# Community contracts: An experimental investigation of rule formation in Indian villages*

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## 1 Introduction

Throughout history, organizations for collective action have emerged and been sustained voluntarily. Greif (1993), Wade (1988), Ostrom (1990, 2000), and Mokyr (2011), among others, demonstrate the capability of autonomous social organizations to emerge and to agree on sharing the burden of funding broadly beneficial activities. The great historian of Britain, T. S. Ashton (1948, p.88) writes that, "In the 18th century, the characteristic instrument of social purpose was not the individual or the State, but the club. Every interest, tradition, or aspiration found expression in corporate form" . While many of these organizations had a narrow business purpose, others did not. Some organizations built hospitals, canals, orphanages, and also contributed to the regulation of new professions. Those organizations filled the void created by a weak state.

However, many communities do not succeed in collective action for reasons that are not well understood. For instance, in his landmark study of 31 irrigated villages in South India, Wade found that nearly half of villages showed no trace of the core voluntary institutions that functioned in other villages (namely, field guards, common irrigators, village council empowered by the villagers, and village standing fund). Yet the villages with, and those without, voluntary institutions faced similar needs to manage shared irrigation channels, open fields at risk from wandering livestock, and the occasional band of marauding mon-

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keys. In a village in Uttar Pradesh that economists had studied for almost 50 years, Dreze and Sharma (1998) paint a picture in which voluntary organizations are "conspicuous by their absence."

> collective institutions such as political parties, trade unions, women's organizations, youth associations, and cooperative societies have been conspicuous by their absence throughout the survey period [1953-1993]....*As things stand, the notion that all adults in the village might gather and deliberate on an equal basis (irrespective of caste, class, and gender) is quite alien to Palanpur's political culture*" (p. 67, emphasis added).
>
> The domain of collective action is potentially quite extensive, but Palanpur's achievements in this crucial field have been extremely limited. In this respect, Palanpur conforms to a familiar pattern in Uttar Pradesh" (p 73).

Little is known about how to improve this situation. Given the many barriers to effective social organization that appear to exist, it is worthwhile to investigate them one-by-one. Here we investigate *the capacity to create and to sustain rules for the efficient level of contributions to a public good.*

Can the nature of the social interactions in a community lead people not to recognize or not to seize opportunities for mutually beneficial cooperation? To investigate this question, we invented a simple variant of the public goods game, and then gave anonymous players the opportunity to vote on a rule to require a minimum contribution to the public good. In this game, the higher the required contribution (up to the maximum feasible level), the greater is each individual's payoff. Our finding is that most groups succeeded in using the rule to boost contributions, but many did not. We seek to explain this.

Neoclassical economics under the standard assumption of rational, self-interested actors provides a simple theoretical account of the evolution of a regulatory regime. Individuals optimize the expected value of their own payoffs. There is a search for mutually beneficial deals and/or a search for the best possible deal. However, as discussed above, field evidence points to the inadequacy of this account. People may have a richer set of preferences, including preferences over *other* people's payoffs and over the *procedure* through which the payoffs are determined (e.g. Bo et al. (2010)). History may shape the ability of individuals to recognize positive-sum games (Guiso et al., 2008); that is, history can shape whether individuals recognize the scope for mutually beneficial cooperation (see Douglas North's recent book on the process of change).

It is particularly relevant today to examine the obstacles to collective action. Central governments in developing countries are increasingly decentralizing power and resources to communities, and donor organizations increasingly rely on community driven development (in which communities must contribute part of the cost of the project, and must also contribute to their management). The promise of participatory development comes from the advantages of information and possibly enforcement capacity at the local compared to the central level. An additional benefit of participatory development may be that the level of cooperation with a policy is greater when it is chosen democratically than when it is imposed exogenously (Bo et al., 2010). On the other hand, local communities may be deeply divided and may have no experience and no culture of cooperative decision making. Mechanisms through which the communities will solve the public good problem that this entails are rarely discussed. It is simply assumed that the needed rules will emerge. As Mansuri and Rao (2012) note,

> ...the policy literature is rife with solutions to market and government failures that assume that groups of people-village communities, urban associations, credit groups, producers' cooperatives-will always work in their common interest. Rarely is much thought given to the possibility of civil society failure.

In this paper, we test whether this assumption is valid in a situation in which conditions are particularly conducive to cooperation: (i) the set of beneficiaries is small and well-defined, (ii) costs and benefits are transparent, and (iii) in equilibrium, expected net payoffs from contributions to the public good are uniform. If we find that a rule for the efficient level of contributions does not emerge in this game, then the usefulness of the assumption that such rules will emerge in naturally occurring situations is called into question. Moreover, the differences we seek to establish between communities in successful social contracting could give us clues to the characteristics of communities in which community-based development is likely to be effective.

## 2 The public gift and social contracting games

Consider a group of 3 players, each with an endowment, $E$. Each player's action is a private decision on the amount that is transferred to the other two players. We call this a *public gift* because when player $i$ gives up an amount $A$ from his endowment, *each* of the other two players receive $A$. The efficient allocation therefore involves all players trans-

ferring their entire amount as a public gift. This would yield an end-game payoff of $2A$ to each of them.

The structure of this *public gift game* is very similar to the more standard public goods game, where players contribute to a common pool and the sum of contributions is multiplied by a factor $m$ and then distributed between the $n$ players in the group. In both cases the marginal return from contributing to the group pool is less than 1 and the efficient solution in both games is for all endowments to be placed in the group pool. The private marginal return from gifts is zero whereas this is $\frac{m}{n}$ for contributions in the public good game. There is a unique Nash equilibrium in both cases in which no player contributes to the public pot.

We developed the gift game because of the ease with which it is understood by subjects not used to computation. When field-testing our experiment, we realized that even among villagers with some education, very few could compute the correct payoffs from alternative strategies in the standard public goods game. In contrast, the notion of public gifts was easily understood because private returns from the gift are zero and the benefits are in the form of reciprocal transfers. Such gift-giving is pervasive in the communities we study and is perceived as beneficial as long as there are norms of reciprocity within a group.

Our main interest is in a modified version of this game, that we call the *social contracting game*. This builds on the public gift game by allowing groups the opportunity to decide collectively on an appropriate level of the gift. Groups are given a default level of a *required* gift, $A$, at the start of the game which can be modified by majority voting. At the start of the game $A = 1$. Each member votes for one of three options: raising $A$ by one unit, lowering it by one unit, or keeping it at the initial level. If there are two or more votes to change the rule in a particular direction, it is changed, else it remains at its initial level. As a tie-breaking rule, we assume that if a player is indifferent between two levels of $A$, he votes for the higher level.

Once the rule or *social contract* is determined, each player simultaneously decides on how much of his endowment to gift and whether or not to monitor the other two players at a cost of $c$. If a players monitors and either of the other two players in the group contribute less than the rule $A$, the monitor earns a reward of $r > c$ and the player who is found to contribute less than $A$ receives a payoff of zero.

Our objective in this paper is to understand why some communities can collectively determine and implement good rules. We begin by a theoretical analysis of the social contracting game. This is followed by our experimental findings. Finally, in Section **??** we use

survey data to correlate social interactions in village communities with the experimental results of groups coming from these villages.

### Equilibrium behavior

Consider the sub-game following the determination of $A$. Each of the 3 players (labeled $i$, $j$ and $k$) must simultaneously decide on how much to give and whether or not to monitor. A player is said to *cheat* if he contributes less than $A$. In our search for equilibrium strategies, we can restrict ourselves to two contribution levels, $A$ and $0$, since players are strictly worse off contributing more than $A$ if they comply, and face the same expected punishment for all values below $A$ if they choose not to comply.

Let $(g_i, m_i)$ be the probability of giving and monitoring for player $i$. There are four possible pure strategies corresponding to the two decisions of giving and monitoring: $\{s_1, s_2, s_3, s_4\} = \{(1,1)(1,0),(0,1),(0,0)\}$. The expected value of gifts received by player $i$ if he is not found cheating is $G_i = g_j g_k 2A + g_j(1-g_k)A + g_k(1-g_j)A$ and his expected benefit from monitoring, as long as he himself is not found cheating, is $M_i = r(1-g_j g_k) - c$. The payoffs for player $i$ from strategies $s_1 \ldots s_4$ are given by

$$\pi_i(s_1) = E - A + G_i + M_i \tag{1}$$

$$\pi_i(s_2) = E - A + G_i \tag{2}$$

$$\pi_i(s_3) = (1-m_j)(1-m_k)[E + G_i + M_i] \tag{3}$$

$$\pi_i(s_4) = (1-m_j)(1-m_k)[E + G_i] \tag{4}$$

We can show that no player can play a pure strategy in any Nash equilibrium of this game. The strategies with cheating ( $s_3$ and $s_4$) are ruled out with the following argument. If a player cheats and is monitored, his payoff is zero and he would do better giving. Any player who always cheats would definitely be monitored since the other players will be better off monitoring him unless they themselves are cheating and being monitored (since their payoff is then zero whether or not they monitor). But in that event, they could in-

crease their payoff by switching to giving and monitoring as long as $E - c > A$.

What about a player always giving in equilibrium? Consider player $i$ playing either $s_1$ or $s_2$. This could only be an equilibrium strategy if another player (say $j$) monitors with positive probability. But since the return to $j$ from monitoring $i$ is zero, it must be that player $k$ cheats with some probability. But under $s_1$, player $i$ always monitors $k$ so the latter would be better off giving than cheating. So $i$ playing $s_1$ cannot be part of an equilibrium strategy profile. Playing $s_2$ (giving and not monitoring) by player $i$ is also ruled out because the net return to monitoring for player $i$ must be at least as large as that for player $j$ since $j$ gets no benefit from monitoring $i$ because $i$ always contributes. So if $j$ monitors, $i$ must also monitor. There are therefore no pure strategy Nash equilibria.

A mixed strategy equilibrium does exist and is characterized in the following result:

**RESULT:** No player plays a pure strategy in any Nash equilibrium of the social contracting game. There is a unique equilibrium in mixed strategies, which is symmetric. All players vote for the highest possible level of the rule $A$ in the voting stage and in the public gift stage, they give $A$ with probability $g^*$ and monitor with probability $m^*$, where $g^* = \sqrt{1 - \frac{c}{r}}$ and $m^* = 1 - \sqrt{1 - \frac{A}{E+2Ag^*}}$.

*Proof:* We have already shown that no player will follow one of the four pure strategies available to them. We have also shown that the probability of giving is strictly between zero and one for all players and that the monitoring probability is also less than one and greater than zero for some player. We now show the monitoring probability $m$ is identical for all players and use this to derive the unique values of $g^*$ and $m^*$.

Note that $m$ cannot be zero for two or more players since the third player would then never give and we have shown that $0 < g < 1$ for all players. Suppose $m_i = 0$ and $m_j, m_k > 0$. It follows that $M_j = M_k = 0$ (otherwise the players would not randomize between monitoring and not monitoring) and also that $g_k = g_j = g$ and $m_j = m_k = m$ (from the expressions for $M_j$ and $M_k$ and from equating the counterparts of (1) and (3) for these players).

With $m_i = 0$, $j$ has a lower probability of being monitored than $i$ and must have a lower value of expected gifts $G_j$ if he is to be indifferent between cheating and giving. This implies $g_i < g$. But this would mean $M_i > M_j$, so $i$ would strictly prefer to monitor and $m_i$, cannot be zero. The mixed equilibrium is therefore unique and symmetric. The values of $g^*$ and $m^*$ are derived by setting $M$ equal to zero for all players and equating payoffs

from cheating and giving:

$$g^* = \sqrt{1 - \frac{c}{r}} \tag{5}$$

Using the expressions for $G$, expected gifts for all players are given by $2Ag^*$ and the monitoring probability is obtained by equating payoffs from $s_1$ and $s_3$. For player $i$, we have $A = [1-(1-m_j)(1-m_k)][2Ag^*+E]$ and since all players face the same $A$, they also choose to monitor with the same probability

$$m^* = 1 - \sqrt{1 - \frac{A}{E + 2Ag^*}} \tag{6}$$

It remains for us to determine the equilibrium level of $A$. If players contribute with probability $g$, their expected gifts are given by $2Ag$ and their cost is $Ag$. Their net payoff is therefore $Ag$, which is increasing in $A$. Voting up the rule is a dominant strategy, given $g$. Since the value of $g^*$ derived above does not depend on $A$, our unique Nash equilibrium is symmetric, with all players voting up the rule and then giving and monitoring with probabilities $g^*$ and $m^*$ respectively.

In the next section we describe the results from our field experiment and compare observed behavior with that predicted in this section.

# 3 The experiment

## Design

Our experiment was conducted with groups of villagers in 24 villages in the state of Uttar Pradesh in North India. All the villages were within a 20 mile radius of the town of Najibabad in the northern part of the state. These villages were selected randomly from a list of nearby villages made available to us by the district administration in Najibabad. We were based at a single location in the town and all sessions of the experiment were conducted there. For each of the sessions our experiment, we had a group of 12 men who arrived together from one of our selected villages to the experiment site. We had initially wanted both male and female subjects but the limited schooling among women in the

area made it difficult for us to find a representative sample of women who understood the game.

We recruited subjects by visiting each of the selected villages a couple of days before the experiment. Households were selected through systematic random sampling that covered the geography of the village. If the principal male member was interested in participating, he was allowed to do so provided he could satisfactorily complete a set of arithmetic exercises which tested his ability to do relevant computations in the game. In 16 of our 24 villages we found enough subjects for 2 sessions, while for the other 8, we conducted only one session. This gives us a total of 40 sessions and 480 subjects. For villages with 2 sessions, we conducted them on the same day to avoid any communication between subjects in the two sessions. The group of villagers in the second session were picked up by jeeps from their villages before those in the first session returned to the village.

The public gift and social contracting games have already been defined in the previous section. They were implemented in the following manner. When the subjects arrived at the site of the experiment, they entered, by choice, one of three rooms. Each room had a place for four players with partitions between them. The experimenter first explained the public gift game, did a number of demonstrations, and then met outside the room with each subject to check his understanding of the game and to review it, if needed.

The public gift game was then played for 6 rounds. To discourage communication among players within a round, each individual was randomly matched with a player in one of the other two rooms. Since a person had 12 partners over the six rounds, and since we drew these partners from a set of only 8 players, each person necessarily interacted with a given player more than once in the public gift game. However, he never knew when he was interacting with the same person, and thus it was not possible for a player to establish a reputation. This was made clear to all players before the start of the game. At the start of Round 5, the experimenter announced that the game would be played 2 more times and before the sixth round, announced that this was the last round.

After the 6 rounds, the experimenter explained the social contracting game and this was then played for 15 rounds, which we label 7-21. In forming new groups in round 7 to play the social contracting game, we sorted players according to the level of their average contribution in rounds 1-6. Group 1 is therefore composed of the three players who were the highest contributors in the public gift game in that session and Group 4 are the three players who contributed the least. All players were told that they would now be in fixed

groups, although they did not know who the other two members of their groups were. We intentionally used the word *group* for this game and not for the public gift game, to emphasize its stable membership and to allow subjects to associate this with collective action problems that they regularly confront within a village.

At the end of each of the 21 rounds, players would receive payoffs in private. Before Round 21 subjects were told that this would be the last round in the game. One assistant was assigned to each room whose sole job was to transmit information about players decisions, so that round payoffs could be calculated (with an Excel program). The assistants returned at the end of each round gave players their payoffs and, in the social contracting game, used coins to indicate on game boards the level of the rule decided on by majority vote. The assistants were girls from a local college. They never spoke to the players. A session lasted about two and a half hours. With each player making decisions in a total of 21 rounds and the number of observations in our experiment data is 10080.

In each round of both games, players were given an endowment of 8 rupees. In the social contracting game, the other parameters are as follows. The monitoring reward was 3, the cost of monitoring was 2 and, in the first round of this game, the default level of the rule was one rupee. We only allowed players to vote in every alternate around starting in Round 7. A player indicated his decision to vote up, vote down, or leave the rule unchanged by adding, removing, or leaving unchanged, the set of white coins on his game board that indicated the level of the rule. Majority rule determined the result of the vote. Thus, the outcome of the vote in the first round would be a rule of 0 if at least two of the three players had chosen to vote the rule down. The outcome would be 2 if at least two of the players had chosen to vote the rule up. Otherwise, the outcome would remain unchanged at the initial default level of 1. This implies that the rule could not jump, it could only crawl.

In all rounds with voting, it takes place before players simultaneously make giving and monitoring decisions. The maximum level of the rule is fixed at 2 rupees since at that level, each player would still be able to pay the monitoring cost of 2 rupees. The optimal path of the rule would start at 2 in round 7, go up by one unit in each voting round and reach 6 rupees by round 15 after which it would stay at that level. The equilibrium giving and monitoring probabilities for any given rule $A$, is obtained by substituting the parameter values from the experiment into the expressions for $(g^*, m^*)$ in our main result. For the parameters in our model, we have a giving frequency of $g^* = \frac{1}{\sqrt{3}}$ or $\approx 0.58$ and a

monitoring frequency of

$$1 - \sqrt{1 - \frac{A}{8 + A\sqrt{4/3}}}$$

A summary sequence for each session is shown in Figure 1.

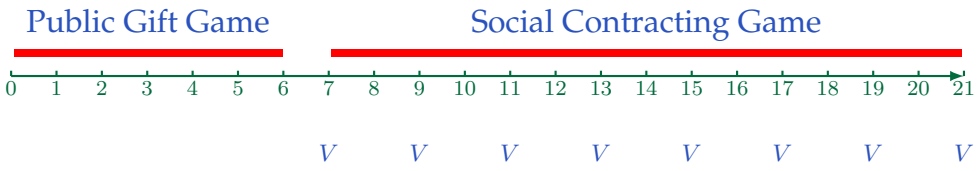


Figure 1: Summary of play in each session

After the game, we interviewed all participants to learn their attitudes toward the game and to obtain information about their political participation, education, occupation, and caste.

### Strategies and outcomes

In the public gift game contributions varied considerably within rounds and relatively little between them. The mean contribution varied only between 2.7 and 2.9 across rounds. The general pattern was for contributions to first rise and then dip in the sixth round, which participants knew to be the last. As described above, subjects were matched by their contributions in this game and entered stable groups for the social contract game. Subjects whose contributions were in the bottom quarter of each session were in Group 4 and their average contribution in the PG game was 1.4 rupees or less than a fifth of their endowment , while the top three contributors were in Group 1and contributed an average of 4.3 rupees.

In the social contracting game, we find that the first 3 groups converge in their contributions and payoffs while Group 4 votes for lower rules and contributes less. This is seen in Figure 3.

The higher contributions seem to have resulted from higher rules. As shown in Figure 3, rules and contributions move closely together,especially in latter rounds.

The most striking pattern is however seen in variations in rule-setting by village. The

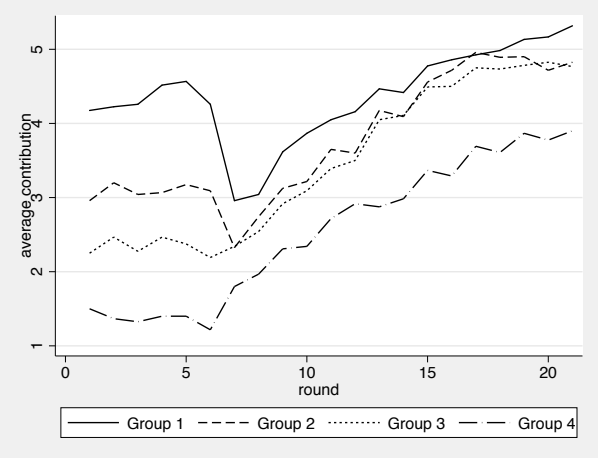


Figure 2: Average contributions by group and round

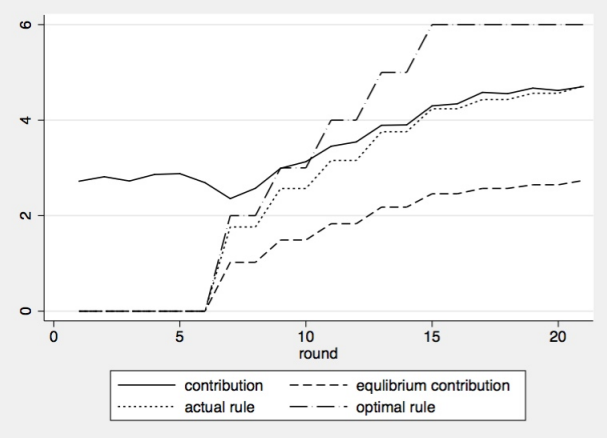


Figure 3: A comparison of contributions, rules, optimal and equilibrium behavior

counterpart of Figure 3 for a set of villages is shown below. We try to explain this in the next section using data from individual respondents in our village surveys.

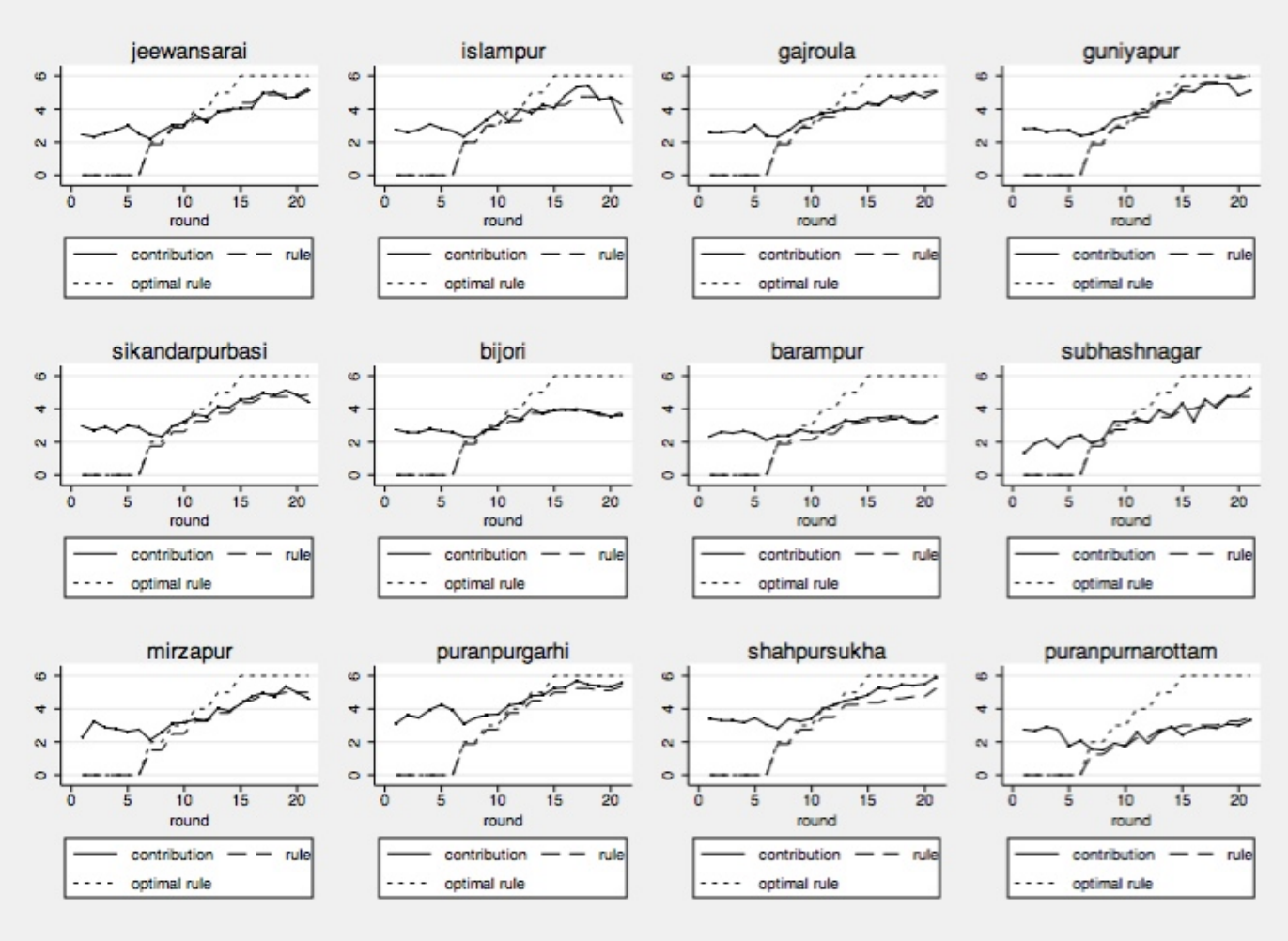


Figure 4: Village-wise rules, optimal and equilibrium behavior

## 4 Village surveys

To understand why some villages were better than others at creating and enforcing rules, we administered two surveys in each of the 24 villages from which our subjects were drawn. In February 2012, we collected data on village infrastructure, demographics, the distribution of land, local elections and some salient village issues. A few months later,

in May and June 2012, we interviewed a sample of men in each of 24 villages. Villages are typically divided into *tolas* or hamlets that are segregated along caste and religious lines; Muslims separated from Hindus, and within the latter, a segregation of low and high castes. Our aim was to draw a sample of 40 households in which the number from each hamlet reflected the size of the hamlet. In the case of some of these hamlets, often those of lower castes or Muslims, this gave us only two households and we over-sampled to push the number up to 4 and the total sample for the village therefore varied between 40-45.

The purpose of these surveys was to get independent information on village characteristics that might affect cooperation. The respondents were not related to the subjects of the experiment and yet, as we see in Tables 1-3 below, cooperation in the experiment seems to be related to village cooperation and trust as measured by these surveys.

# Appendix B Constructing indices of trust and government outreach

- Implementation - This is a sum of dummies on questions regarding the how a particular scheme is implemented in the village. There are 7 schemes which were asked. So a score of 3 would imply that a person believes that 3 out of 7 were implemented well in the village. The 7 schemes were ICDS,NREGA,IAY,RSBY,Krishi Card,JSY and Mid Day Meal. The question asked was "Do you think it is well implemented within the village? 1-Yes 0-No.
- Scheme Benefit - Same as above except that the question was whether the scheme was beneficial for the village. The question was "Do you think this is a potentially useful scheme for the village?" - Same coding as above.
- Trust - How many of Priests,Shopkeepers,Lawyers, Doctors and Politicians do people trust
- Contribution - Sum of dummies as to whether or not they contribute money for Id, Ramlila, Temple/Mosque Construction, Girl Weddings and Funerals. Question was "Contributed Money 1-Yes 0-No".
- Inclusion - How many social events do they celebrate inclusively amongst Weddings, Mundan-Akika, Funeral,Iftar, Diwali,Holi and Dusshera. Did they celebrate with everyone in the village, or only members their own family, or only members of their own caste, or members of their own religion? Since these are religious festivals, to celebrate only with members of owns own religion cannot be taken as a sign that groups are not interacting with each other, nor is celebrating with ones own family (which involves excluding other members of ones jati). To celebrate with only ones jati, however, is clearly a sign of isolation. For each festival, the response Only with those from my own caste was coded as exclusive, while all others were not.
- Capable Pradhan- Percentage of respondents who feel capable of becoming pradhan. Question was "Do you think that a member of your family is capable of becoming the pradhan? " 1-Yes 0-No

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Table 1: Trust and social connections in A and B villages

| Variable | Min | Med | Max | A | B | Diff | T-stat |
|---|---|---|---|---|---|---|---|
| Fractionalism | 0 | 0.7 | 0.89 | - | - | - | 0.35 |
| Village size (no. of households) | 85 | 256 | 1046 | - | - | - | |
| Education (years) | 4.26 | 6.74 | 8.98 | 6.68 | 6.73 | -0.05 | -0.18 |
| % of respondents who excluded other castes from at least one festival | 0% | 12.5% | 25% | 10% | 15% | -5% | -2.19* |
| No. of social events celebrated inclusively | .5 | 2.2 | 2.5 | 2.12 | 1.97 | 0.15 | 1.79* |
| No. of public goods and events for which contributions are made | 0.875 | 1.71 | 2.45 | 1.95 | 1.62 | 0.33 | 5.32*** |
| % of respondents who feel capable of becoming *pradhan* | 27.5% | 50% | 70% | 56% | 48% | 8% | 2.54** |

*All entries are averaged at the village-level. Min is the smallest such average, Med is the median value, and Max is the largest such average.*
*A: Average in high-voting villages*
*B: Average in low-voting villages*

Table 2: Empowerment and government schemes in A and B villages

| Variable | Min | Med | Max | A | B | Diff | T-stat |
|---|---|---|---|---|---|---|---|
| % of respondents who feel they would make good *pradhans* | 50% | 67% | 89% | 73% | 65% | 8% | 2.18** |
| No. of professions trusted | 2.28 | 2.64 | 3.08 | 2.72 | 2.56 | .16 | 1.92* |
| % of respondents who feel that luck is partly to blame for bad outcomes | 10% | 30% | 50% | 29% | 32% | 3% | -.91 |
| % of respondents who believe that people get the respect they deserve | 28% | 44% | 63% | 44% | 45% | -1% | -.35 |
| No. of schemes known | 2.31 | 3.125 | 3.5 | 3.12 | 2.99 | .14 | 1.64 |
| No. of schemes yielding benefits to the respondent | .38 | 1.03 | 1.68 | 1.13 | 1 | .13 | 2.05** |
| No. of schemes that the respondent believes yields benefits to the village | 1.9 | 2.67 | 3.33 | 2.7 | 2.56 | .14 | 1.31 |
| How easy it is to get things done | -1 | .35 | 1.94 | .56 | .15 | .41 | 1.71* |

*All entries are averaged at the village-level. Min is the smallest such average, Med is the median value, and Max is the largest such average.*
*A: Average in high-voting villages*
*B: Average in low-voting villages*

Table 3: Background characteristics A and B villages

| Variable | Min | Med | Max | A | B | Diff | T-stat |
|---|---|---|---|---|---|---|---|
| Asset ownership index (PCA) | -1.87 | -.14 | 2.05 | .06 | -.06 | .12 | .85 |
| Asset ownership index (simple) | 6.05 | 9.5 | 13.3 | 9.98 | 9.56 | .42 | 1.41 |
| Cultivable land | 3.4 | 9.27 | 18 | 10.64 | 8.85 | 1.79 | 1.27 |
| % of respondents who were landless | 15% | 47.5% | 64% | 41% | 46% | -5% | -1.5 |

*All entries are averaged at the village-level. Min is the smallest such average, Med is the median value, and Max is the largest such average.*
*A: Average in high-voting villages*
*B: Average in low-voting villages*