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THE VALUE OF SOCIAL NETWORKS IN RURAL PARAGUAY

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ABSTRACT. We conduct a set of field experiments in rural Paraguay to measure the value of reciprocity within social networks in a set of fifteen villages. These experiments involve conducting dictator-type games; different treatments involve manipulating the information and choice that individuals have in the game. These different treatments allow us to measure and distinguish between different motives for giving in these games. The different motives we're able to measure include a general benevolence, directed altruism, fear of sanctions, and reciprocity within the social network. We're further able to draw inferences from play in the games regarding the sorts of impediments to trade which must restrict villagers' ability to share in states of the world when no researchers are present running experiments and measuring outcomes.

1. Introduction

Accounts of difficulties faced by peasant households in developing countries often revolve around a belief that these households are constrained by market failures, particularly failures in markets for credit and insurance.

Any market involves exchange, and when one says that a particular household has been harmed by market failure, this is simply another way of saying that there existed some feasible exchange which could have benefitted both that particular household and some other, but that something prevented consummation of that exchange.

Much of what is interesting in development economics (and perhaps in economics more generally) involves developing our understanding of what 'things' might impede otherwise mutually beneficial exchanges. We have theoretically satisfactory accounts of some categories of such impediments, including private information and limited commitment.[1]

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[1] We say that accounts of these are "satisfactory" because the impediment to trade can be related to an observable feature of the environment. For example, in some circumstances it may not be possible for the two parties to a labor contract

For other sorts of market failures, we have useful but unsatisfactory models. For example, one might simply impose on ones' model an *ad hoc* limit on the total amount of debt one household can accumulate. This may be a perfectly sensible way to proceed; certainly it's generally true that households can't borrow arbitrarily large sums. But while useful, this treatment is unsatisfactory: any account of *why* households are limited in their borrowing would have to appeal to some more primitive impediment to trade (e.g., limited commitment makes default possible in some states of the world). These models are unsatisfactory because they can't be used to predict what would happen if the economic environment were to change—to use the language of Haavelmo (1944), they lack "autonomy" from the conditions of the underlying environment. What if bankruptcy legislation changed the probability of default? A model featuring an arbitrary limit on debt accumulation simply can't tell us anything useful about the consequences of this sort of change in the economic environment.

In this paper we undertake what might be called "structural experimentation" in order to sort out what kinds of mechanisms exist to help the people who live in rural Paraguay overcome various possible impediments to trade. These (unknown) impediments to trade will help to to determine whether or not different motives for transfers can be distinguished within the context of our experiments. We're interested in understanding the importance of reciprocity in the social networks in which these villagers are embedded, and in placing a value (which will depend on these impediments) on reciprocity in the social network.

To estimate the value of these social networks, our basic strategy is to visit those villages, and then to offer a randomly selected 'treatment' group (i) some money; and (ii) the opportunity to invest some or all of this money with a high expected return, but only on behalf of others in the village.

Our arrival in the village and treatment of a random selection of subjects induces idiosyncratic shocks to the income of selected members of the village. At one extreme, in the absence of any impediments to trade, one would expect the villagers to fully insure against these

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to observe the actions of the other, perhaps with the consequence that each can be compensated not according to their labor, but instead only according to the observable output they produce. These constraints are imposed by the physical environment in which those two parties operate—accomplishing the required task may involve each party occupying geographically distant fields. In this case, the introduction of some new technology (say, of binoculars) may make it possible for the two parties to observe each other, and thus eliminate this source of private information from the list of impediments to exchange.

shocks, along the lines described in Townsend (1994). If the villagers are fully insured, the subjects should invest all of their stake, and the recipients of this largesse should in turn share their bounty with everyone else in the village according to some fixed, predetermined rule. At another extreme, impediments to trade might lead the subjects in our experiments to make no investments at all.

At either of the extreme outcomes it's relatively easy to place a value on the social network. However, as it happens, subjects in our experiments tended not to respond in such extreme ways, and tended to invest some but not all of their initial stakes. This tells us that the Paraguayan villages we investigated do not belong to the Panglossian world imagined by Townsend, but strongly hints that social networks and mechanisms exist in these villages which move the allocations toward the Pareto frontier.

What can we say about the mechanisms that induce the observed levels of investment? We consider several different motives which might lead a subject to make an investment on another's behalf. First, the subject might invest from a motive of undirected general *benevolence*—by making an investment she helps another more than she herself is harmed. Second, in addition to the sort of undirected benevolence, the subject might also invest on a particular other's behalf because she wishes that particular person well. We call this directed *altruism*. In our account altruism is distinguished from benevolence by being directed toward improving the welfare of some particular person.

A third motive for making investments may simply be to avoid *sanctions*. We have every reason to believe that the villagers we study live in a social environment which encourages some sorts of behaviors with rewards, and discourages others with punishments. Though the world described by Townsend (1994), with its sharing and Pareto optimality has a pleasant sound to it, this sharing and optimality describes only what happens in equilibrium. Extreme punishments for deviations from prescribed behavior may be required to implement the optimal sharing rule. Even in environments without full risk sharing, we might expect there to be rules governing the sharing of income such as the windfalls we provide via our experiments. Deviations from these rules may be discouraged by any of a variety of punishments, possibly including social exclusion or even physical violence.

If allocations in the villages are less than fully Pareto optimal, then a fourth motive for making an investment on behalf of others may become important. When there's full risk sharing, it will matter how *much* one invests, but it shouldn't matter on *whose* behalf the investment is made: any beneficiary will share the proceeds with the rest of the village in precisely the same way. In contrast, when there's *not* full risk-sharing, the identity of the beneficiary matters. An intuition for this behavior is that the investments observed in the experiments may be efforts to earn 'credit' with selected members of the village. Making such investments might be a simple way for the subject to repay past debts, or to curry favor with selected members of her social network. When the subject cares about *who* is the recipient of her largesse (beyond what can be explained by altruism) then we regard this as evidence of the importance of the agent's social network.

In Section 2 we describe a sequence of models of dynamic risk sharing under different combinations of impediments to trade. We begin with a benchmark model with no frictions; proceed to a simple model which introduces limited commitment; turn to an alternative model which has full commitment but private information; and finally describe a model featuring both limited commitment and private information. In Section 3 we show how to incorporate the random event of our experiment into the dynamic program facing the villagers, and describe the predictions each of our models makes regarding this event and the pattern of transfers observed within our experiment, which is more fully described in Section 5. We then separately identify the contributions of benevolence, altruism, punishments, and one's social network to the behavior observed in the experiments. We further use the data gathered from the experiment to distinguish among the different models in Section 7. Section 8 concludes.

2. Model

In this section, we sketch a sequence of simple models, each of which generates some distinct hypotheses regarding the allocation of resources within the villages we study. Though we later explain our conduct of some experimental treatments within the village, the models described in this section do *not* correspond to the different treatments. Rather, the various treatments are designed to winnow the list of models—we will show that the predictions of some of the models we describe are inconsistent with outcomes observed within the experiment.

Consider a set of individuals in a village; index these individuals by $i = 1, 2, \ldots, n$. Each individual lives for some indeterminate number of periods. In each period, some state of nature $s \in \mathcal{S} = \{1, 2, \ldots, S\}$ is realized.

Given that the present state of nature is s, then individual i's assessment of the probability of the state of nature being $r \in \mathcal{S}$ next period is given by $\pi^i_{sr} > 0$.

At the beginning of the period, each individual i has some non-negative quantity x_i^m of assets indexed by $m = 1, \ldots, M$. Thus, each individual's portfolio of assets is an M-vector, written $\mathbf{x}_i$; conversely, all n individuals' holdings of asset m is an n-vector $\mathbf{x}^m$. The $n \times M$ matrix of all individuals' asset holdings is written as $\mathbf{X}$.

Each individual i may choose to save or invest quantity k_{ii}^m in asset m on her own behalf. Individual i can also make a non-negative contribution to the assets held by someone else—a contribution by person i of asset m held by person j is written k_{ij}^m, so that as a consequence person i's total holding of asset m is $k_{\cdot i}^m = \sum_{j=1}^n k_{ji}^m$, while the portfolio held by i is $\mathbf{k}_{\cdot i} = [k_{\cdot i}^1 \ldots k_{\cdot i}^m]$. The $n \times M$ matrix of person i's investments (whether made on her own behalf or on others') is written $\mathbf{k}_{i\cdot}$, which is assumed to be drawn from a convex, compact set Θ_s^i in state s (this allows us to impose restrictions such as requiring non-negative investments or state-dependent borrowing constraints on the problem should we wish). The sum of investments over all n individuals yields another $n \times M$ matrix, written $\mathbf{K} = \sum_{i=1}^n \mathbf{k}_{i\cdot}$. It will sometimes be convenient to consider the sum of all investments *except* for i's; we write this as $\mathbf{K}^{-i} = \sum_{j \neq i} \mathbf{k}_{j\cdot}$.

The $n \times M$ matrix of investments $\mathbf{K}$ yields an $n \times M$ matrix of returns $\mathbf{f}_r(\mathbf{K})$ in state r, which becomes next period's initial matrix of assets $\mathbf{X}$.

Individual i discounts future utility using a possibly idiosyncratic discount factor δ_i. Thus, if i's discounted, expected utility in state r is U_r^i, then i's discounted, expected utility in state s can be computed by using the recursion

$$U_s^i = u_s^i + \delta_i \sum_{r \in \mathcal{S}} \pi_{sr}^i U_r^i$$

for all s.

The values of the $\{U_s^i\}$ which satisfy the above recursion depend on the more primitive momentary utilities $\{u_s^i\}$. These, in turn, must be feasible given the resources $\mathbf{X}$ brought into the period and the resources $\mathbf{K}$ taken out. Given these resources, we denote the set of feasible utilities for all n villagers in state s by $\Gamma_s(\mathbf{X} - \mathbf{K})$. The n-vector of all individuals' momentary utilities is written as $\mathbf{u}$.

Assumption 1. The correspondences $\Gamma_s : \mathbb{R}^{nM} \to \mathbb{R}^n$ for $s = 1, 2, \ldots, S$ are each compact, convex, have continuously differentiable frontiers, and non-empty interiors.

So, given $\mathbf{X}$, $\mathbf{K}$, and the state s, any feasible assignment of momentary utilities must lie within the set $\Gamma_s(\mathbf{X} - \mathbf{K})$. Let $g_s : \mathbb{R}^n \to \mathbb{R}$ be a function describing the distance from a point $\mathbf{u}$ in $\Gamma_s(\mathbf{X}-\mathbf{K})$ to the frontier. Any feasible utility assignment will satisfy $g_s(\mathbf{u};\mathbf{X}-\mathbf{K}) \geq 0$, while any efficient utility assignment $\mathbf{u}$ will satisfy $g_s(\mathbf{u};\mathbf{X}-\mathbf{K}) = 0$.

2.1. **Full Risk Sharing.** Now, let us consider the problem facing some arbitrarily chosen individual i in the absence of any impediments to trade.

Problem 1. Individual i solves

$$V_s^i(\mathbf{U}^{-i},\mathbf{X}) = \max_{\{\{\mathbf{U}_r^{-i}\}_{r\in\mathcal{S}},\mathbf{u}_s,\{\mathbf{k}_{j\cdot}\}_{j=1}^n\}} u_s^i + \delta_i \sum_{r\in\mathcal{S}} \pi_{sr}^i V_r^i\left(\mathbf{U}_r^{-i}, \mathbf{f}_r\left(\sum_{j=1}^n \mathbf{k}_{j\cdot}\right)\right) \tag{1}$$

subject to the promise-keeping constraints

$$u_s^j + \delta_j \sum_{r\in\mathcal{S}} \pi_{sr}^j U_r^j \geq \underline{U}^j \tag{2}$$

for all $j \neq i$ where $\underline{U}^j$ is i's promise to j regarding his utility; subject also to the requirement that assigned utilities be feasible,

$$g_s\left(u_s^1,\ldots,u_s^n;\mathbf{X}-\sum_{j=1}^n \mathbf{k}_{j\cdot}\right) \geq 0, \tag{3}$$

that each individual's investments are feasible,

$$\mathbf{k}_{j\cdot} \in \Theta_s^j \quad \text{for all } j = 1,\ldots,n. \tag{4}$$

Problem 1 is very like the problem facing a social planner, and like the social planner's problem can be used to characterize the set of Pareto optimal allocations. In one standard special case we might think of individual i's problem as one of allocating consumption across individuals in different states, as in, e.g., Townsend (1994).

Proposition 1. *A solution to Problem 1 exists, and satisfies*

$$\lambda_s^j = \frac{\partial g_s/\partial u^j}{\partial g_s/\partial u^i}, \tag{5}$$

$$\lambda_r^j = \frac{\delta_j}{\delta_i}\frac{\pi_{sr}^j}{\pi_{sr}^i}\lambda_s^j, \tag{6}$$

and

$$\frac{\partial g_s}{\partial x_j^m} = \delta_i \sum_{r\in\mathcal{S}} \pi_{sr}^i \frac{\partial g_r}{\partial x_j^m}\frac{\partial \mathbf{f}_r}{\partial k_{\cdot j}^m} + \sum_{l=1}^n (\bar{\eta}_{lj}^m - \underline{\eta}_{lj}^m) \tag{7}$$

for some non-negative numbers $\{\lambda_s^j, (\lambda_r^j)_{r\in\mathcal{S}}, \left((\bar{\eta}_{ij}^m, \underline{\eta}_{ij}^m)_{i=1}^n\right)_{m=1}^M\}$.

Proof. The payoffs u_s^i are bounded, the discount factor δ_i is less than one, and the constraint set is convex and compact, all by assumption, so that Problem 1 is a convex program to which a solution exists. The Slater condition is satisfied and the objective and constraint functions are all assumed to be continuously differentiable in u_s^i and x, so that the first order conditions will characterize any solution. The first order condition associated with the choice object u_s^i is given by (16). Combining the first order conditions for U_r^i with the envelope condition with respect to U_s^i yields (12). □

2.2. **Hidden Investments.** Let us now add a particular sort of friction to the problem described in Section 2.1. We allow some of the villagers to make *unobserved* investments, introducing an element of private information into the environment.

The addition of private information requires some modification to the model described above. Our basic approach involves manipulating the space of possible states $\mathcal{S}$. Let $\mathcal{S}_1$ denote the subspace of publicly observed states, and assume that the realization of any state $s_1 \in \mathcal{S}_1$ determines the set of *feasible* investments $\Theta_{s_1}^j$ for each the $j = 1, \dots, n$ agents in the village.

As before, each individual j chooses a matrix of investments $\mathbf{k}_{j\cdot} \in \Theta_{s_1}^j$. Let $\Theta_{s_1} = \{\sum_{j=1}^n \mathbf{k}_{j\cdot} | (\mathbf{k}_{1\cdot}, \dots \mathbf{k}_{n\cdot}) \in \Theta_{s_1}^1 \times \Theta_{s_1}^2 \times \cdots \times \Theta_{s_1}^n\}$ be the space of feasible *aggregate* investments when the (sub)space is s_1. Further, let $\Theta = \bigcup_{s_1 \in \mathcal{S}_1} \Theta_{s_1}$ denote the set of aggregate investments feasible in *any* state. This sum of the actual investments made by these agents help to determine the overall state, so that our new, augmented state space can be written $\mathcal{S} = \mathcal{S}_1 \times \Theta$.

We imagine that the first $\bar{n} < n$ agents may have the opportunity to make hidden investments, so that for any $j \leq \bar{n}$, agent j chooses a matrix of investments $\mathbf{k}_{j\cdot} \in \Theta_{s_1}^j$. Note that we assume that the nth agent (and possibly others) do *not* make hidden investments—though n may make investments $\mathbf{k}_{n\cdot}$, his investments are public information (this simplifies our modeling task by allowing us to set up n as the "principal" in a more-or-less standard principal-agent model).

Recall from above that we'd written the sum of all agents' investments as $\mathbf{K}$, and all agents' save agent j's investments as $\mathbf{K}^{-j}$. Now, to focus attention on j's choice of investments taking all other investments as given, we write the sum of all investments as $\mathbf{K} = (\mathbf{K}^{-j}, \mathbf{k}_{j\cdot})$.

We now turn our attention to the problem facing individual n when there's no problem with commitment, but when j can make (or fail to make) a hidden investment which affects the probability distribution of assets in the next period. Individual n, acting as an uninformed principal, can recommend to j that she make some particular investment $k_{j\cdot}$. We assume that all individuals' portfolios x^j are public in every period, so that i knows exactly what investments are feasible, and the exact portfolios which would be held by everyone in the population in any subsequent state—thus the 'state variables' in n's problem are always public. This allows us to avoid the complexity associated with dynamic principal-agent problems in which assets (as opposed to investments) are privately observed (e.g., Cole and Kocherlakota, 2001; Doepke and Townsend, 2006; Fernandes and Phelan, 2000). Instead, individual j takes an investment 'action' which affects her current-period utility, and which also influences the probabilities of next period's state. A complete description of the current state s *including* the investments made by the agent is a triple $s = (s_1, \mathbf{K}^{-j}, \mathbf{k}_{j\cdot})$; that is, the public (sub)state s_1, aggregate investment $\mathbf{K}^{-j}$ by everyone *but* j, and j's investments $\mathbf{k}_{j\cdot}$. Thus, we write the subjective probabilities for j as $\pi^j_{(s_1,\mathbf{K}^{-j},\mathbf{k}_{j\cdot})r}$. Then incentive-compatibility constraint requires that

$$(u^j_s, \mathbf{k}_{j\cdot}) \in \operatorname*{argmax}_{(\hat{u}^j_s, \hat{\mathbf{k}}_{j\cdot})} \hat{u}^j_s + \delta_j \sum_{r \in \mathcal{S}_1} \pi^j_{(s_1,\mathbf{K}^{-j},\mathbf{k}_{j\cdot})r} U^j_r. \tag{8}$$

such that

$$\hat{u}^j_s \in \Gamma^j_{s_1}(\mathbf{X} - (\mathbf{K}^{-j}, \hat{\mathbf{k}}_{j\cdot})) \tag{9}$$

and

$$\hat{\mathbf{k}}_{j\cdot} \in \Theta^j_{s_1}. \tag{10}$$

This model closely resembles the model of Lehnert et al. (1999).

Problem 2. Individual i solves (1) subject to (2), (3), (4), and the incentive compatibility constraints (8).

Assumption 2.
(1) For any (k, s) there exists a $(\hat{k}, \hat{s})$ such that $f_s(k) = f_{\hat{s}}(\hat{k})$, and other observables that depend on the state are unchanged (e.g., $\Gamma_s(X) = \Gamma_{\hat{s}}(X)$).
(2) The probabilities $\pi^j_{sr}(k)$ are strictly positive for all k;
(3) The probabilities $\pi^j_{sr}(k)$ are continuously differentiable for all $(s, r) \in \mathcal{S} \times \mathcal{S}$.
(4) The first order approach is valid.

The first two parts of the assumption amount to a way of requiring that the only way to draw inferences regarding the agent's choice of investment k is via the observation of realized returns to the investment

$\mathbf{f}_r(k)$. The second two parts are necessary to guarantee that the first order conditions associated with Problem 2 (i) exist and (ii) characterize the constrained optimum.

Proposition 2. *A solution to Problem 2 exists, and satisfies*

$$\lambda_s^j = \frac{\partial g_s/\partial u^j}{\partial g_s/\partial u^i}, \tag{11}$$

$$\lambda_r^j = \frac{\delta_j}{\delta_i}\frac{\pi_{sr}^j}{\pi_{sr}^i}\lambda_s^j, \tag{12}$$

and

$$\frac{\partial g_s}{\partial x_j^m} = \delta_i \sum_{r\in\S} \pi_{sr}^i \frac{\partial g_r}{\partial x_j^m}\frac{\partial \mathbf{f}_r}{\partial k_{ij}^m} + \eta_{ij}^m. \tag{13}$$

2.3. **Limited Commitment.** Now, suppose that after any state s any individual j can deviate from any existing agreement. The value of the deviation depends on their portfolio of assets $\mathbf{k}_{\cdot j}$, and is given by $A_s^j(\mathbf{k}_{\cdot j})$. Then for any arrangement to be respected, after any state s the continuation utilities received by j must satisfy

$$U_r^j \geq A_r^j(\mathbf{k}_{\cdot j}), \tag{14}$$

for all $j \neq i$, while for individual i the arrangement must satisfy

$$V_r^i(U_r^{-i}, \mathbf{f}_r(\mathbf{K})) \geq A_r^i(\mathbf{k}_{\cdot i}). \tag{15}$$

This arrangement assumes that the investment decision k_{ji}^m is public, so that i can tell j to make the investment that maximizes i's discounted, expected utility, subject only to resource constraints, the requirement that i keep his promises, and that *given* the investments chosen or recommended by i that j's continuation payoffs be greater than the payoffs to deviating (after every date-state).

Problem 3. Individual i solves (1) subject to (2), (3), (4), and the limited commitment constraints (14) and (15).

This is essentially the model of Ligon et al. (2000), and similar results follow.

Proposition 3. *A solution to Problem 3 exists, and satisfies*

$$\lambda_s^j = \frac{\partial g_s/\partial u^j}{\partial g_s/\partial u^i}, \tag{16}$$

$$\lambda_r^j = \frac{\delta_j}{\delta_i}\frac{\pi_{sr}^j}{\pi_{sr}^i}\left(\frac{1+\phi_r^j}{1+\phi_r^i}\right)\lambda_s^j, \tag{17}$$

and

(18)
$$\frac{\partial g_s}{\partial x^m_j} = \delta_i \sum_{r\in\mathcal{S}} \pi^i_{sr} \frac{\partial g_r}{\partial x^m_j} \frac{\partial \mathbf{f}_r}{\partial k^m_{\cdot j}} + \sum_{l=1}^{n} (\bar{\eta}^m_{lj} - \underline{\eta}^m_{lj}) - \delta_j \frac{\lambda^j_s}{\mu_s} \sum_{r\in\mathcal{S}} \pi^i_{sr} \phi^j_r \frac{\partial A^j_r}{\partial k^m_{\cdot j}}.$$

When an adequate commitment technology is available, Proposition 1 tells us that the 'planning weights' λ^j_r will remain fixed across dates and states. In contrast, when commitment is limited, individuals may sometimes be able to negotiate a larger share of aggregate resources. More precisely, the weights λ^j_r will satisfy a law of motion given by (17). Furthermore, i will do his best to structure asset holdings across the population so as to avoid states in which others can negotiate for a larger share. He can control this to some extent by assigning asset ownership to those households who are least likely to otherwise have binding limited commitment constraints in the next period. This introduces a distortion into the usual intertemporal investment decision, leading to a modified Euler equation given by (18).

2.4. **Hidden Transfers with Limited Commitment.**

3. Example

In each of the villages we're considering, one day in the summer of 2007 a *gringa* rolled unexpected into town. The villagers didn't know she was coming. However, they must have known of the possibility that she'd come—they'd seen this *gringa loca* before Schechter (2007).

In this section we show how to model the event of *la gringa's* arrival from the viewpoint of the villagers, and how to deal with the probability distribution over different possible future states induced by the experiments conducted by *la gringa loca*.

Let utility be defined over one consumption good c as $u(c)$. Assume that $u'(c) > 0$ and $u''(c) < 0$ and the Inada conditions hold. The consumption of person i in state 0 is $c^i_0 = \sum_{m=1}^M x^m_{i0} - \sum_{j=1}^n (\sum_{m=1}^M k^m_{ij} + \tau_{ij})$, or his endowment minus the investments he makes for everyone's future minus the net transfers he makes to everyone today.

3.1. **Chosen Revealed Game.**

The set of states as it relates to the games is $S = \{0, 1, 2, 3, 4, 5, 6, 7\}$. *La gringa* comes in state 0 and then rolls the die to see which of states 1 through 6 will occur. After that, state 7 occurs. The transition matrix as it relates to the game is:

$$\pi = \begin{bmatrix} 0 & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

The kronecker product of this matrix with a transition matrix relating to the weather is what is taken to determine the full state of nature.

Now consider the special case in which there are a total of three people; only person one plays the game. Let ω be the endowment which does not come from the game. So we have:

$$\mathbf{x} = \begin{bmatrix} 10+\omega_1 & 0 \\ \omega_2 & 0 \\ \omega_3 & 0 \end{bmatrix}$$

where the first column is the asset normally available in the village (agriculture?) and the second column is the asset which *la gringa* makes available.

The player's (individual 1's) value function in the chosen revealed game is the following, and note he has to choose a recipient q:

$$V_0^1(U_0^2, U_0^3; \mathbf{x}) = \max_q [\max_{\{c_0^j\}_{j=2}^3, \{\{U_r^j\}_{j=2}^3\}_{r=1}^6, \{\{k_{1j}^m\}_{j=1}^3\}_{m=1}^M} [u(c_0^1) + \delta \sum_{r=1}^6 \pi_{0r} U_r^1(U_r^2, U_r^3; f_{rq}(\mathbf{k}_1))]]$$

where $\mathbf{k}_1$ is the investments made by individual 1 in all assets of all three individuals. In addition, f_{rq} means person q is the one chosen to be sent money in the gringa's game. The player is not allowed to choose to send money to himself; he must choose one of the other individuals. Still, he could choose an individual, and then choose to send that individual nothing (keeping all of the money for himself). Given that the gringa triples the amount sent and also adds a random amount to it, the recipient can still expect to receive some money even if the sender does not send any of his endowment.

So, in this game we have the following for the functions f_{rq} which tells the amount brought into the second period for each player. Remember subscripts mean the state of nature for f, V, and U while superscripts are the person. In the case of k and τ the subscripts are first the giver and then the receiver while the superscript is the asset being invested in. For x the subscript is the person and the superscript is the asset. The depreciation or appreciation rate is ρ which is the same for everyone.

$$\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = f_r(\mathbf{k}) = \begin{bmatrix} \rho \sum_{j=1}^{3} k_{j1}^1 & 0 \\ \rho \sum_{j=1}^{3} k_{j2}^1 & I(q=2)(3k_1^2 + 2r - 2) \\ \rho \sum_{j=1}^{3} k_{j3}^1 & I(q=3)(3k_1^2 + 2r - 2) \end{bmatrix}$$

3.2. **Non-chosen Revealed Game.** This game is quite similar to the previous one except that the player does not choose to whom he wants to give the money and the player does not know to whom it will be given when he decides how much to send (although he finds out at a later point in time.

So, we can think of using the same transition matrix π written above and taking its kronecker product not only with the transition matrix of weather, but also a transition matrix which is n by n and determines which person in the village will be the recipient.

The player's (individual 1's) value function in the non-chosen revealed game is the following:

$$V_0^1(U_0^2, U_0^3; \mathbf{x}) = \max_{\{c_0^j\}_{j=2}^3, \{\{U_r^j\}_{j=2}^3\}_{r=1}^6, \{\{k_{1j}^m\}_{j=1}^3\}_{m=1}^M} [u(c_0^1) + \delta \sum_{r=1}^{6} \pi_{0r} U_r^1(U_r^2, U_r^3; f_r(\mathbf{k}_1))]$$

The main difference between this maximization problem and the previous one is a) he no longer maximizes over q and b) we now have f_r rather than f_{rq} since the recipient is now part of the state of nature rather than a choice variable.

Let r_1 be the person who is randomly chosen and r_2 be the roll of the die. The matrix f is now as below:

$$\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = f_r(\mathbf{k}) = \begin{bmatrix} \rho \sum_{j=1}^{3} k_{j1}^1 & 0 \\ \rho \sum_{j=1}^{3} k_{j2}^1 & I(r_1=2)(3k_1^2 + 2r_2 - 2) \\ \rho \sum_{j=1}^{3} k_{j3}^1 & I(r_1=3)(3k_1^2 + 2r_2 - 2) \end{bmatrix}$$

3.3. **Chosen Non-revealed Game.** The chosen non-revealed game basically has the same format of function f as does the corresponding revealed game. The real difference is in terms of the information available to each individual which will be evidenced in the maximization problem but not in the investment function f. One should note, though, that there must be at least two players for the non-revealed game to work (otherwise actions can be inferred). So, the f matrix in the chosen non-revealed game with both individuals 1 and 2 acting as dictators is as follows:

$$\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = f_r(\mathbf{k}) = \begin{bmatrix} \rho \sum_{j=1}^{3} k_{j1}^{1} & I(q_2 = 1)(3k_2^1 + 2r_2 - 2) \\ \rho \sum_{j=1}^{3} k_{j2}^{1} & I(q_1 = 2)(3k_1^2 + 2r_1 - 2) \\ \rho \sum_{j=1}^{3} k_{j3}^{1} & I(q_1 = 3)(3k_1^2 + 2r_1 - 2) + I(q_2 = 3)(3k_2^1 + 2r_2 - 2) \end{bmatrix}$$

where q_i is the choice of receiver made by player i and r_i is the roll of the die for player i.

3.3.1. *Non-chosen Non-revealed Game.* The non-chosen non-revealed game basically has the same format of function f as does the corresponding revealed game, but as in the other non-revealed game we need at least two players. So, the f matrix in the non-chosen non-revealed game with both individuals 1 and 2 acting as dictators is as follows: Let r_1 be the person who is randomly chosen and r_2 be the roll of the die for player 1 and let r_3 be the person who is randomly chosen and r_4 be the roll of the die for player 2. The matrix f is now as below:

$$\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = f_r(\mathbf{k}) = \begin{bmatrix} \rho \sum_{j=1}^{3} k_{j1}^{1} & I(r_3 = 1)(3k_1^2 + 2r_4 - 2) \\ \rho \sum_{j=1}^{3} k_{j2}^{1} & I(r_1 = 2)(3k_1^2 + 2r_2 - 2) \\ \rho \sum_{j=1}^{3} k_{j3}^{1} & I(r_1 = 3)(3k_1^2 + 2r_2 - 2) + I(r_3 = 3)(3k_1^2 + 2r_4 - 2) \end{bmatrix}$$

4. Data

In 1991, the Land Tenure Center at the University of Wisconsin in Madison and the Centro Paraguayo de Estudios Sociológicos in Asunción worked together in the design and implementation of a survey of 300 rural Paraguayan households in sixteen villages in three departments (comparable to states) across the country. Fifteen of the villages were randomly selected, and the households were chosen randomly stratified by land-holdings. The sixteenth village was of Japanese heritage and was chosen on purpose due to the large farm size in that village. The original survey was followed up by subsequent rounds of data collection in 1994, 1999, 2002, and, most recently, in 2007. All rounds include detailed information on production and income. In 2002 questions on theft, trust, and gifts were added. Only 223 of the original households were interviewed in 2002.[2]

In 2007 new households were added to the survey in an effort to interview 30 households in each of the fifteen randomly selected villages

[2]Comparing the 2002 data set with the national census in that year I find that the household heads in this data set were slightly older, which makes sense given the sample was randomly chosen 11 years earlier. The households in the 2002 survey were also slightly more educated and wealthier than the average rural household, probably due to the oversampling of households with larger land-holdings.

for a total of 450 households. In one small village only 29 households were surveyed. These 449 households were given what was called the 'long survey'. This survey contained most of the questions from previous rounds and also added many questions measuring networks in each village.

The process undertaken in each village was the following. We arrived in a village and found a few knowledgeable villagers and had them help us to collect a list of the names of all of the household heads in the village. We also asked the knowledgeable villagers to tell us the names of a few of the poorest villagers and a few of the richest villagers. Every household in the village was given an identifier. At this point we randomly chose new households to be sampled to complete 30 interviews in the village. (This meant choosing anywhere between 6 and 24 new households in any village in addition to the original households.)

The 'long survey' was carried out with each of these 30 households. Network questions included a) which household would your household go to if you needed to borrow 20,000 Gs, b) which household would go to your household if they needed to borrow 20,000 Gs, c) which households has your household lent money to in the past year, d) which households have lent money to your household in the past year, e) which households have given your household money to deal with health shocks in the past year, f) which households has your household given money to deal with health shocks in the past year, g) which households contain the godparents of the children of the head of your household, h) for which household heads' children is the head of your household a godparent, i) to which households has your household given agricultural gifts in the past year, j) from which households has your household received agricultural gifts in the past year, k) which households contain a child, sibling, or parent of the household head or his spouse, l) with which households were land transactions (renting for a fee, borrowing for free, or sharecropping) carried out in the past year. Since we had a list of the names of all of the household heads in the village we could match the answers to these network questions with the identifiers of each household.

We invited all of the households which participated in the long survey to send a member of the household (preferably the household head) to participate in a series of economic experiments. These experiments will be described in more detail in the next section. For now, I would like to point out that one of the experiments involved the player choosing another household in the village to whom it wished to transfer money. If the chosen household had not been surveyed previously, then we carried out the 'short survey' with those additional households. 161 households responded to the short survey with a minimum of 0 in a village and a maximum of 18. This shorter survey contained all of the network questions which were asked in the long survey but did not contain the detailed production questions from the longer survey. The short survey also asked the respondents how they would have played in the games if they had participated.

5. Experiment

The majority of experiments run in both the United States and in developing countries are anonymous and involve no partner choice. Experimental economists find evidence of altruism, trust, and reciprocity in such anonymous settings, suggesting that these more behavioral concepts have economic impacts in the real world Carter and Castillo (2002). But, many of the real world situations in which these concepts affect outcomes are not anonymous and do in fact involve partner choice. Glaeser et al. (2000) run non-anonymous trust experiments with Harvard undergraduates and allow them to meet to come up with a list of the friends they have in common before they participate in the games. They find that partners who have more common friends and who have known each other longer are both more trusting and more trustworthy. This result could be due either to increased altruism between more connected partners, or due to the possibility for repeated interactions outside of the experimental setting, although the authors are not able to distinguish between the two hypotheses.

There are two other recent papers in which villagers choose their partners in experiments.[3] In work by Barr and Genicot (2008), rural Zimbabweans choose risk-pooling groups with which to play. While pooling risk does not increase payoffs *per se*, it does decrease the riskiness of outcomes. One limitation is that they cannot compare play when villagers choose their own network with play when that network is assigned. In a microfinance program designed by Karlan et al. (2005), participants receive loans sponsored by one of their fellow villagers. Loans sponsored by friends have a higher interest rate than loans sponsored by those further away in the social network. They plan to look at how much lower the interest rate must be to induce a villager to ask for a loan sponsored by someone outside his social network. Thus, they

[3]Slonim and Garbarino (2005) allow some players to choose characteristics of their partner (age and gender) and find that senders in both the dictator game and the trust game who chose their partner send more than those who did not.

will measure how much a villager is willing to pay to avoid interacting with someone outside of his social network, not the ability of the network to increase returns for its members.

Regarding the experiments we carried out in Paraguay, a day or two after conducting the long survey with 30 households in a village we invited them to send one member of their household, preferably the household head, to participate in a series of economic experiments. The games were held in a central location such as a church, a school, or a social hall. Of 449 households, 449 (83 per cent) participated in the games. This share is quite similar to the 188 out of 223 (or 84 per cent) who participated in the games carried out in 2002. The games carried out in 2002 were different from those carried out in 2007 and so the participants had no previous experience with the games in 2007.

We designed four experiments which are each variants of the dicator game and, together, can be used to measure the value of village institutions and networks. In the traditional dictator game, a dictator is given a sum of money and must decide how to divide it between himself and an anonymous partner. In the four experiments we conducted, we doubled the money sent by the dictator to his anonymous partner. While only those individuals who showed up for the experiment could act as dictators, any household in the village could be a recipient.

We carried out an anonymous version of this game measuring social preferences in an anonymous one-shot setting. The second game was basically the same, but players were warned that when the game was over we would reveal to them who their partner had been. The person receiving the money would also find out the rules of the game and who sent the money. The villagers may have their own (unobserved) system of sanctions and rewards which they can impose on each other after the end of the experiments. Whereas the original dictator game would measure how altruistic a player feels towards his village-mates inherently, the revealed partner dictator game measures the value of the community in which players live given the village institutions of sanctions and rewards which are already in place.

In the third and fourth versions of the game, the dictator could choose to which household he would like to send money. In the third version the recipient was not told who sent him the money and in the fourth version he was told. From this one can measure the value of sanctions and rewards within the village, as well as the value of being able to direct investments to particular individuals within the village.

5.1. **More Detailed Design.**

Anonymous Game: The dictator chooses how much to send to some anonymous person in the village. Neither the sender nor the receiver ever knows who their partner was. This game measures *benevolence* B.

Revealed Game: The dictator chooses how much to send to an anonymous person in the village. He knows that at the end of the game he will find out to whom he sent the money. He also knows that the recipient will learn the rules of the game and from whom the money came. This measures $B + S$ where S is related to the the value of *sanctions* to the village community, since the dictator can be punished (or rewarded) by the villagers outside the game.

Chosen Game: The dictator chooses how much to send and to which household he would like to send it. The recipient will *not* learn from whom he received the money. (This is obviously difficult to enforce in practice; see below for more details.) This measures $A+B$ where B is *benevolence* as measured in the first game and A is directed *altruism*. This does not involve S since the receiver should never find out from whom the money came and so should have no way of punishing the dictator.

Chosen Revealed Game: The dictator chooses how much to send and to which household he would like to send it. The recipient will learn from whom he received the money. This measures $A + B + S + R$ where B is benevolence, A is directed altruism, S is the value of sanctions to the village community, and R is the value of reciprocity within the dictator-specific social network.

Although the dictator makes choices for both the chosen revealed and non-revealed games, only one of the two is (randomly) chosen to affect actual payoffs. This step was taken to aid in anonymity in the non-revealed version. In addition, in all four versions, we altered the probability distribution relating the amount of money sent to the amount of money received. For each of the four versions and for each of the dictators we rolled a die; the dictator knew that we were going to roll a die but did not see the result of the roll. On a roll of one, the recipient received an extra 2 thousand Guaranies (KGs; at the time the experiments were conducted, one thousand Guaranies was worth approximately 20 US cents); a roll of two meant an extra 4 KGs; a roll of three meant an extra 6 KGs; a roll of four meant an extra 8 KGs; and a roll of five meant an extra 10 KGs; finally, a roll of six meant that no extra Guaranies was added. Thus, the more money a

	Choose	Don't Choose
Two-sided Anonymity		B
One-sided Anonymity	$A + B$	
Non Anonymous	$A + B + S + R$	$B + S$

TABLE 1. Treatments and Motives for Transfers

dictator sent, the more money a recipient would receive on average, but the exact amount received had a random component. This was another step taken to ensure that in the chosen (non-revealed) game the dictator couldn't prove to the recipient that he had chosen him.

In the short survey we asked respondents how they would have played if they had been invited to participate in the economic experiments. In this case we did not worry about whether the recipient could find out the money was sent by the respondent since all decisions were hypothetical. So, in order to simplify the explanation of the game for the respondents and ease in understanding we did not incorporate the roll of the die and the additional random component received in these questions. This means that the expected amount received by the dictator's partner is 5 KGs less in the hypothetical question than in the actual games.

A graphical representation of the experiments is shown in Table 1. In one column the dictator chooses and in the other column he does not choose to whom he would like to send the money. The three rows represent two-sided anonymity, one-sided anonymity (the dictator knows the matching but the recipient does not), and no anonymity.

Note that there are actually two types of non-anonymity which might be called ex-ante and ex-post non-anonymity. When the dictator chooses his partner in the non-anonymous row he chooses how much money to send after knowing the identity of the recipient (ex-post non-anonymity). In the non-anonymous row when the dictator does not choose his partner he does not find out to whom the money is going until after he chooses how much money to send (ex-ante non-anonymity). It would be impossible for the dictator to choose his recipient with ex-post non-anonymity. It would be possible for the dictator to be randomly assigned a recipient but be told who it was before he made his decision. This would measure $A + B + S$ but the A would be altruism directed towards the random recipient. This last technique is used by Leider et al. (2007) within a network of Harvard undergraduates.

The game took approximately three hours from start to finish and players were offered 1 KGs extra for arriving on time. We used our vehicle to pick up participants who were not able to get to the game using their own means of transport. In this case they were offered 1 KGs if they were ready when the vehicle arrived at their residence.

The players received no feedback about the outcome in each version until all four sets of decisions had been made. The order of the four versions was randomly chosen for each participant. Players may become more or less generous with experience, and this could bias estimation of the value of the network. With four experiments there are twenty-four possible orderings for the experiments. But, we only implemented the 12 orderings which kept the chosen revealed and chosen non-revealed games together. This is because we asked players to which household they wished to send money. Then we asked the two questions of how much they would send if the recipient would find out their identity and how much they would send if the recipient did not find out in the randomly chosen order. We might ask the revealed version first or the non-revealed version first, but we would never ask the chosen revealed, then ask one of the non-chosen games, and then go back to ask about the chosen non-revealed.

Dictators were not allowed to choose to send money to their own household, nor could their own household be randomly chosen to receive money from themself. The dictators were given 14 KGs (a bit less than $3US) in each version of the dictator game. A day's wages for agricultural labor at the time was approximately 15 to 20 KGs. The average winnings for the players (not including the 1 KGs received if the player showed up or was ready on time) was 40.93 with a standard deviation of 21.71. The maximum won by a player was 205 KGs and the minimum was 0. The dictators earned payoffs for three of the four games in which they acted as dictator, and in addition had the possibility of earning payoffs as a recipient. In addition to the winnings earned by players, many recipients throughout the village also received money.

A self-interested model of preferences would assume that a dictator chooses a recipient for strategic reasons to maximize utility vis-a-vis consumption. This may not be true; a dictator may choose someone to whom he feels altruistically. After participating in the games we asked players two questions. First we asked them why they chose the recipient they chose. The options were a) "he is a good friend"; b) "he is a good person"; c) "he needs money now"; d) "he always needs money"; e) "I trust him"; and f) "I owe him a favor." Players could choose multiple motives (and in practice never chose more than two).

	Non-chosen Non-revealed	Non-chosen Revealed	Chosen Non-Revealed	Chosen Revealed
Basic Model	W_0	W_0	W_0	W_0
PI	$f(P, B)$ (inferred)	W_0	$f(P, B)$ (inferred)	W_0
LC	$f(P, B)$ (inferred)	$f(P, B)$	$f(A, P, B, S)$ (inferred)	$f(A, P, B, S)$
LC & PI	$f(B)$	$f(P, B)$ (revealed)	$f(A, B)$	$f(A, P, B, S)$ (revealed)

TABLE 2. Payoffs from the treatments in different village environments

We also asked the subjects how they decided the quantity to invest in the two versions of the games for which they chose the recipient. The answers were categorized into one of two possibilities: a) "the person needs the money and I don't care if he knows that it comes from me or not"; and b) "the person will know the money is from me and that was important to my decision making".

6. Estimation

In order to clarify our thinking, it is useful to lay out what utility levels will be in each version of the dictator game under three different assumptions about the state of the world. The work could be one of full risk sharing within the village which is the basic model. We could also maintain the idea that all information is public but add in limited commitment (LC). Lastly, we could have both limited commitment and non-contractibility (due to private information) (LC & PI).

In the above table we see that if there is full risk sharing then total utility after any of the four games will be exactly the same. It does not matter to whom the money is sent or whether or not we inform the villagers the identity of the individual with whom they were partnered. All money is shared so as to keep the ratio of marginal utilities between individuals constant and there is no private information so individuals can infer who sent money to whom even if we do not inform them.

In the model with only limited commitment, the households are not able to keep secrets from one another. As in the basic model, all consumption and income is observed and so the households are able to infer perfectly who sent money to whom even if we do not inform them. That explains why there is no difference in utility between the revealed and non-revealed versions of each game. On the other hand, with limited commitment, there is a difference in final utility depending on whether the player can or cannot choose the recipient. The function f in the table above is not the same as the function f which transforms investments today into payoffs tomorrow. I no longer assume additivity, as in the previous table, since concavity of the utility function may cause these measures to not be additive.

The model with both limited commitment and private information implies there will be a different level of utility for each game. If we do not reveal to the villagers who sent money to whom, then they can not infer it. This case is equivalent to what we were assuming in the table in the previous section.

7. Results

We can calculate the quantities B, A, S, and R assuming additivity and that they are directly measurable vis-a-vis the amount sent as in the table in the previous section. We measure these quantities for two groups of people: the people who actually participated in the games, and the people who were chosen by the dictators and were then asked hypothetical versions of the games.[4]

The average amount sent (out of a maximum of 14 KGs possible), was 5.08 KGs in the anonymous game, 5.47 KGs in the revealed game, 5.40 KGs in the chosen game, and 5.93 KGs in the chosen revealed game. (For the 61 observations which come from games run by Charles, the corresponding quantities are much lower, although still showing a similar pattern; means for these are 3.53, 3.54, 4.12, and 4.93 KGs.) Table **??** show these numbers and their standard deviations.

When looking Table 4, one should remember that B is benevolence, S is sanctions, A is directed altruism, and R is reciprocity in the social network. "Motive - poverty" means that one of the motives for choosing the recipient was that he needs the money now, or he needs the money always. "Motive - friend" means that one of the motives for choosing the recipient was that he is a good person, a good friend, I trust him, or I owe him a favor. Some observations could be classified in both categories since people were allowed to choose more than one motive.

[4]We also experiment with including or excluding games run by "Charles", an enumerator who misbehaved by encouraging players to send less money so that they could win more. (The answers to the hypothetical questions in the short surveys conducted by Charles also send much less money. Perhaps he wanted the results in his surveys to 'match' the results from the actual games he conducted.)

Setting (No. of Obs.)	Non-chosen Non-revealed	Non-chosen Revealed	Chosen Non-revealed	Chosen Revealed
Real Games	5084	5466	5394	5927
(371)	(2695)	(2687)	(2679)	(2840)
Hypothetical	6601	7173	7075	8098
(173)	(3445)	(3359)	(3224)	(3295)

TABLE 3. Averages Sent. Numbers in parentheses are standard deviations.

Controls (Players in Category)	B	S	A	R
Everyone	5084	383	310	151
(371)	(140)	(120)	(119)	(159)
No Charles	5390	455	255	23
(310)	(153)	(130)	(130)	(174)
Motive - poverty	5229	549	529	0
(153)	(223)	(187)	(196)	(257)
Motive - friend	4983	261	130	270
(230)	(172)	(149)	(142)	(193)
Choose - not know	5189	365	389	-35
(285)	(155)	(137)	(131)	(173)
Choose - know	4733	442	47	767
(86)	(319)	(252)	(274)	(367)

TABLE 4. Real games. Numbers in parentheses are standard errors.

"Choose - will know" means the dictator cares that the receiver will know who chose him. "Choose - won't know" means the dictator says the receiver needs the money and so the dictator doesn't care if the receiver knows who chose him. This was not asked in the hypothetical set of questions.

To calculate means and standard errors in the first row of Tables 4 and 5, one can run the following regression, clustered at the individual level:

$$y_{ij} = B + PT_2 + AT_3 + (P + A + S)T_4 + \epsilon_{ij}$$

where T_2, T_3, and T_4 are dummies for the non-chosen revealed game, the chosen non-revealed game, and the chosen revealed game respectively. The player's subscript is i and the game's subscript is j. In the subsequent rows, we run additional regressions including dummy variables for not being in the category of interest (e.g. not having a

Category (Players in Category)	B	S	A	R	
Everyone	173	6601	572	474	451
(173)	(263)	(235)	(237)	(284)	
No Charles	154	6896	539	474	578
(154)	(281)	(255)	(261)	(302)	
Motive - poverty	62	7258	-48	210	1129
(62)	(425)	(336)	(359)	(413)	
Motive - friend	111	6252	928	622	18
(111)	(329)	(311)	(310)	(370)	

TABLE 5. Hypothetical questions. Numbers in parentheses are standard errors.

motive of poverty) interacted with each of the treatments. Each row of the tables represents a separate regression.

There are some interesting things to note about these two tables.

(1) All four variables are positive on average.
(2) The value of sanctions S seems to be larger than the value of directed altruism A (as well as larger than the value of reciprocity in the social network R).
(3) In the real games, the value of reciprocity in the social network is greater when players state that the motive behind choosing the person did not have to do with poverty, while directed altruism is higher when the dictator claims to have chosen the recipient due to poverty. Related, dictators who say that they care whether or not the recipient knows the money is from them have a higher value of the network. Dictators who claim not to care if the recipient knows who the money comes from have a higher value for directed altruism. (Actually, and quite interestingly, dictators who choose a recipient based on the recipient's level of poverty, and who don't care if the recipient knows where the money is coming from also have higher values of benevolence (and are wealthier).) The results from the hypothetical games on this seem to be the exact opposite, which is hard to rationalize.

When looking at the amount sent over the four different versions of the game, one notices that order is important. People tend to give more at first and get stingier as the rounds progress. Order effects are less significant when the games are asked as hypothetical questions.

To calculate means and standard errors in the first row of Tables 4 and 5, one can run the where T_2, T_3, and T_4 are dummies for the non-chosen revealed game, the chosen non-revealed game, and the chosen revealed game respectively. The player's subscript is i and the game's subscript is j. In the subsequent rows, we run additional regressions including dummy variables for not being in the category of interest (e.g. not having a motive of poverty) interacted with each of the treatments. Each row of the tables represents a separate regression.

We have tried many ways of controlling for order effects. The approach used here involves estimating the regression discussed above, clustered at the individual level:

$$y_{ij} = B + ST_2 + AT_3 + (A + S + R)T_4 + \epsilon_{ij}$$

but adding additional right hand side variables which represent order effects (as well as a dummy for whether the data was collected by Charles). In this way we predict how much would have been sent in each version of the game if it had been the first game played and if it had not been conducted by Charles.

Let us number the anonymous game 1, the revealed game 2, the chosen non-revealed game 3, and the chosen revealed game 4. The 12 orders possible were {1,2,3,4}, {1,2,4,3}, {1,3,4,2}, {1,4,3,2}, {2,1,3,4}, {2,1,4,3}, {2,3,4,1}, {2,4,3,1}, {3,4,1,2}, {4,3,1,2}, {3,4,2,1}, and {4,3,2,1}. Games 1 and 2 may be separated, but games 3 and 4 were never separated.

As explanatory variables representing order effects, we include an indicator for whether game 2 came before game 1 multiplied by a treatment 1 indicator, an indicator for whether game 2 came before game 1 and the two games were separated from one another multiplied by a treatment 1 indicator, an indicator for whether game 1 came before game 2 multiplied by a treatment 2 indicator, an indicator for whether game 1 came before game 2 and the two games were separated from one another multiplied by a treatment 2 indicator, indicators for whether game 3 came before came 4 multiplied by treatment 3 and 4 indicators, and indicators for whether game 1 was separated from game 2 multiplied by treatment 3 and 4 indicators. We also include indicators for whether Charles ran the experiment interacted with each treatment indicator. These regressions were run separately for both the actual games and the hypothetical answers.

Because the order effects were mostly insignificant in the regressions on the hypothetical data, we also employ the same techniques as above, but controlling only for Charles and not for the order effects with the

Category (Players in Category)	B	S	A	R
Everyone	5747	240	305	199
(371)	(189)	(270)	(253)	(417)
Motive - poverty	5869	413	562	68
(153)	(244)	(302)	(291)	(476)
Motive - friend	5657	131	116	316
(230)	(220)	(287)	(269)	(418)
Choose - not know	5806	236	388	20
(285)	(200)	(288)	(259)	(429)
Choose - know	5515	291	3	854
(86)	(329)	(324)	(339)	(515)

TABLE 6. Real games: Controlling for order and Charles. Numbers in parentheses are standard errors.

hypothetical data. This should decrease noise in the predicted amount sent.

In Table 6 one can see that the values still tend to be positive. The value of sanctions still seems to be higher than the value of directed altruism. On the other hand, benevolence and the value of reciprocity in the social network are both higher after controlling for order effects, while sanctions and directed altruism are both smaller. It is still the case that the value of reciprocity the social network is greater when players state that the motive behind choosing the person did not have to do with poverty and that they care whether the recipient knows the money came from them. Directed altruism and benevolence are still lower in these cases. So, the main results which held in the actual data continue to hold when controlling for order effects.

The results from the hypothetical games in Tables 7 and 8 on this last point continue to be the exact opposite. Those who chose a recipient because they were poor have a higher value of the social network and a lower value of directed altruism. (Although, they do have a higher value of benevolence, as in the real games.) These strange results could be due to noise since these questions were asked hypothetically. It also could be due to the fact that these people do not constitute a random sample as do the people who participated in the actual games. The people answering the hypothetical questions are those who were chosen to be recipients by some household playing in the actual games. This leads to selection issues (which the theory may be able to say something about). An additional surprising and unexplained characteristic of Table 7 (but not Table 8) is that in this table the value of the network tends to be negative.

Category (Players in Category)	B	P	A	S
Everyone	6809	1147	682	-529
(173)	(367)	(506)	(441)	(708)
Motive - poverty	7423	706	427	39
(62)	(482)	(531)	(496)	(763)
Motive - friend	6365	1542	915	-933
(111)	(408)	(544)	(490)	(742)

Table 7. Hypothetical questions: Controlling for order and Charles. Numbers in parentheses are standard errors.

Table 8. Hypothetical questions: Controlling for Charles but not order

	Players in Category	B	P	A	S
Everyone	173	6896	539	474	578
		(281)	(255)	(261)	(302)
Motive - poverty	62	7563	-84	209	1261
		(426)	(336)	(371)	(426)
Motive - friend	111	6544	894	621	145
		(341)	(332)	(333)	(381)

Numbers in parentheses are standard errors.

7.1. **Do people choose a recipient they think can't punish them?** Many people have suggested that the dictator may specifically choose a recipient who is not part of his social network (i.e., who can't punish him) in order to be able to keep more of the endowment and send less money. Such a person would send more to the randomly chosen revealed recipient than to the person he chose himself when identities are revealed. Out of the 371 participants in the actual games, there are 87 (or 23%) of the players who do just that. Of the 173 people asked the hypothetical questions in the survey, 33 (or 19%) of the people do that.[5]

[5] I get similar results when looking at the predicted amount sent when controlling for order and Charles, or just for Charles. In the real games when controlling for order and Charles, 99 (or 27%) of the players give more to the revealed randomly chosen person than the revealed person they chose themselves. In the hypothetical questions, when controlling for order and Charles 71 (or 41%) give more, and when just controlling for Charles 30 (or 17%) give more. 87% of the cases in the real games when a person gives more controlling for order and Charles, the person also gives more when not controlling for anything. This is true for 46% of the cases in

We could compare characteristics of these dictators who seem to choose recipients they are not afraid of (and don't benefit from?). These dictators are, themselves, wealthier than the average dictator. In the real games their average wealth is 201,000 KGs compared to 91,300 KGs for those who do not play that way. This is not true in the hypothetical games, where average wealth is 20,800 KGs rather than 46,200 KGs.

Since we also know something about the characteristics of the chosen recipients as individuals, as well as characteristics regarding how they are linked in the social network to the dictator, we could possibly say something interesting about this group of people by comparing characteristics of the recipients they choose in comparison with the characteristics of the recipients that other people choose.

One thing we have not yet examined is the wealth level of the chosen recipient. In the real game, these people do choose poorer recipients (average wealth of 38,300 KGs rather than 45,900 KGs). For the hypothetical questions this is also the case (average wealth of 25,900 compared with 176,000 KGs).

Tables 9 and 10 show the proportion of players sending more money in one treatment than another in the real games and hypothetical questions respectively. (The numbers do not sum to 1 due to players which send the same amount in both treatments.) The intuition from our model does not tell us anything about whether people should send more in the non-chosen revealed (sanctions) treatment or in the chosen non-revealed (directed altruism) treatment, so we have no predictions about the value of the (2,3) or (3,2) elements of the figure. But, we do predict that people should send the least in the non-chosen non-revealed (anonymous) treatment and the most in the chosen revealed (social network) treatment. This would predict that the numbers on the left and bottom sides would be close to 1, while the numbers on the right and top should be 0. Although the shares do not border on 1 and 0, it is the case that most people behave as predicted. There is still a large proportion of people which exhibits unexpected behavior. (Order effects might reduce some of this.)

8. Conclusion

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the hypothetical questions when controlling for order and Charles, and 100% of the cases when only controlling for Charles.

	Non-chosen Non-revealed	Non-chosen Revealed	Chosen Non-revealed	Chosen Revealed
Nc-Nr	•	0.24	0.27	0.20
Nc-R	0.40	•	0.34	0.23
C-Nr	0.35	0.29	•	0.21
C-R	0.46	0.37	0.42	•

Table 9. Real Games: Proportions sending more. Numbers represent the proportion of subjects who sent higher transfers under the row treatment than the column treatment.

Table 10. Hypothetical Questions: Proportions sending more

	Non-chosen Non-revealed	Non-chosen Revealed	Chosen Non-revealed	Chosen Revealed
Nc-Nr	•	0.27	0.24	0.18
Nc-R	0.38	•	0.32	0.19
C-Nr	0.39	0.34	•	0.12
C-R	0.51	0.45	0.44	•

Numbers represent the proportion of subjects who sent higher transfers under the row treatment than the column treatment.

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