamics,* 1, 593-622.

Luzzati, Tommaso (1999). "Economic Theory and Conformism." In *Beyond the Representative Agent,* ed. by Mauro Gallegati and Alan Kirman, Edward Elgar, Cheltneham, UK, 111-140.

Ostrom, Elinor; James Walker and Roy Garden (1992). "Covenants with and without a Sword: Self-Governance is Possible." *American Political Science Review*, 86: 2, 404,417.

Ostrom, Elinor; James Walker and Roy Garden (1994). *Rules, Games, and Common-Pool Resources*. The University of Michigan Press, 1994.

Smith, Jeffrey M. and Paul A. Bell (1994). "Conformity as a Determinant of Behavior in a Resource Dilemma". *The Journal of Social Psychology*, 134:2, 191-201.

Walker, J.; Garden R and Ostrom, E (1990). "Rent Dissipation in a Limited Access Common-Pool Resource: Experimental Evidence." *Journal of Environmental Economics and Management*, 19: 203-211.
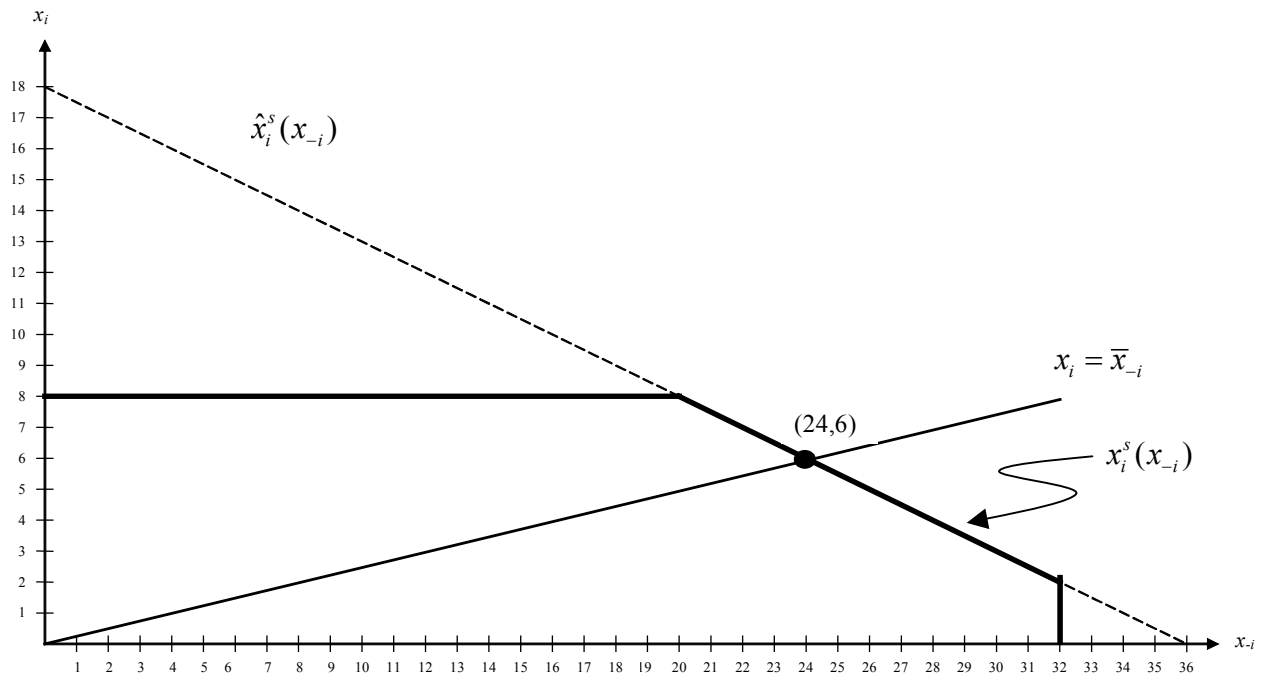
Figure 1: An Individual's Self-Interested Nash Strategy
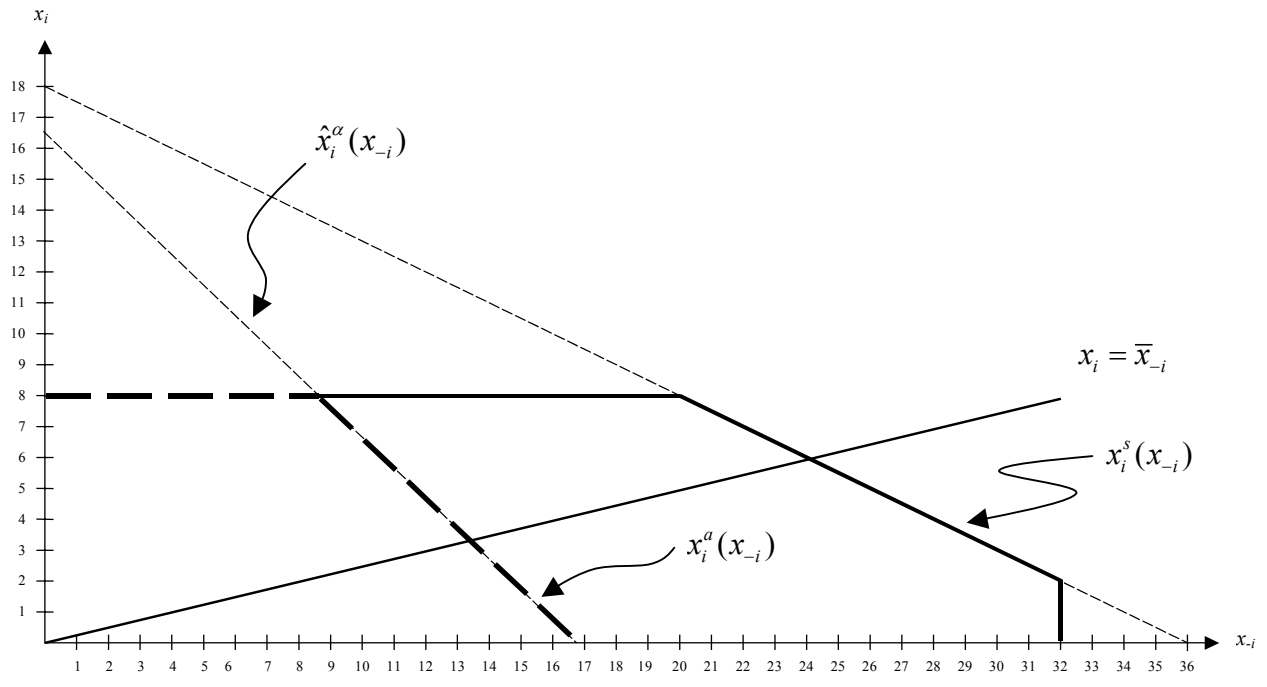
Figure 2: Balancing Altruism and Pure Self Interest.
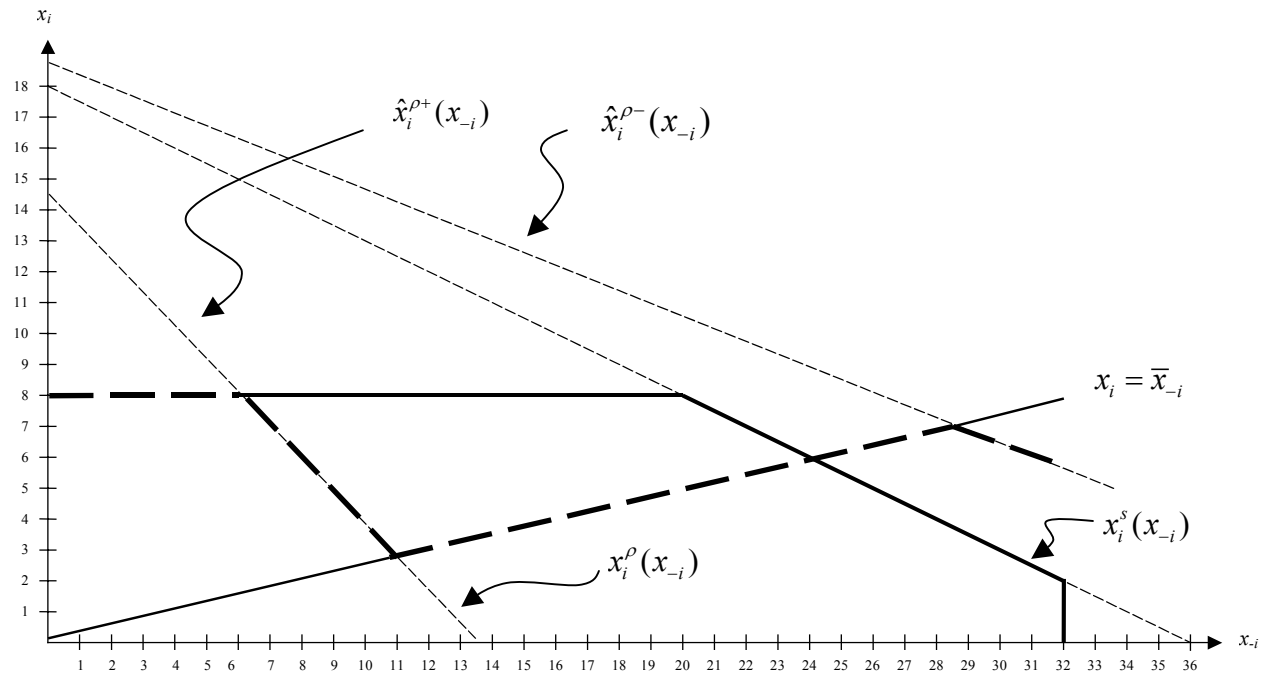
Figure 3: Balancing Reciprocity and Self-Interest.

Table 1: Summary statistics of subject characteristics

Region	Mean Age	Mean number of years of formal education	Number of Males	Number of Females
Magdalena	41.3	4.8	119	21
Pacific	39.9	5.4	123	17
Caribbean	34.6	6.4	65	75
All Regions	38.6	5.5	307	113

Table 2: Summary statistics of individual extraction and the extraction of others

Variable	All rounds	Last round
Mean Level of extraction	4.6	4.8
Mean Deviation From Self-Interested Best response	2.5	2.3
Mean Expected Level of Extraction of Others	15.37	15.38
Mean Actual Level of Extraction of Others	18.32	19.14

Table 3: Random effects Tobit models of individual best responses

	MODEL 1	MODEL 2	MODEL 3
Constant	2.46 (0.45)***	2.48 (0.43)***	2.32 (0.43)***
$0 \leq x^e_{-i} < 4$	0.07 (0.62)		
$4 \leq x^e_{-i} < 8$	0.04 (0.05)		
$8 \leq x^e_{-i} < 12$	0.17 (0.04)***		
$12 \leq x^e_{-i} < 16$	0.09 (0.04)**		
$16 \leq x^e_{-i} < 20$	0.12 (0.04)***		
$20 \leq x^e_{-i} < 24$	0.10 (0.50)**		
$24 \leq x^e_{-i} < 28$	0.17 (0.06)***		
$28 \leq x^e_{-i} < 32$	0.16 (0.07)**		
$0 \leq x^e_{-i} < 8$		0.06 (0.02)***	
$8 < x^e_{-i} \leq 32$		0.13 (0.007)***	
x^e_{-i}			0.11 (0.01)***
Period	0.03 (0.01)***	0.03 (0.01)***	0.04 (0.01)***
Regional Effects			
Pacific	-0.06 (0.21)	-0.05 (0.21)	-0.38 (0.30)
Magdalena	0.08 (0.21)	0.08 (0.21)	-0.06 (0.29)
Pacific$\times x^e_{-i}$			0.02 (0.01)
Magdalena$\times x^e_{-i}$			0.01 (0.01)
Individual Characteristics			
Age	0.00 (0.006)	-0.00 (0.006)	-0.00 (0.006)
Gender =1 if female	0.04 (0.20)	0.04 (0.20)	0.06 (0.20)
Education (years)	0.10 (0.03)***	0.10 (0.03)***	0.10 (0.03)***
Wald χ^2	**447.96***	**444.74***	**441.92***

The dependent variable is the individual's level of extraction, x_i. Standard errors are shown in parenthesis. * reflect p-values: * $p \leq 0.10$; ** $p \leq 0.05$; *** $p \leq 0.01$.
Number of observations = 4050. Number of subjects = 405.

Appendix: Instructions [11]

Introduction
The exercise in which you are going to participate can be different from other exercises in which members of your community might have participated in the past; therefore, any comments that you might have heard about the exercise does not necessarily apply to the version in which you will participate.

This exercise is similar to a situation in which a group of people has to make decisions on how to use a community owned natural resource. For example, a forest, a drinking water source, or a fishing area.

You have been selected to participate in a group of 5 people. Today, there are 3 groups participating at the same time. However, each group is independent and the decisions of the other groups do not affect the decisions of your group. Each group will be differentiated by the color of the sheets used during the exercise.

In this exercise you will earn money depending on your decisions and the decisions of the other members of your group. The reason why we use money in this exercise is to represent real life situations in which your economic decisions will bring yourself monetary consequences. You will play several rounds equivalent, for example, to periods such as years, months, or fishing seasons.

In each round, you will earn a number of points that will be equivalent to a number of pesos. At the end of the exercise, we will sum the total number of pesos earned in all the rounds, we will round the total earned, and we will personally hand that to you in cash.

We will now explain how to participate in the exercise. Please pay a lot of attention to the instructions. If you understand the instructions, you will be able to make better decisions in the exercise. Please, remain seated and do not speak with other participants. If you have a question, raise you hand. The assistant will answer your question in private.

Earnings Table
We will now hand out the EARNINGS TABLE which contains all the information you will need to make your decisions in this exercise.

All participants have the same EARNINGS TABLE that you do. The numbers in the table are points equivalent to the pesos you can earn in each round, depending on both what you decide to extract and the decisions made by others in your group.

In each round you have to decide how many units of the resource you will extract. We will call your decision "MY LEVEL OF EXTRACTION." These units correspond to the columns 1 to 9 in the EARNING TABLE. In this exercise, each participant can extract a maximum of 9 units, and a minimum of one.

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[11] Juan Camilo Osorio translated the instructions from Spanish to English.

In the EARNINGS TABLE, the decisions of the other members of your group correspond to the column "LEVEL OF EXTRACTION OF OTHERS", which will be a number between 4 and 36. This number is the sum of the units extracted by the other members of the group. When you make your decision, you will not know the decisions made by the other members of your group.

Once all participants hand in their decisions, we will sum all the levels of extraction and will announce the group's TOTAL LEVEL OF EXTRACTION. With this information you will be able to calculate the "LEVEL OF EXTRACTION OF OTHERS," which is equal to the "TOTAL LEVEL OF EXTRACTION" minus "MY LEVEL OF EXTRACTION".

Let's see some examples so that you can understand how to use the EARNINGS TABLE.

Imagine you decide that "MY LEVEL OF EXTRACTION" is 4 units, and that the other members of the group extract 4 units each. We will announce that the TOTAL level of extraction is 20 units. Since you decided to extract 4, you can calculate the "LEVEL OF EXTRACTION OF OTHERS," which is equal to the "TOTAL LEVEL OF EXTRACTION" minus your level of extraction. In this case, the "LEVEL OF EXTRACTION OF OTHERS" is $20 - 4 = 16$ units. Thus, as seen in the table, your earnings will be 859.

In the previous example all the members of the group picked the same level of extraction. However, each person can pick a different number. For example, if you choose 4 and the other members of the group extract 2, 3, 7 and 8, we will announce that the TOTAL level of extraction is 24. Given the fact that you decided to extract 4, the "LEVEL OF EXTRACTION OF OTHERS" will be 20. In other words, the total level of extraction (24) minus your level of extraction (4). In this case, as seen on the table, your earnings will be 754.

The EARNINGS TABLE has an additional table called "Average of the others". This column indicates you the average decision of your group for a determined level. For example, if the others extract 8, this means that the average amount extracted per person is 2. Instead, if the others extract 20, the average amount extracted per person is 5.

Take a few seconds to look at the EARNINGS TABLE and understand how it works. If you have any questions, please raise your hand and someone will come to you.

Decision Card
I will now explain how you will inform us in each round your level of extraction. In each round you will receive a "decision card". The decision cards are these small pieces of paper.

In each round you will have to write:
- The number of the round, which will be announced by us.
-"MY LEVEL OF EXTRACTION", in other words, how many units will you extract, which in this case will be a number between 1 and 9.
-You also have to write what you think the other members of your group will extract.

This is the sum of the levels of extraction that you think the other 4 members of your group will extract. This sum is a number between 4 and 36. Remember that when you make your decision you do not know what the others are choosing. However, we want to know how much you think the others will extract. For example, if you think that two people will choose 3 and the other two 5, then, what you think the others will extract is 16 (3 +3+ 5 + 5).

What you write on the level of extraction of others will not affect your earnings, either if it is equal or different to what actually happened. However, we are interested to know what you are thinking about the level of extraction of the others when you make your choice.

After all the members of your group have made their decisions, we will pick up the 5 participants' cards and calculate the groups' TOTAL level of extraction. Once we announce the total extraction of the group you will be able to calculate the true "LEVEL OF EXTRACTION OF OTHERS." With this information and your level of extraction, you will be able to calculate how much you earned by looking at the EARNINGS TABLE.

It is very important that you remember that your decisions are private and that you can not show them to the other members of the group. We will only announce the TOTAL level of extraction.

Calculations sheet
Each one of you will receive a calculations sheet with which you record your decisions and earnings. Please write your participant number in the calculations sheet. This is the same number that is written in the decision cards.

Let's see how to use the calculations sheet by looking at an example. Suppose you decided to extract 4 units. In consequence, you have to write 4 under column A of the calculations sheet, as shown in the example. You should also write this number in "MY LEVEL OF EXTRACTION" in the Decision Card .You are writing your decision in two places, in the Decision Card, which you will hand in back to us, and in the calculations sheet. Please, check that you have written the same number in the two sheets before you hand in the decision card.

After all the members of the group have finished taking their decisions, we will pick up the cards of the 5 participants and calculate the groups' TOTAL level of extraction.

Suppose the "TOTAL LEVEL OF EXTRACTION" is 20 units. You should write 20 in the column B in the calculations sheet. In order to calculate accurately the "LEVEL OF EXTRACTION OF OTHERS," you should subtract Column A ("MY LEVEL OF EXTRACTION") from Column B ("TOTAL LEVEL OF EXTRACTION"). You should write the result in Column C ("LEVEL OF EXTRACTION OF OTHERS"). In our example, the "LEVEL OF EXTRACTION OF OTHERS" is 16 (20 – 4.)

In order to calculate your earnings, you should use the EARNINGS TABLE. In this case, given that "MY LEVEL OF EXTRACTION" is 4 and the "LEVEL OF EXTRACTION OF OTHERS" is 16, then your earnings will be 859. This is the information you should write in column D.

Practice rounds

Before we begin the exercise we will do some practice rounds. The decisions that you take in these practice rounds would not affect your earnings today.

The first practice round will be done altogether. First, write the number of the round in the decision card, in this case (P) of practice. After that, looking at the EARNINGS TABLE suppose that each one of you picked 5. Write this in the decision card and in Column A of the earnings sheet. You should also write in the decision card what you think the other members of your group will extract. In this case, it is 20, because we know that all of them picked 5. Remember, when we begin the real exercise, you will not know the exact number of extraction of the other members while you will be picking your level of extraction. In the next rounds you will write what you think the others will extract.

Given that all the members of the group picked 5 in this example, the total level of extraction for the group is 25. Each one should write now 25 under Column B ("TOTAL LEVEL OF EXTRACTION") in the calculations sheet.

Now subtract "MY LEVEL OF EXTRACTION" (5) from the "TOTAL LEVEL OF EXTRACTION" (25). In other words, column B minus Column A. This operation is equal to 20. This number is the true "LEVEL OF EXTRACTION OF OTHERS", which you should write in Column C. Using the number in Column A, "MY LEVEL OF EXTRACTION," and the number under column C, the "LEVEL OF EXTRACTION OF OTHERS", you should use the earnings table to determine your earnings for this round. In this case, your earnings will be 790. Write your earnings in column D.

We did this example and the previous one supposing that everyone picked the same level of extraction. However, when you make your decision, you may choose the level of extraction that you want by looking at the EARNINGS TABLE. *Are there any questions?*

Let's continue with the next practice round. First, write down the round's name in the decision card, in this case (P) of practice. Now, each one of you has to decide your level of extraction using the EARNINGS TABLE. Write it down in the decision card and in Column A in the calculations sheet. Before you hand in the decision card, check that the number in column A is equal to the one you wrote in "MY LEVEL OF EXTRACTION" in the decision card. You should also write in the decision card the level of extraction that you believe the other members of the group will extract.

EARNINGS TABLE

Level of extraction of others	My level of extraction								
	1	2	3	4	5	6	7	8	9
4	900	996	1087	1172	1252	1326	1395	1458	1516
5	882	976	1064	1146	1223	1295	1361	1421	1476
6	864	955	1040	1120	1194	1263	1326	1384	1436
7	846	934	1017	1094	1165	1231	1292	1347	1396
8	829	914	994	1068	1137	1200	1258	1310	1357
9	811	893	970	1042	1108	1168	1223	1273	1317
10	793	873	947	1016	1079	1137	1189	1236	1277
11	775	852	923	989	1050	1105	1154	1198	1237
12	757	831	900	963	1021	1073	1120	1161	1197
13	739	811	877	937	992	1042	1086	1124	1157
14	721	790	853	911	963	1010	1051	1087	1117
15	703	769	830	885	934	978	1017	1050	1077
16	686	749	807	859	906	947	983	1013	1038
17	668	728	783	833	877	915	948	976	998
18	650	708	760	807	848	884	914	939	958
19	632	687	736	780	819	852	879	901	918
20	614	666	713	754	790	820	845	864	878
21	596	646	690	728	761	789	811	827	838
22	578	625	666	702	732	757	776	790	798
23	560	604	643	676	703	725	742	753	758
24	543	584	620	650	675	694	708	716	719
25	525	563	596	624	646	662	673	679	679
26	507	543	573	598	617	631	639	642	639
27	489	522	549	571	588	599	604	604	599
28	471	501	526	545	559	567	570	567	559
29	453	481	503	519	530	536	536	530	519
30	435	460	479	493	501	504	501	493	479
31	417	439	456	467	472	472	467	456	439
32	400	419	433	441	444	441	433	419	400
33	382	398	409	415	415	409	398	382	360
34	364	378	386	389	386	378	364	345	320
35	346	357	362	362	357	346	329	307	280
36	328	336	339	336	328	314	295	270	240