Too Much Cooperation - Work Exchange in Peruvian Communities

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Abstract: The general assumption in the Social Capital literature is that cooperation is good for development. However, such studies often analyze tasks where, in reality, compliance depends on institutional powers. This data set of 49 Peruvian highland communities - a questionnaire survey conducted by the author - includes work exchange as an example of a truly voluntary agreement between rural peasants. A regression analysis gives a significant hump-shaped effect. Some work exchange increases income, but the marginal effect actually turns negative for the 40 percent most cooperation minded communities. A game theoretical model demonstrates that rational agents will cooperate too much in traditional work tasks if the prevailing norms do not change as individual solutions become more efficient during the modernization process.

Code-words: Social Capital, reciprocity, work exchange, collective action, institutions, modernization, Peru

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1 Introduction

Modernization is an all-embracing and often speedy process in poor communities in the developing countries. The physical world and pattern of society around their traditional way of life might change dramatically from one decade to the other. New roads facilitate communication in and out of previously isolated societies. Artificial electric light makes it possible to work and socialize during the night. The introduction of market economies gives them access to a whole new range of goods. The consumption pattern might change, but also production since the use of modern inputs like fertilizers and machinery make it possible to farm in a different way. Further, marketable products often differ from their traditional products. The internal life of previously relatively isolated rural communities are in for deep changes, not at least because they are exposed to new ideas, norms and moral values through the interaction with the larger modern society. The pessimists in development research predict a breakdown in the "social fabric" of the community. More individualism reduces cooperation, which leads to less production, more internal conflicts, more individual risks as traditional insurance systems weather, etc. The optimists on the other hand emphasize increased productivity due to learning, specialization and trade, which in the end improves welfare in general as the material living standard rises.

Most papers in the extensive Social Capital (SC) literature focus on negative effects of modernization. A prominent line of thought is as follows: Contacts outside reduce the effect of internal sanctions, leading to an increasing number of defectors from cooperative setups, which may imply a collapse in collective action. One example is Bardhan (2000), who finds the functioning of the irrigation systems (which are based on collective action both in maintenance and administration) in a cross-section of Indian communities to be worse, the higher their trade volume compared to total income, and the shorter the distance to urban areas. Such studies on the effect of integration into the modern society on traditional forms of cooperation is interesting in itself, but a similar economic interpretation is only possible if one assumes that cooperation is technically efficient and that the collective action inducing phenomena do not affect income negatively through other channels.

There are three important reasons to question the relevance of this traditional collective action approach if the aim is to explain income[1]. (i) More individualistic norms might be devastating to cooperation, but at the same time nourish individual progress with a counteracting effect on the income level. (ii) The integration to the modern society can reduce the ability to sanction defectors, but at the same time increase the payoff from cooperation in new fields. (iii) Cooperation can actually be unproductive, but still maintained due to some social payoff or norms that prevent the use of more efficient individualistic production techniques. A fundamental issue is hence to assess the productivity of cooperation before I conclude anything about the desirability of collective action and Social Capital. It seems strange that poor people tend to cooperate more than rich if SC is an important productivity factor. To paraphrase the main puzzle of this paper as a question: "If cooperation is so smart, how come you ain't rich?".

[1] This paper does not estimate welfare in general since utility of non-material nature is not directly measurable.

The Peruvian highlands is chosen for field research since traditional small scale farmers are assumed to be especially vulnerable with a high risk of becoming losers in the modernization and market integration processes. A questionnaire survey on cooperation, institutional organization and income at the community level was carried through in all 49 rural communities in a highland district of Peru. An official household level agricultural survey from the same area from earlier years supplements the econometric analysis. It reveals that the estimated effect of some cooperation is positive, but the marginal effect on income decreases and actually becomes negative when cooperation becomes the normal way of working as it is for a large number of communities. The negative effect of "restricted access groups" exploiting outsiders (e.g. mafia, racism) is commonly recognized. However, the results of this study imply further that "open access groups" can lead to greater cooperation than than what is economically optimal. This notion of "negative SC" hence represents a new approach in the literature.

The very success of the Social Capital concept in social research and politics has made the assessment of its importance and productivity a pressing issue. It has become legitimate to use development aid on social activities with the expectation that improving the "social fabric" will have productive implications at a later stage[2]. Realized investments in the main village of the survey district of this study are one example. The main "plaza" was converted from a rustic common room with lots of different uses including trade, as vividly described by Vílchez Amésquita (1961), to a recreational park including fountains and statues using municipal funds. Vegetable market and small-scale traders are now restricted to the back streets, while the "arena" is left for military parades and Sunday strolls by the new village (state and NGO employed) middle-class. The money has hence not just been wasted from an economic development point of view, one may speculate if it has actually led to a reduction in income generating infrastructure.

2 Theory

2.1 General discussion

Fundamental characteristics of a society that facilitate informal cooperation have in recent years been labeled Social Capital (SC) and loosely defined for example by La Ferrara (2000) p.1 as "...the stock of norms, trust and civic networks". It is supposed to decrease in traditional societies during the dynamic process of modernization, but the underlying reasons for its decay may actually reveal whether it can be regarded as a good or a bad thing. The introduction of formal institutions might render traditional institutions and norms superfluous. Business partners will in a modern society rely on contracts and law enforcement instead of handshakes and rumor based punishment in closed circles as described in the seminal work on Magribi traders by Greif (1993). A breakdown of SC may then just represent an indication of economic development. The impact might be disastrous on the other hand if no formal institutions evolve, either before or after the decay of SC. High crime rates in urban slums are striking

[2] SC projects normally do not distort markets and induce unfair competition. So they might have become popular among the multilateral organizations due to the lack of negative effects rather than the existence of positive ones.

examples. The collapse of traditional production arrangements in the countryside might be just as destructive. A typical example of sub optimal exploitation of common property resources is overgrazing on community lands by individually owned herds. Income generating infrastructure is hard to construct and maintain if people loose their ability to coordinate actions, as Bardhan (2000) finds in his study of irrigation communities in Southern India.

These examples illustrate how SC can both induce collective action in the creation of a public good and facilitate private exchanges between individuals. The latter is a necessary condition for a society to use its resources in an optimal way in order to exploit both specialization and economies of scale. Trust between individual contractual partners is important even in developed economies since forced compliance through the legal system is costly. Trust is even more important in order to achieve efficient production in rural areas in developing countries, where most state institutions are weak or absent. The labor market is normally thin in rural areas in Peru, and you risk finding help if you base your activity on hiring people on the spot market, according to Gonzales de Olarte (1994) and Blum (1995). Reciprocity then often becomes an important part of a work exchange deal even in cases when monetary compensation is paid in each individual turn. "If I work for you today, I expect you to do the same for me in the future when I call upon you" represents a normal way of thinking.

The causal chain in the economic analysis is assumed to go from trust to cooperation that improves economic efficiency and hence entails higher income. SC is by many researchers and policy makers seen as "The hidden variable" which explains the puzzle of large-scale poverty in the technically advanced and integrated world of today, e.g. Platteau (2000). Increasing SC at given levels of official institutional power is hence assumed to be a good thing and a pronounced goal of development-oriented policies. The first objection to this way of reasoning is the question whether it is actually more efficient to work together on a given task rather than solving it alone.

The immediate answer is that it will depend on the actual circumstances. I do not have to care from a policy perspective since rational utility maximizing agents will always choose the optimal solution. But an individual who decides on whether to enter into a cooperation scheme or not, does not only care about the immediate productivity and monetary outcome denoted (Π). He also considers non-monetary utility and indirect effect on monetary payoffs either later or in other situation (U). This could hence be both norms and preferences on one side, and future payoff, which are affected by the individual's actions of today. The expected costs element of entering into the cooperation scheme (C) represents the own individuals labor effort and other cost elements. High U and low C, might induce cooperation even if Π is negative, and the contra-intuitive results that more cooperation-minded people will actually earn less is perfectly possible.

The fundamental condition for an individual to enter a cooperation scheme is trust in partners to fulfill their agreed obligations. This can either be interpreted as higher expected payoff or as a lower coordination costs. More trust hence leads to more cooperation, ceteris paribus. But many sources of

trust are actually not related to the SC concept at all. Furthermore, the trust inducing reasons might have a decisive impact on both monetary and non-monetary payoffs. Trust is hence not only an exogenous variable that just influences the expected cost of cooperation, but the underlying source of trust also affects the income and utility level. The notion that trust in general improves economic efficiency and increases income is hence not a trivial assumption at all.

The following discussion of possible reasons for human action and their potential implications for cooperation is useful in order to trace the effect of trust on income. (i) A rational agent just maximizing (hedonic) utility would defect in a one-shot prisoners dilemma type of situation which characterizes what Ostrom (1990) calls "social dilemmas", i.e. situations where people are tempted by short term profits to defect from cooperation agreements. When repeated interaction is possible, the individual will include the effect on possible future cooperation agreements and the associated payoffs when they choose whether to fulfill their agreed immediate obligations or not. Since market integration increases the possibility area, contact between two individuals will become less frequent and induce less trust and hence less cooperation. This is interpreted as a SC-effect in the literature even if the causal mechanism is pure (hedonic) utility maximization. (ii) Institutional intervention of a third party in deals between individuals alters the individual payoff from defection, for example through monetary fines or imprisonment. (iii) Breaking existing norms of accepted behavior will similarly entail retaliation from the affected individual and/or others members of the society that implies reduced income opportunities in the future. (iv) An individual has preferences for both material and non-material payoffs. The latter also includes consequences for others and circumstances outside ones own domain. An altruist will for example include the utility of others as an element in his own utility function. The perception of oneself as a "just and good man" can further give some people utility in itself. So even if the individual knows for sure that defection in cooperation schemes is not detected and no retaliation of any kind is expected, it does not mean defection will take place.

Rational agents will take all the preceding points into consideration when making their choice of action. People are supposed to weigh the possibility of being caught and the effect of the punishment vs. the hedonic utility (the utility from material consumption) derived from their action, before they make up their minds on what to do. People's inherent preferences and costumes often imply that cost-benefit analysis at the margin in "moral" matters do not take place. According to Elster (1998) such general preferences represent categorical imperatives that tell you what to do and what not to do. The very act of calculating and aggregating utility then often implies a break with your own moral[3]. Distinguishing

[3]Elster further emphasizes how people normally internalize a norm as own preferences, often represented as feelings like "guilt". Theories within social psychology underline the dynamic and endogenous aspect of individual preferences, for example the theory of cognitive dissonance in Festinger (1957) that assumes people will tend to change preferences in order to minimize the difference between the actions they do and feelings about what they are doing. Political changes can hence have a rather strong social engineering effect. If market economies induce and reward individual actions, then people will start perceiving individual actions as more morally defendable even if this reduces the degree of collective actions. This implies a spillover effect from (i), (ii) and (iii) to (iv) as norms and institutions slowly change.

between institutional and normative origin of retaliations to defectors in trust based cooperation schemes in developing countries is further complicated by the blurred nature of formal boundaries of institutions and the effects often lumped together as SC in the literature[4].

Some actions will in the end not seem rational at all under the given circumstances. The field of behavioral economics has in the latter years given strong evidence of "other" forms of rationality in experimental settings. Kahneman (2003) stresses limits to the use of all available information. The information processing of the human brain is influenced by attribute substitutions, prototypes, framing effects etc. and this gives rise to actions that might systematically depart from the expected utility maximizing optimum. The process of learning is probably important in this context of transformation from traditionally rural societies to market integrated ones. People tend to act upon their experiences without processing existing information. "If it worked yesterday, I will do it again today " or "I never try out anything which is not proven to work" are common rules-of-thumb in human decision making. It will hence take some time before changes in the underlying aspects of the society actually trickle down to change people's behavior. But when it does, large changes might come in a short time[5]. This implies cooperation might persist for a long time after it has become an inferior solution in modern societies. This point will be thoroughly discussed in a formal game theoretical model in the next sub-section.

This discussion of different underlying reasons of human actions that make people trust worthy illustrates that cooperation might give a negative income effect. Some common examples known from standard economic theory are signaling games (i.e. rewards are associated with the action itself and not the outcome), strong preferences for social interaction rather than material consumption, lags in learning and biased perceptions of the actual world.

The second objection to the assumed productivity of trust inducing social phenomena is their potentially negative side effects on other aspects of productivity and economic activity. One example is norms of conformity that put significant pressure on people to act like others and hence facilitate cooperation since it is easier to assess what to expect from others. Negative reactions from fellow community members might counterweight expected higher income from education, trying out new business ideas, etc., and norms can hence constitute an indestructable barrier to creativity and development[6]. Individualism

[4] A constructive suggestion in Torsvik (2000) to the problem is to separate between Institutional SC and Civic SC.

[5] The sudden increase in onion production for commercial sales in the late 1980'ies (long after markets were introduced and the access road constructed) in some of my field research communities is a typical example of copying behavior in rural areas.

[6] The famous (conformity) Law of Jante in Sandemose (1962) facilitated cooperation between traditional fishermen on the coast of Denmark, but blocked individual initiatives to improve their own livelihood through education, new business ideas, etc. Strong British labor unions coordinated strikes to improve the general working conditions and income for all possible, but group pressure at the same time undermined individual progress through education and career. The explicit costs of reproducing a cooperative minded culture can in a development country context take enormous proportions. For example Rao (2002) find expenditures on religious festivals to take 20% of total income in a study of Indian communities. Such spending are seen as necessary in order to be accepted and be part of the society and in the end obtain income.

is thought to be a fundamental characteristic of a modern market economy, and it seems reasonable to expect that individual development is realized at the cost of collective solutions. Collective solution enhancing institutions, norms and preferences are features of the culture of a society in general and might go hand in hand with other seemingly unrelated restrictions on individual actions that are not consistent with economic maximization. The most striking examples are probably religious bans which leave resources unexploited with a negative effect on economic development, e.g. the prohibition of female participation in the work force, consumption of certain animals which hence induce a sub optimal allocation of lands, etc.

2.2 Game theory model

2.2.1 Intuition

The purpose of the game theoretical model is to show that norms that originally sustain an efficient level of cooperation through punishment might induce too much cooperation after a transition of the society. I will first give an intuitive description of how the model works, and then proceed with a more formal setup.

Several strategies might be subgame perfect Nash equilibriums for the same task in the game theoretical model described in the next section. A high cooperation equilibrium induces an individual to accept cooperation proposals even though it implies a considerate immediate loss, because they (correctly) expect to be on the receiving end later. In a low cooperation equilibrium, an individual will only accept minor immediate losses since he does not expect others taking major losses to help him in the future either. A community that has coordinated they expectations on the high trust level can be defined as a community with much SC, and vice versa for low trust levels.

As agents will always have a short term incentive to deviate (if he does not consider potential negative effect on future interactions), punishment for deviators may be necessary to sustain cooperation. Direct punishment, for example through imprisonment, can be defined as Institutional Capital (IC). Indirect forms of punishment like gossip and not at least "guilt" as previously discussed, are supposed to be aspect of SC. Punishment will independent of source facilitate coordination of expectations (trust) on the high cooperation equilibrium. It is hence difficult to separate trust from punishment (or put differently, SC from IC) as discussed in earlier chapters.

I assume the punishment level is persistent even if the payoff from cooperation changes due to aspects of modernization, e.g. market integration. It can take decades to change traditions, while the productivity of cooperation might change from one day to another. The game model demonstrates that cooperation will still be a subgame perfect Nash equilibrium even in tasks where average payoff has become negative

This money could alternatively have been used for productive investments. The need to get out of such "high cost" social equilibrium by the individuals has been used as an explanation for the protestant awakening which has swept through the my field research district of Tambo in the latter decades.

after the transition. This is so because there is a punishment attached to refuse cooperation proposals in tasks that traditionally have been solved in work exchange relations. The faster a community is able adjust punishment behavior of its members, the less work exchange will take place and the higher will the income level be. The reminder of this chapter gives the details of the theoretical game model leading to the hypothesized negative relation between work exchange and income. Readers mainly interested in empirical evidence can go straight to Chapter 3.

2.2.2 Game description

The game analysis whether two individuals A and B will cooperate through work exchange in various tasks $i\epsilon\{1, 2..m\}$. A task is a specific work operation that can take place nearly continuously (food preparation), once or several times during the year (sawing, harvesting, etc.) or rarely (house construction). There are two ways to solve a given task i, either working alone or by work exchange. The latter implies that one individual first helps the other to do the needed work, and then the beneficiary reciprocates by working for the other in the same task later. The time between giving and receiving work is normally no longer than a month. Each work exchange is defined as an episode of the game. The agreement to cooperate is an oral contract for the specific episode of the given task. If the partners wish to repeat the interaction in another episode, for example by sawing together next season too, will they have to agree on a new contract.

In practice the content of work exchange agreements is set by norms of the community where one-to-one is the "rule of thumb", i.e. a labor hour for a labor hour. This rule actually prevents exchange schemes between tasks since the perceived cost of labor depends on the given task, e.g. it "costs" more sweat to handplow than construct houses. I will hence assume work exchange will only take place within the same task in this game theoretical model.

The efficiency of cooperation differs between tasks. Furthermore, payoff from a given work exchange episode will differ between the individuals taking part due to circumstances of stochastic nature, e.g. the effect of rainfall depend on individually chosen type of crop. The average payoff from work exchange compared to working alone in an episode of the given task i is denoted Π_i. Tasks are ranked according to their profitability of cooperation, i.e. $\Pi_1 > \Pi_2 > ... > \Pi_m$. Due to the "one-to-one" restriction set by norms, all forms of side payments are ruled out in this model. The stochastic element denoted $Y\epsilon\left[-Y^M, Y^M\right]$ is added to the average payoff in a symmetrically opposite manner for each individual, i.e. A receives the payoff $\Pi_i - Y$ and B receives the payoff $\Pi_i + Y$ in a given episode of work exchange for task i. This stochastic element is normalized to be equal for all tasks i to facilitate the presentation.

I will initially assume that the individual with a higher payoff than average (hereafter denoted *proposer)* will always propose cooperation in the tasks i of interest for this analysis where $\Pi_i \geq 0$. Then the individual with a lower than average payoff (hereafter denoted *respondent*) will have to decide whether to

accept or not. Consider the following strategies for each task i denoted $S_i = \left(S_i^A, S_i^B\right)$ with the following elements:

$$S_i^A = \left\{ \begin{array}{l} Accept\ if\ Y \epsilon \left[-Y^M, Y_i^{'}\right] \\ Refuse\ if\ Y \epsilon \left\langle Y_i^{'}, Y^M \right] \end{array} \right\}$$

$$S_i^B = \left\{ \begin{array}{l} Accept\ if\ Y \epsilon \left[-Y_i', Y^M\right] \\ Refuse\ if\ Y \epsilon \left[-Y^M, -Y_i'\right\rangle \end{array} \right\}$$

Thus cooperation will be accepted if $Y \epsilon [-Y_i', Y_i']$ and not accepted if $Y \epsilon \left[-Y^M, -Y_i'\right\rangle \cup \left\langle Y_i', Y^M\right]$. Once the cooperation proposal is accepted, the work exchange will take place, i.e. no defection is possible. But refusing to accept cooperation proposals in a given tasks i where work exchange is the tradition, is regarded as defection to a more generalized agreement of cooperation within task i. A refusal will hence in this model imply that cooperation within this specific task i will not be possible in the future and the game hence ends. However, a refusal in one task is assumed not to affect the individual's cooperation behavior in other tasks reflecting that people tend to perceive each task as a separate arena.

2.2.3 Subgame perfect Nash equilibria

In the following presentation I treat the example where $Y \geq 0$. A is then the *respondent* but I will suppress the index since the expected payoff from cooperation in each future episode Φ_i for a task i is equal for both individuals players due to the symmetry in the stochastic element Y, i.e. $\Phi_i = \Phi_i^A = \Phi_i^B$. Then

$$\Phi_i = \int_{-Y^M}^{-Y_i'} 0 f(Y) dY + \int_{-Y'}^{Y_i'} (\Pi_i - Y) f(Y) dY + \int_{Y_i'}^{Y^M} 0 f(Y) dY \tag{1}$$

Equation (1) can be explained as follows. When $Y \epsilon \left[-Y^M, -Y_i'\right]$, B will refuse cooperation and the game ends with zero payoff for both. When $Y \epsilon \left[Y_i', Y^M\right]$, A will refuse with similar result, while cooperation with payoff $\Pi_i - Y$ is realized when $Y \epsilon [-Y_i', Y_i']$. I will all through the analysis assume that Y is uniformly distributed on $\left[-Y^M, Y^M\right]$ with normalized $Y^M = 1$ which imply $f(Y) = \frac{Y}{2}$. Then $\int_{-Y_i'}^{Y_i'} Y f(Y) dY = 0$ and the probability function $P(Y_i') = \int_{-Y_i'}^{Y_i'} f(Y) dY = Y_i'$. Equation (2) will then follows from equation (1), i.e.

$$\Phi_i = Y_i' \Pi_i \tag{2}$$

Given the strategy S_i described above is the discounted stream of initially realized payoff and expected future payoffs for given task i for the responder denoted Ψ_i. Thus for a discount factor δ is

$$\begin{aligned}\Psi_i &= \Pi_i - Y + \delta\Phi_i + \delta^2 P(Y^1)\Phi_i + +\delta^3 P(Y^1)^2\Phi_i + ... + \delta^t P(Y^1)^{t-1}\Phi_i \\ &\Downarrow \\ \Psi_i &= \frac{1}{1-\delta Y_i'}\Pi_i - Y \end{aligned} \tag{3}$$

A strategy pair S_i is a subgame perfect Nash equilibrium if neither of the players will achieve a higher payoff by using an alternative strategy given the strategy of the other and must S_i be a Nash equilibrium in all subgames of the game. As this is a repeated game, it is sufficient to test for alternative strategies that deviate in the initial episode when Y is drawn by nature. It follows from the standard analysis of trigger strategies equilibrium that the strategy S_i with $Y_i' \epsilon \left[0, Y^M\right]$ in task i is a subgame perfect Nash equilibrium if $\Psi_i \geq 0$ for $Y \leq Y_i'$ (better to accept cooperation than end the game with zero payoff), and if $\Psi_i \leq 0$ for $Y \geq Y_i'$ (better to end the game with zero payoff than accept cooperation and proceed the game).

From equation (3) we find that $Y = Y_i'$ give $\Psi_i = 0$ if $\Pi_i = (1 - \delta Y_i')\, Y_i'$. If $Y < Y'$ will $\Psi_i > 0$ and $Y > Y_i'$ give $\Psi_i < 0$. This proves S_i with Y_i' in task i with Π_i on the line in Figure (1) below are subgame perfect Nash Equilibria when the discount factor for payoffs in future episodes $\delta = 0.9$. I have then assumed a normalization of time between episodes for the different task i in order to include them in the same model specification.

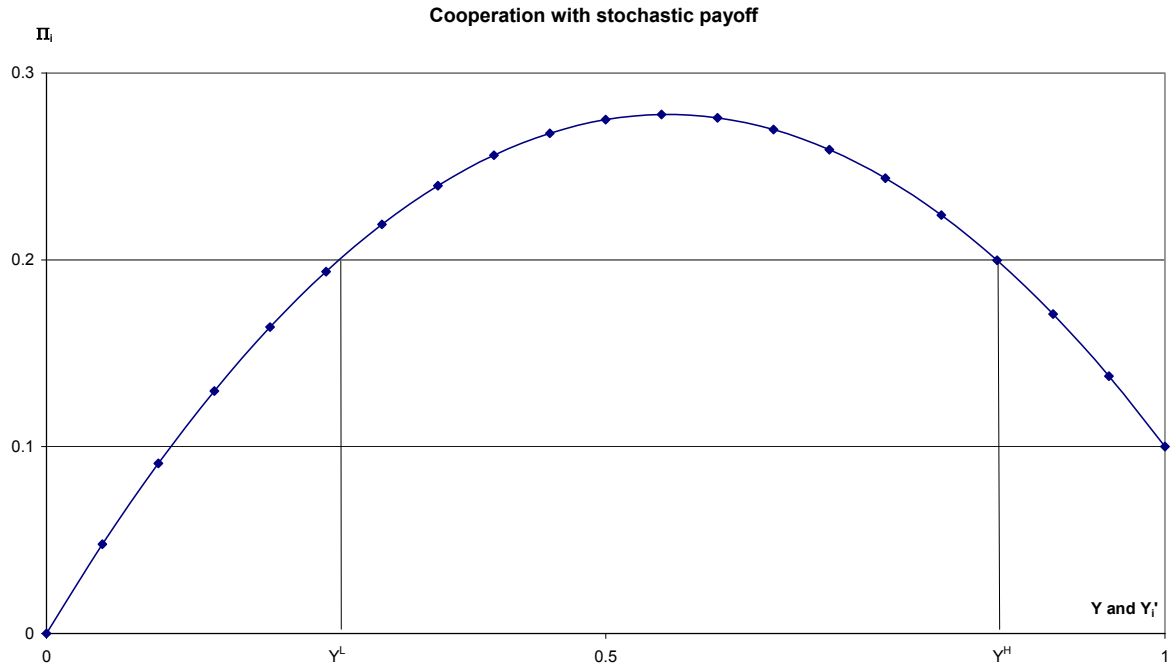


Figure (1): The Y_i' in the S_i strategies are given on the horizontal axis and the payoff Π_i for task i is given on the vertical axis. The line hence represents subgame perfect Nash equilibria when $\delta = 0.9$. Y^L is the low and Y^H is the high interior equilibrium equilibrium.

A given combination of Y_i' for S_i, given on the horizontal axis, and Π_i, given on the vertical axis, for a task i will on the line in Figure (1) constitute the set of interior subgame perfect Nash equilibria for this game ($Y_i' = 1$ is also subgame perfect Nash equilibria in tasks i with $\Pi_i \geq 0.1Y^M$). When the realized stochastic value is lower than the limit Y_i' value of the strategy will the respondent accept cooperation proposals, i.e. if $Y \leq Y_i'$ for S_i will there be cooperation. The respondent will refuse if the stochastic value is higher, i.e. if $Y > Y_i'$ for S_i will there be no cooperation. Take task i with $\Pi_i = 0.2Y^M$ as an example. Then three strategies S_i are subgame perfect Nash equilibria. The first is for S_i with $Y_i' = Y^L$. Then equation (3) demonstrate that $\Psi_i \geq 0$ for $Y \leq Y^L$ and $\Psi_i < 0$ for $Y > Y^L$. The second is for S_i with $Y_i' = Y^H$ which is proven to be a Nash equilibrium in the same manner. The third is for S_i with $Y_i' = Y^M = 1$. Then $\Psi_i \geq 0$ for $Y \leq Y^M$ and $Y > Y^M$ does not exist.

The line in Figure (1) is hump-shaped for $\delta = 0.9$. Higher discounting of future payoffs would push the curve upwards. There are hence three different categories of task i. When

- $\Pi_i < 0.1Y^M$ will only a low cooperation equilibrium exist. Then $Y \leq Y_i'$ implies cooperation since $\Psi_i \geq 0$ according to equation (3), and $Y > Y_i'$ will lead the respondent to refuse cooperation proposal since $\Psi_i < 0$ and hence end the game.
- $\Pi_i \epsilon \left[0.1Y^M, 0.2776Y^M\right]$ will there be one low and one high interior subgame perfect Nash equilibrium strategy in addition to the full cooperation strategy as described for task i with $\Pi_i = 0.2Y^M$ above.
- $\Pi_i > 0.2776Y^M$ is S_i with $Y_i' = Y^M$, the only subgame perfect Nash equilibrium. Then a strategy S_i with $Y_i' < Y^M$ give $\Psi_i > 0$ for $Y > Y_i'$ and the responder would hence accept cooperation proposals when he is not supposed to according to the proposed interior strategy.

The ability of a community to coordinate expectations on the high rather than the low equilibrium in the second group of tasks i will be even more important in the long run. According to the model cooperation will in task i with $\Pi_i < 0.2776Y^M$ take place since there is a positive probability of $Y = Y^M$. But reasoning outside the model one may argue that the high trust equilibrium is unstable. If both players for some reason or another adjusted their strategy by accepting cooperation proposals at a Y marginally higher than Y_i' it will pay off to accept at even higher Y values than the ones given in the adjusted strategy. Dynamic adjustments will then in the end give full cooperation, i.e. S_i with $Y_i' = Y^M$ as the realized strategy. Due to the same type of mechanism the low cooperation strategy will give no cooperation in the end. One important aspect of Social Capital is hence to coordinate expectations on the high cooperation equilibrium. The lack of cooperation in all task i with $\Pi_i > 0$ is hence a inefficiency for the combined

economy of both individuals (i.e. the society) even if one of the partners might immediately be worse off by cooperating than not in a given episode of the game.

Punishment is one device applied to coordinating such expectations, and I will in the proceeding section estimate the sufficient punishment to induce cooperation for all task i with $\Pi_i \geq 0$.

2.2.4 Equilibria with punishment

To sustain cooperation, I assume that there is an immediate punishment $Z < 0$ for an agent that refuses cooperate. The equivalent to equation (1) is then as follows.

$$\Phi_i^Z = \int_{-Y^M}^{-Y_i'} 0 f(Y)dY + \int_{-Y_i'}^{Y_i'} (\Pi_i - Y) f(Y)dY + \int_{Y_i'}^{Y^M} Z f(Y)dY \tag{4}$$

He will get zero if he proposes and B refuses, i.e. when $Y \epsilon \left[-Y^M, -Y_i'\right\rangle$. There is cooperation with payoff $\Pi_i - Y$ if $Y \epsilon [-Y_i', Y_i'\rangle$. He gets the punishment Z when he refuses to accept cooperation, i.e. when $Y \epsilon \left\langle Y_i', Y^M\right]$. Given the same explicit Y distribution as in the pervious section where a normalization of $Y^M = 1$ imply $\int_{Y_i'}^{Y^M} f(Y)dY = \frac{1-Y_i'}{2}$, equation (5) will follow:

$$\Phi_i^Z = Y_i'\Pi_i + Z\left(\frac{1 - Y_i'}{2}\right) \tag{5}$$

The equivalent discounted expected stream of payoffs from equation (3) will then be

$$\Psi_i^Z = \frac{1}{1 - \delta Y_i'}\Pi_i - Y + \frac{\delta}{1 - \delta Y_i'} Z\left(\frac{1 - Y_i'}{2}\right) \tag{6}$$

A punishment Z that give a higher payoff for the respondent by accepting rather than refusing to cooperate , i.e. $\Psi_i^Z \geq Z$, for all realizations of Y in tasks i with $\Pi_i \geq 0$ will lead to higher (or equal) aggregated payoff for all individuals. Such punishment, or rather the threat of punishment since it will never be effectuated in equilibrium, is hence collectively rational.

How large must the punishment be to achieve this aim of full cooperation? With normalized $Y^M = 1$, S_i with $Y_i' = 1$ will be a subgame perfect Nash equilibrium in task i with $\Pi_i = 0$ if $Z = -Y^M = -1$. It satisfies the conditions since $\Psi_i^Z = Z$ if $Y = 1$ in equation (6) and $\Psi_i^Z < Z$ for $Y < 1$. A lower punishment level $Z > -1$ will give $\Psi_i^Z < Z$ if $Y = 1$ for S_i with $Y_i' = 1$, which hence does not constitute a subgame perfect Nash equilibrium pair of strategies. A punishment $Z = -1$ is hence a necessary condition in task i with $\Pi_i = 0$. Since Ψ_i^Z in equation (6) is increasing in Π_i, $Z = -1$ will be sufficient to make S_i with $Y_i' = 1$ subgame perfect Nash equilibrium in all tasks i with $\Pi_i > 0$ too.

Still, it can be demonstrated that interior strategies S_i with $Y_i' < 1$ may sustain a subgame perfect Nash equilibria when $Z = -Y^M$ for some task i with $\Pi_i \geq 0$ due to the hump-shaped relation demonstrated in Figure (1)[7]. The punishment level must actually increase to $Z = -1.19 \cdot Y^M$ in order make full cooperation the only subgame perfect Nash equilibrium when $\delta = 0.9$. Both levels are hence collectively rational, but I will in the proceeding analysis use the lower punishment level $Z = -Y^M$ as a matter of convenience even though the harder punishment would lead to more inefficiencies (and hence give stronger support for the hypothesis of too much cooperation in this paper).

2.2.5 Negative payoff shock

I have earlier argued that the integration of traditional communities to the modern society may have a large impact on both the relation between individuals and the payoff from different types of economic activity. I will now find the new set of subgame perfect Nash equilibrium strategies for the same tasks i where a *responder* will be punished for refusing to cooperate. I will not consider other or new tasks where cooperation might have become more profitable. In practice will it take long time before they are able to coordinate cooperation after a transition in tasks where there is no tradition of cooperation.

For simplicity, I assume there is a negative constant shift in the average payoff for all traditional tasks to $\Pi_i - k$ where $k > 0$. The equivalent to equation (5) with the same Y distribution is then:

$$\Phi_i^{Z,k} = Y_i' \left(\Pi_i - k\right) + Z\left(\frac{1 - Y_i'}{2}\right) \tag{7}$$

I further assume the community maintains the punishment level $Z = -Y^M$. The normalized $Y^M = 1$ give the equivalent equation (6) of the discounted expected stream of payoff:

$$\Psi_i^{Z,k} = \frac{1}{1 - \delta Y_i'}\left(\Pi_i - k\right) - Y - \frac{\delta}{1 - \delta Y_i'}\left(\frac{1 - Y_i'}{2}\right) \tag{8}$$

The only difference from the pre-transition solution in equation (6) is hence the average payoff element which is reduced by a constant. Then S_i and Π_i combinations on the $\delta - 0.9$ curve in Figure (2) below represents subgame perfect Nash equilibrium strategies since $\Psi_i^{Z,k} \geq Z$ for $Y \leq Y_i'$ and $\Psi_i^{Z,k} < Z$ for $Y > Y_i'$. We have subgame perfect Nash equilibria for task i where $\Pi_i - k < 0$ since Z is related directly to the task i and not to the payoff.

[7] Or parallel to the $\delta - 0.9$ line in Figure (2) but with Π_i and not $\Pi_i - k$ on the vertical axis.

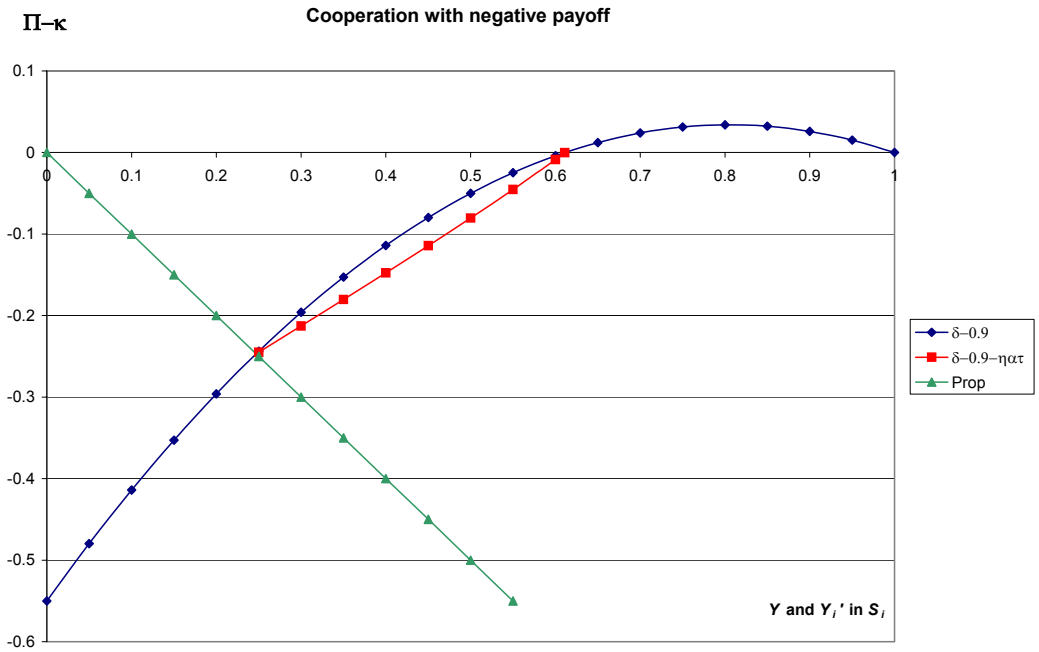


Figure (2): In task i with $\Pi_i - k$ will realized Y equal or larger than the value given on the $Prop$ line induce cooperation proposals. Strategy S_i with Y_i' and payoff $\Pi_i - k$ for task i on the $\delta - 0.9$ line are subgame perfect Nash equilibria if there are proposals in every episode. The combinations on the $\delta - 0.9 - hat$ line will similarly be subgame perfect Nash equilibria if the respondent only expect cooperation proposals when cooperation is profitable.

Before the transition, one of the individuals would always propose cooperation. With $Y \geq 0$, individual B will after the transition only propose cooperation if $\Pi_i - k + Y \geq 0$ (and vice versa for A when $Y < 0$). All realized Y on the right side of the $Prop$ line in Figure (2) will hence lead to cooperation proposals in the associated task i with payoff $\Pi_i - k$. This is an optimal *proposer* strategy if he does not take the effect of his actions on potential future payoffs into consideration. Strategic actions, like propose for high Y values since this will lead the counterpart to refuse and hence end the game with zero payoff, is hence ruled out. No cooperation proposal will be treated as nothing had happened, i.e. the payoff is zero for both and the game continues to the next episode.

If the responder do not consider the adjusted proposer behavior and still expect cooperation to be proposed for all tasks i where cooperation took place before the transition, will the inefficiency area now be restricted by the X axis, $Prop$ line and $\delta - 0.9$ line in Figure (2). This implies cooperation will be proposed and then accepted for a given task i with $\Pi_i - k < 0$ if $Y \geq -(\Pi_i - k)$, i.e. right side of $Prop$ line, and $Y \leq Y_i'$ of the associated strategy S_i for task i on the $\delta - 0.9$ line.

But *respondent* strategy of task i will only change from the pre-transition strategy if the individuals actually understand there has been a shift in the average payoff. Then rational players will also adjust

the expectations about *proposer* behavior and make use of this knowledge when choosing the *respondent* strategies. The equivalent to equation (9) giving the expected payoff in each future episode is then:

$$\widehat{\Phi}_i^{Z,k} = \int_{-Y^M}^{-\widehat{Y}_i'} 0f(Y)dY + \int_{-\widehat{Y}_i'}^{-Y_i^S} (\Pi_i - k - Y)\, f(Y)dY + \int_{-Y_i^S}^{Y_i^S} 0f(Y)dY + \int_{Y_i^S}^{\widehat{Y}_i'} (\Pi_i - k - Y)\, f(Y)dY + \int_{\widehat{Y}_i'}^{Y^M} Zf(Y)dY \quad (9)$$

$$\Downarrow$$

$$\widehat{\Phi}_i^{Z,k} = P(Y_i'^S)\,(\Pi_i - k) + \int_{\widehat{Y}_i^1}^{Y^M} Zf(Y)dY \quad (10)$$

$$\Downarrow$$

$$\widehat{\Phi}_i^{Z,k} = \left[\widehat{Y}_i' + (\Pi_i - k)\right](\Pi_i - k) - \frac{1 - \widehat{Y}_i'}{2} \quad (11)$$

Equation (9) shows that if $Y \epsilon \left[-Y^M, \widehat{Y}_i'\right\rangle$ will A propose and then receive zero since the game ends as B will refuse cooperation proposals. If $Y \epsilon \left[-\widehat{Y}_i', -Y_i^S\right]$ will A propose and B accept which hence give A the payoff $\Pi_i - k - Y$. When $Y \epsilon \left\langle -\widehat{Y}_i', \widehat{Y}_i'\right\rangle$ will none of them find it profitable to propose and the payoff is zero for both. For $Y \epsilon \left[Y_i^S, \widehat{Y}_i'\right]$ will B propose and A accept, while A will prefer to refuse and hence take the punishment Z if $Y \epsilon \left\langle \widehat{Y}_i', Y^M\right]$. Equation (10) follows since the probability that a game will be proposed and then accepted is $P(\widehat{Y}_i'^S) = \int_{-\widehat{Y}_i'}^{-Y_i^S} f(Y)dY + \int_{Y_i^S}^{\widehat{Y}_i'} f(Y)dY$. Then equation (11) follows due to the normalized $Y^M = 1$ and a redefined probability function $P(\widehat{Y}_i'^S) = \int_{-\widehat{Y}_i'}^{\widehat{Y}_i'} f(Y)dY - \int_{-Y_i^S}^{Y_i^S} f(Y)dY = P(\widehat{Y}_i') - P(Y_i^S) = \widehat{Y}_i{}' - Y_i^S$. The last step is valid because Y is uniformly distributed. The *proposer* strategy gives $Y_i^S = -(\Pi_i - k)$ and then $P(Y_i'^S) = \widehat{Y}_i' + (\Pi_i - k)$ for our tasks i of interest where $(\Pi_i - k) < 0$ and $Y_i' > -(\Pi_i - k)$. The discounted stream of future payoffs equivalent to equation (8) is then:

$$\widehat{\Psi}_i^{Z,k} = \frac{1 - \delta(\widehat{Y}_i' + (\Pi_i - k))}{1 - \delta\widehat{Y}_i'}(\Pi_i - k) - Y - \frac{\delta}{1 - \delta\widehat{Y}_i'}(\frac{1 - \widehat{Y}_i'}{2}) \quad (12)$$

We see directly from equation (12) that this induces a downward shift in the line for subgame perfect Nash equilibrium strategies marked to the $\delta = 0.9$ *hat* line in Figure (2). This is because $\widehat{\Psi}_i^{A,Z,k} \leq \Psi_i^{A,Z,k}$ for a given task i with $\Pi_i - k \leq 0$ and $\widehat{Y}_i' = Y_i'$ since $1 - \delta(\widehat{Y}_i^1 + (\Pi_i - k)) \leq 1$ in the interval of Y where proposals actually will take place. A *responder* will hence put more emphasis on the immediate punishment Z of refusing to accept cooperation compared to the "indirect punishment" of a negative average payoff $\Pi_i - k$ in future interactions as cooperation will take place more seldom.

The economic inefficiency of too much cooperation is represented by the area between the X axis, $\delta = 0.9$ *hat* and *Prop* lines. This implies cooperation will be proposed and then accepted for a given task i with $\Pi_i - k < 0$ if $Y \geq Y^S = -(\Pi_i - k)$, i.e. right side of *Prop* line and $Y \leq \widehat{Y}_i'$ of the associated strategy S_i for task i on the $\delta - 0.9$ *hat* line.

The higher the initial punishment level, the more inefficient cooperation. If $Z = -1.19 \cdot Y^M$, as is earlier found to be necessary to guarantee pre-transition socially efficient *respondent* strategies, will the $\delta = 0.9$ *hat* curve shift leftward and hence induce a larger efficiency loss.

This game theoretical model illustrates how communities with much SC can end up cooperating too much after market integration. A community with less SC and less/lower punishment might have ended up just at the right level after the transition period. Different levels of initial SC and the changes in payoff from cooperation due the transition of the society following modernization and market integration can hence give rise to a hump-shaped effect of work exchange on income.

This model setup implies that only the individual will be punished just once. An alternative would be that the game did not end if someone refused to cooperate, and the same individual could hence be punished again and again. However, if norms of cooperation are frequently broken people will become more reserved against taking actions of punishment since sanctions often imply a real cost for the punisher too. Then cooperation in tasks with negative average payoff will cease over time too, and the model is hence a realistic representation of the world. A more uneven distribution of the stochastic value Y would also make inefficient cooperation more persistent. Then the punishment would be equal to the worst possible situation, but he will mostly prefer to cooperate since the responder hardly ever gets such bad outcome.

The examples in this chapter emphasize the theoretical possibility that people who cooperate more earn less. I will now proceed to assess the causal mechanisms and effects of cooperation on income in a given rural area in the developing country Peru. The district consists of several small communities in the middle of the modernization process from being isolated traditional societies to modern market economies. The dispersion in cooperation level is surprisingly large taking the high degree of cultural and geographical similarities in this district into consideration.

3 Empirical study

3.1 Social capital and cooperation productivity measurement

Much of the empirical SC-literature focuses on norms and preferences and proxy this by some kind of perceived level of trust and trustworthiness in a given society. Putnam et al. (1993) argue that civic activity, i.e. being members of organizations, reading newspapers etc., make people more empathic and hence more willing to cooperate in "social dilemmas" which then constitutes an indirect measure of SC[8]. Other authors have later preferred to measure the level of trust and trustworthiness directly. Either by experimental games, i.e. Glaeser et al. (2000), or by survey questionnaires, like Knack and Keefer (1997) using the World Value Survey where people were asked if "..most people can be trusted?" for cross-section analysis on country level. A similar approach can be used on all empirical levels, like Narayan

[8] Putnam et al. (1993) found a positive effect on the efficiency of governmental institution in their famous study of Italy.

and Princhett (1999) who carried through a household questionnaire survey for 1376 households in 87 rural Tanzanian villages mixing the two approaches. Each family was asked about membership in groups and its characteristics, and then about their subjective level of trust in others and perceptions of social cohesion in the village. Most studies hence actually try to measure the underlying variable for norms directly in order to apply these in econometric work, and *not* the actions resulting thereof - which is my research approach.

Most of the empirical literature relates SC-proxies to some "social dilemma" and it is tacitly understood that the resulting cooperation has a positive effect on income. Preceding the SC-literature, Ostrom (1990) studied how local societies organize the exploitation of common pool resources (CPR) as a problem of "collective action". She finds different variables like homogeneity of the society to have a significant impact on the cooperation level. In Ostrom (2003) she argues that the effects work through cooperation inducing norms, "trust", "cultural identity" and the equilibrium combinations of reciprocal action rules chosen by the population, i.e. what I would call SC in this paper. The CPR-literature uses variables that are thought to work through the SC-effect in the econometric models, to explain the cooperation level. The negative impact of integration on cooperation in the set of Indian irrigation communities found in Bardhan (2000) is meant to be interpreted this way. Similarly, the Dayton-Johnson (2000) study of irrigation communities in Mexico[9] finds homogeneity within the community to have a positive impact on cooperation. None of these studies actually go beyond estimating the partial effect of trust on cooperation in exemplified "social dilemmas", nor do they measure the impact of cooperation on income.

Narayan and Princhett (1999) is one of the few studies that try to estimate the total income effect of SC. They find that income of the individual households increases with proxies for "trust" in reduced form regression models. The average number of organizational membership in the village had a significant positive impact on income level, while the households had no positive effect of belonging to more organizations themselves. SC is hence more a public than a private good[10]. But group membership can depend on the income level as some kind of consumption good, and the authors hence use "trust in strangers" and "trust in government" as instrument variables which renders significant results. These instruments are not valid in the opinion of Durlauf (2002), being incorrectly excluded from the original econometric model since he finds it rather non-controversial that societies with higher generalized trust also achieve more economic progress. Knack and Keefer (1997) do a similar exercise on a cross-country level and find the World Value Survey question of "...most people can be trusted" to be positively correlated with the average income level, but the endogeneity problem is expected to be just as important at this aggregation level. My paper follows the approach taken by Narayan and Princhett (1999) in using the income level as

[9] These resemble the communities of the Peruvian highland of this study both in natural conditions, infrastructure and culture.

[10] The effect is surprisingly strong. Increasing average membership in groups by one standard deviation increases expected incomes by 20-50%. A similar increase in schooling entails just a 3 to 5% increase in income, while non-farm physical assets is associated with 19-22% more income.

the left hand side variable, but differs by introducing cooperation resulting from SC as the explanatory variable rather than a proxy for SC itself.

3.2 Econometric analysis of work exchange in Tambo

3.2.1 Reciprocal traditions and community characteristics

Social anthropologists like Mayer (2002) often characterize the Peruvian highland as "the heartland of reciprocity". The forefathers of the inhabitants of the district Tambo in the Department of Ayacucho, where the survey of this author took place, were once part of the Incan empire. Quechua is the spoken language, even though people are now able to communicate in Spanish, and old traditions are still in place. The fundamental unit of social identification is the community. The communities differ considerably in size - from 12 to 180 households in this sample of 49 communities - but are organized in a rather similar manner (see summery statistics of main variables in Appendix). Community assemblies with compulsory attendance for (at least) all heads of households are held about four times a year. The assembly elects the president and other members of the community council, representatives for other offices like the defense committee, irrigation committees, etc. Even the official state representative is defacto elected by the community, since the government tends to appoint the candidate proposed by the community assembly.

The communities might have different juridical status. Some are "recognized peasant communities" with registered common property rights to land. Others are non-registered communities where people have individual property rights even though few have legally registered entitlement papers[11]. The difference is rather superficial, as most land has been handed out to households for individual use and family based inheritance rights are practiced in all communities. Most communities were forced to choose between the two property right systems when they were handed over land from the large estates during the land reforms of the 1970s. The result is a rather even distribution of land independent of the property rights system in place[12]. Both common property rights to land and missing official property documents impede reconcentration of land without the acceptance of the community assembly. The main explanation for the existence of communities as units of organization is the need to protect individual property rights, Gonzales de Olarte (1994). A family alone would not have the power to stop encroachments, either from other poor farmers or large capital owners, if they stand outside a mutual defense organization since the state apparatus is nearly absent in this poor part of the countryside and documents of formal property rights have played a minor role until today.

[11] A large-scale entitlement program financed by the Interamerican Development Bank is now registering all plots and houses in both rural and urban areas in Peru. The official explanation is that a public property register makes it possible for the owners to use property as collateral in order to loan money for productive investments in line with the thoughts of de Soto (2001). Formal entitlement is a basis for the introduction of property tax in the future, assumed by many as the government's hidden agenda.

[12] Fairly equal land distribution is probably a necessary condition for reciprocal work exchange not being replaced by a market oriented labor market.

With this fundamental basis of institutional power, the community assembly and council are able to organize different forms of collective action like building and maintenance of infrastructure on irrigation systems, schools, roads, etc.; make attendance to assemblies compulsory; put pressure on people to take part in defense committees and mother clubs[13], or purely voluntary organizations like dance and music groups. Different forms of sanctions are imposed on people who do not comply with their obligations, starting with oral warnings and monetary fines and ending in the most extreme cases with confiscation of property, imprisonment and eviction from the community. Well functioning communities have hence institutional power to carry through collective action projects.

The line between institutional power and truly individual based voluntary cooperation is hence blurred. The aim of this paper is to measure the productivity of SC induced types of cooperation and it is hence important to select the variants that are less influenced by institutional aspects of power[14]. The community authorities do not interfere or influence the implicit contracts of work exchange between individuals. At most they mediate between the partners if a conflict erupts. *Work-exchange* is then a variable that is based on trust that originates in Social Capital rather than institutional factors and is hence chosen for this analysis.

3.2.2 Productivity effects

The agricultural production function is normally assumed to be homogenous of degree one in the basic inputs land, water, labor, capital, fertilizers and other chemicals for agricultural production, i.e. a general increase in all inputs entail an identical increase in income. The technical efficiency in the use of these inputs and the prices obtained from the products might however depend on cooperation, knowledge and transport facilities through higher production volumes, better prices and easier access to profitable markets.

Work exchange might lead to more efficient use of resources in the Peruvian highlands in several ways. The fundamental characteristic is to increase the number of people working on a given project at the same time, which opens for economies of scale effects. In the poor district of Tambo this is related to the lack of production capital. Tractors and other modern machinery are hardly existent and even plough oxen are scarce. The solution is to apply the traditional hand plow (*Chaquitaccla).* Three people working together - two trampling the hand plough into the ground and one taking a grip on the tuft of grass in order to till it over - are supposed to be able to turn the land faster than when each is working alone equipped with a separate hand plow. This system also gives rise to specialization gains since the labor power of youngsters is best exploited as tilling assistants.

[13] The voluntary aspect of the defense committees is low since the military in practice made it compulsory. Membership in Mother Clubs is considered a necessity in order to receive governmental food aid.

[14] Incumbent leaders can impede real democracy within the community by making the life of opponents difficult, for example by refusing to sign individual petitions for public documents, make false reports to central authorities and abuse their power in other ways. People hence often feel forced to participate in communal works that are initiated by the community elite, often in combination with central authorities.

A concentrated effort is often necessary in order to exploit short windows of opportunities given by nature or human organization in traditional agriculture. For example, the land is humid and soft just after rainfalls. One hour of work with the hand plough will then till a lot more land than later when the land dries up and hardens. The same applies to irrigated land, since water is distributed in turns. Working for each other is hence technically efficient in the sense that land is tilled while soft and the others have also something to do while they are waiting for their turn of the water. Geographical distribution of land, soil types, etc. makes people have different needs at different times and work exchange can hence induce the optimal use of labor over time for the whole community as such. The freed resources can be used to increase the use of the other inputs, for example to till more land (if such is available), improve irrigation systems or engage in other fertility improving activities, ranging from collecting cow dung to engage in wage labor in order to buy commercial fertilizers and pesticides. Work exchange is not restricted to purely manual work since two and three teams of plough oxen working together is common in most places and were also observed in Tambo.

The farmers themselves tend to mention competition between participants in work exchange schemes as the most important production-enhancing factor. Working faster, doing more and better than the others becomes a more important element the larger the group. "Working alone, you fall asleep" is the standard comment[15]. If this is an inherent characteristic of self-motivation and hence the people's ability to work hard, it stands in direct contrast to the assumed shirking effect when people work for others in modern societies.

On the other hand there are several aspects of work exchange that might reduce income. Large distances in this highland area force people to walk pu til several hours to a given plot. If one person stayed for a longer time in order to work the land alone, or actually construct the house close to the field instead of clustering in groups, a lot of travel time would be spared.

Other goals than maximization of expected income can be important to explain behavior that does not necessarily seem rational. Working together is often regarded as a social happening and hence juxtaposed to a consumption good, and Mayer (2002) hence doubts this costume will ever disappear. The expected standard of decent treatment is high, since good food, alcohol and coca leaves are served several times during the day[16]. This should only represent an expense and not influence gross income. Meanwhile, this reduces physical working capabilities in some degree and people might turn too sociable, taking too

[15] I experienced variants of this phenomenon when I unexpectedly showed up in the fields to make interviews. People were more than willing to talk when they were working alone. A small group would sooner or later become impatient even though just some of them were asked to respond while the others kept on working. In large groups people could refuse to take time off at all.

[16] When good service is a cultural obligation in work exchange arrangements, the general result is that participants (mostly men) hence consume a larger stake of the available family resources than the people doing household tasks (mostly women). A parallel might be the obligation for business leaders to "wine and dine" in the business community, a social equilibrium where the stockholders and consumers pay the cost (the former through lower business profits and the latter in form of higher product prices).

many pauses. Since people also derive utility from the social interaction in itself, technical efficiency and optimal time allocation might be considered to be of secondary importance. Income insurance is further an important feature of reciprocal work exchange. Not to repay your obligations is normally accepted in case of "force majeure". One example is to send your son - who is normally not as productive - as replacement in work exchange schemes if the farmer is not able to attend due to illness or injuries, for example with a broken leg. People who normally work together can further constitute an "insurance club" for goods in case some of the members do a very bad harvest. According to Gonzales de Olarte (1994) agricultural production is considered to be individual property in good times, but turns common property when hunger strikes. Finally accidents and injuries unfortunately constitute an important part of physical labor. The farmers can hence prefer to work together as a precaution in case of accidents.

Few people depend purely on wage income in these rural highland communities, since most households have their own plots. It is hence a risky business even for well-situated farmers not to take part in work exchange schemes since there is no labor market as such. The anthropological and peasant theory literature is full of examples of how peasants punish non-cooperative minded people by refusing to give a hand when help is most needed, no matter how much money they are offered[17]. The fear of being stamped as "non-cooperative" can hence force people to take part in a proposed work exchange scheme that actually do not lead to higher income in itself, since they does not want to risk being prevented from making similar propositions when it is actually productive. Indirect and often unrelated rewards from taking part in work exchange (and hence labeled cooperation minded) can be access to public funds, political power and positions in the community, could hence take the character of rent-seeking activity and represent a drag on the economy.

The rules of the game of reciprocity are culturally given and seldom open for negotiation. Tit-for-tat exchange measured in hours under similar circumstances is the basic rule. There might exist ratios of exchange between different kinds of work (and those might change over time as the composition of tasks in the community changes), but not between different levels of inherent working capabilities. According to Mayer (2002), disproportional exchange between people with different levels of working capacity will "infer poison in a relationship". Gonzales de Olarte (1994) finds work exchange groups (of either highly productive or low productive) individuals to seldom cross. Total production would probably increase if people with low and high capabilities work together - which is the implication of a wage labor system where the market decides how the "cake" should be split between the different partners - but this is in practice ruled out. The "cake" splitting problem of cooperation between unequals hence leads to a sub optimal combination in the use of the community's total labor resource of the community in general.

[17] Mayer (2002) mentions an example of pure revenge and Gonzales de Olarte (1994) stresses the lack of labor in peak seasons which imply a rather high shadow wage on labor. The latter point is emphasized by Blum (1995), who calculated the marginal productivity of work during peak seasons to be 10 times higher than the going wage rate, but this becomes irrelevant since nobody would work for so low wages if there were no reciprocity attached.

Asymmetrical relations within the community might further induce the less powerful to trade work for influence with the more powerful according to Mitchell (1991) and the marginal productivity of labor might hence be lower under such conditions than when the community members are on an equal footing.

The specialization and economy of scale effects on technical efficiency should make communities where there is more work exchange to have a higher income. But other aims than the maximization of expected income might lead people to cooperate more than optimal to maximize income. As shown in the game theoretical model above, the very norms giving rise to this way of organizing the labor market might induce negative income effects. The 49 communities in the district of Tambo in the Peruvian highland differ a lot in their use of work exchange, even though they are geographically and culturally quite similar. The mean number of days per worker spent in work exchange schemes is 90 days a year, but the standard deviation is 78 with maximum 300 days a year and a minimum of 0. This is a rather high spread between the communities and makes it more likely to find significant results in the econometric analysis.

3.2.3 Community cross-section regression model

The questionnaire survey took place during the spring 2002. All rural communities in the district of Tambo in the Peruvian highland were included, while the urban district capital was excluded. The division into communities in the statistical material follows the lines of the municipal authorities in COZODES, i.e. units which were made responsible for organizing the Defense Committees during the civil war initiated by the Shining Path guerrilla, Municipality (2002).

The intention of this fieldwork survey was to register the level of different forms of cooperation within each community, how the community institutions worked and the degree of economic integration with the rest of society. The respondents were normally one or more elected representatives of the communities ("an authority") who would assess production, sales, other income sources, average days of work exchange and other cooperation variables and institutional aspects for the whole community as such. Household interviews (even a stratified sample) were beyond the reach with the given time frame of this project. I was willing to accept less accurate estimations of community averages in order to obtain a larger sample of communities, since the point of interest of this study is the effect of community level culture on the living standard in general. The positive effect of interviewing representatives of the community is probably a lower risk of intended misinformation, since households would be more scared about abuse of information, e.g. individual taxation[18].

However, the roughness of the survey made it difficult to assess some variables that are normally included in production functions. The exclusion of labor probably does not represent a major source

[18] This method is anycase, no guarantee to obtain truthful information, as community leaders might believe an impression of poverty would entail help from NGOs and state run agencies, but the problem is less severe since there is no personal implications for the respondent. The hard work of the field researcher is to dig deeper for correct information when the answer does not seem correct. Too many interviewers take a short cut by making their own estimations in order to save time.

of estimation bias since most people are occupied in different work related activities most of the day. Attempts to register the use of labor within the agricultural sector would have further been insecure as people would have had problems in separating form the other sources of income animal husbandry, other sales and wage labor[19]. Capital is further left out since most people just use simple traditional technology. The use of plough oxen is not very extensive and hence the exclusion probably does not give rise to serious estimation biases. Some aspects of soil fertility like the use of chemical fertilizers and pesticides is also not included. These basic production factors are hence part of the residual of the econometric model.

All basic production variables are measured in units per person, i.e. the estimated total for community as such, divided by the number of people living there. Income is restricted to agricultural income (*Agri-income*) that constitutes about 50% of all income in the survey, since work exchange is supposed to be more common within this field. Animal husbandry also constitutes a large part, but the calculation is probably more inaccurate. The same applies to salary work outside the community, and production for sale that is mostly transformed agricultural products, for example the traditional freeze-dried potato. *Agri-income* is measured in average New Soles per year per household.

The following explanatory variables will be included in the regression model explaining the agricultural income denoted *Agri-income*. *Land*; measured in units of valley bottom equivalents since land in valley sides and highlands are less useful for agricultural production. *Water*; the units of water supplied through irrigation system is calculated by multiplying different areas with assessed supply of water within the given system (area of well irrigated land is hence an alternative interpretation). *Ecology*; an indicator for natural soil fertility which has a higher value the more of the land of the community which is in valley bottoms compared to valley sides and highlands. *Road*; a dummy for being connected with a road or not. *Work exchange*; The average number of days adult men work together with others in work exchange schemes that directly or indirectly imply a duty to reciprocate (including some where money is given in return as discussed in the theoretical model).

The simple correlation coefficient of *Work-exchange* and *Agri-income* is small and even negative (-0.0433). The discussion of several potential negative income effects of work exchange given in the preceding chapter opens for a negative relation in general. On the other hand, it does seem reasonable that some types of work exchange have a positive income effect. The most obvious is economies-of-scale situations like ploughing after rainfalls and after given turns in the irrigation system. A quadratic function that allows for a non-monotonous relationship seems proper and is applied in the econometric model below. Few variables are included in the econometric model in order to not lose degrees of freedom since only 49 observations are included in the sample.

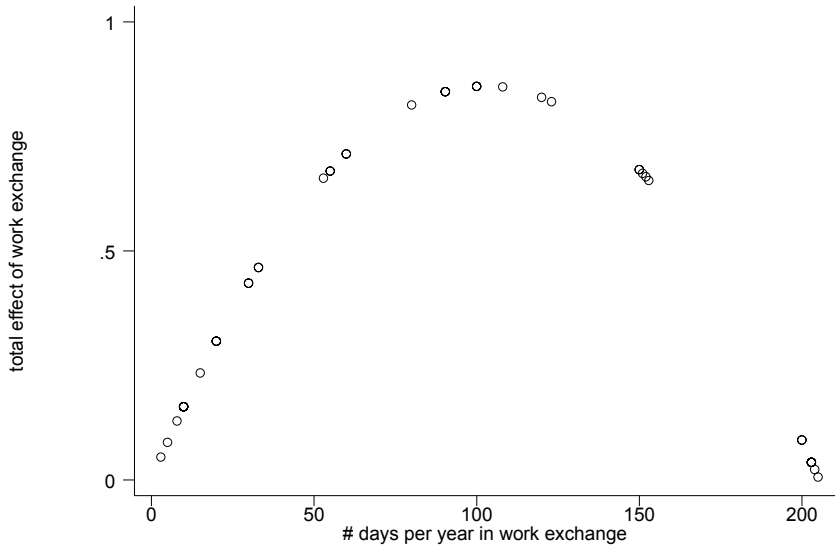
[19] There is no real monetary labor market in the district. Exchange of work or non-monetary rewards are common within the communities, and there is little contact between members of different communities. The type of wage labor in this study is hence mostly farm work in the distant jungle or in the district capital.

Variables	Full sample			No outliers		
ln(*Agri Income)*	Coef.	t	P>|t|	Coef.	t	P>|t|
Constant	5.14	7.53	0.0%	4.64	7.06	0.0%
ln(*Land)*	0.1526	1.29	20.3%	0.1894	1.66	10.5%
ln(*Water+0.5)*	1.7128	2.03	4.9%	1.2051	1.53	13.4%
ln(*Ecology)*	0.6198	1.19	24.0%	1.0172	2.01	5.2%
Road	0.6166	2.22	3.2%	0.6659	2.49	1.7%
Work-exchange	0.0105	1.85	7.1%	0.0167	2.21	3.3%
Work-exchange^2	-0.000044	-1.94	5.9%	-0.000081	-2.39	2.2%
N	49			45		
R^2	32.5%			46.1%		
Adjusted R^2	22.9%			37.6%		

Table 1: Results of OLS regression on a log-linear model explaining average agricultural income per person (*Agri-income*) in the highland district of Tambo in Peru, using a logarithmic transformation of *Land* and *Water*. *Ecology* is an indicator of soil fertility, *Road* is dummy for road connection and *Work-exchange* is the numbers of days working together with others.

The explanation power with R^2 equal to 32.5% in this model using the all observations is rather high compared to similar regression models using cross-section data sets with few observations by other authors. *Water*, *Ecology*, *Road* and *Work-exchange* are significant at 10% level, while *Land* and *Ecology* turns out to be insignificant. In order to check for model robustness, four outliers[20] are taken out of the sample, reducing the numbers of observations to 45 communities. The coefficient estimations are still rather robust to the model specifications. All signs are as expected. All variables are nearly significant at 10 percent level when outliers are taken out of the sample. The positive coefficient for work exchange and negative coefficient for work exchange squared give rise to a hump-shaped effect of work exchange on income and the estimated total effect is given in graph 1.

[20] One observation of 300 days a year, which seems excessive, and three communities reporting no work exchange at all.



Graph (1): Aggregated effect using estimated coefficients for both level and squared work exchange effect on income, when outliers are taken out of the sample.

The positive effect of work exchange reaches its maximum at 103 days a year. The result is that 18 out of the 45 communities included in this sample actually choose to work more together than income maximizing behavior should imply[21]. The significance of the estimated coefficients giving rise to this hump-shaped effect of work exchange is robust to different estimation strategies. A sensitivity analysis using constant values from 0.25 to 2 in the logarithmic transformation of irrigation area (which is necessary since about 1/3 of the communities have no irrigation at all), reveals that the coefficient value for *Work-exchange* is just altered in a minor way. Since the separation of land and irrigated land might seem artificial, I also tried an alternative specification using a weighted sum of dry and irrigated land. The applied relative productivity relation of 1.48 for irrigated land compared to rain fed land is estimated from household level data in the same area, see discussion below. In this alternative model specification all coefficients are still significant at 10 percent level both in the full sample and when the outliers are taken out of the sample, and hence support the findings in the original setup given in table (1).

There are several possible sources of estimation bias in this regression model. One source of bias in the estimated coefficient for *Work-exchange* is the often-assumed simultaneous dependency of the level of work exchange on income. The development literature in economics and other fields uses arguments for cooperation like "rings of survival", "being so poor that you have to cooperate" or "poor people do not have the money to hire labor and hence have to exchange between themselves". These phrases do not give any direct explanations why cooperation should be more productive for the poor than the rich[22]. However, the poor might have stronger preferences for non-monetary results of work exchange as discussed in previous sections of this paper. This applies to the sociability effect since poor people

[21] A contagion effect between different tasks can prevent changes. The communities might prefer to keep the unnecessary high level of cooperation rather than risk that all cooperation falls apart if they try to adjust the norms.

[22] Poverty should not in itself prevent functioning monetary labor markets, just imply lower equilibrium wages. The real

often need to work all day in order to feed the family. If they want to spend time with their friends and family they will have to do this during working hours. People with more resources can afford to spend time just interacting with their friends, for example doing sports, drinking beer at the canteen, etc. Casual observations in the field also indicate that especially youngsters (who still have little income) prefer not to organize work exchange schemes in order to prevent the accompanying consumption cost. This would hence give rise to opposing income simultaneity effect, since richer people can hence afford to work together.

Income insurance is another aspect. It is more important, the higher probability of crossing the survival line. Work exchange in order to prevent serious problems or in case of accidents is probably also more important for the poor since they tend to work on more risk prone sites and situations. The correlation between *Total income* and *Work-exchange* of -0.15 is just significant at a 30% level. This indicate that the poor do not necessarily cooperate more in this sample, but I will anyhow correct for this by using an instrument variable method below.

Another source of bias in the estimated coefficient is a possible correlation between latent variables left in the residual and the variable included in the regression models, especially the variable *Work-exchange* of our main interest. There is no variable for human capital in this analysis. One might assume that norms facilitate collective action have a negative impact on individual development. There is hence a negative correlation between human capital that would be incorporated in the residual and the level of work exchange. The access to plough oxen is another latent variable. It represents the labor force of many manual hands and the farmer would hence be able to finish the work by himself (or just involving his own family) within an acceptable time frame. Cooperation might then become less productive according to the reasons given above[23].

A valid instrument for *Work-exchange* might solve these two main problems of estimation bias. Such instrument must first of all be correlated with *Work-exchange* (in the best case be a direct causal factor). Secondly, it must not be correlated with the residual. The latter requirement implies that the instrument variable must not be correlated with the latent variables, nor represent a latent variable with an effect on agricultural income itself. Whether the community is juridically a "registered peasant community" with common property rights to the land or a more loose organization where the farmers have private property right to their own land, is a potential instrument variable. The correlation between the dummy for individual property rights to land (*Organization*) and *Work-exchange* is -0.37. One possible explanation might be that close-knit communities chose common property rights in the 1970'ies and the underlying

explanation can be some kind of moral hazard problem in renting labor that is harder to overcome by poor/traditional than by the richer/modern farmers and communities. Fluctuating monetary income in combination with scarcity of saving opportunities for the poor will further lead to a fluctuating "shadow-price" on money. Other means of exchange then reduce this insecurity.

[23] Cooperation might anyhow be useful at a more advanced technology level too. I observed several teams of plough oxen working the same plot at the same time.

norms and culture behind this decision prevail. Even though farmers in the two systems experience no difference in their practical lives, the very possibility that the community council can question their property rights might induce people to behave more cooperation friendly[24]. *Organization* is not thought to have a direct impact on agricultural productivity nor income since people behave as their land is their private land independently of their juridical status. It is hence no reason to expect it to be correlated with the capital level, (e.g. plough oxen) or other forms of excluded production enhancing investments (e.g. soil erosion prevention) since the security of investment is more or less the same. However, a problem using *Organization* as instrument for *Work-exchange* is the possible link from the underlying norm system working through the latent variable of individual human capital as described above. This effect is not thought to be very strong and I will hence ignore this possible source of estimation bias for now. In neither type of community do the leadership introduce any form of taxation directly on the production volume since the indirect taxation through compulsory work on community infrastructure is related to the number of household members and plot area. The communities in practice chose the form of organization in the early 1970's and it has been impossible to change until today. Casual evidence from fieldwork indicates that there is no direct underlying productivity effect of *Organization* due to reasons behind choice of organizations. The communities that chose common property rights historically do not seem to be more traditional today. They have the same level of education, speak equally well Spanish and are not more isolated geographically. This indicates that *Organization* is a valid instrument variable for *Work-exchange*.

But one instrument variable of dummy nature is not enough to estimate a quadratic function. Yet, other good instrument variables are difficult to find. A regression model with linear effect of *Work-exchange* is hence estimated using standard OLS and then by 2SLS model using *Organization* as instrument for *Work-exchange*. The former gives a positive but insignificant coefficient. The latter increases the estimated coefficient value slightly as expected from the discussion of possible estimation bias, but this is neither significant. This implies that simultaneity bias is not a major concern in this analysis.

A competing interpretation of the popular thesis of poverty induced work exchange might be that there is some underlying variable that make people both poor and cooperation more productive at the same time. Or put differently, cooperation might be productive under some circumstances while in others not. Different interaction variables for *Work-exchange* and other variables are included one at the time in quadratic work exchange effect regression models. None of the "suspects" given by reasoning in the section 3.2 above turns out to be significant. Neither irrigation water (economies of scale due to time pressure), land[25] (similar reason), better functioning community organization represented by the ability

[24] Tossing people out of the community if they for example do not comply with their obligations to work on communal infrastructure is mentioned as a possibility in some communities with common property rights to land.

[25] Blum (1995) finds small amounts of work exchange to be a sign of poverty rather than modernity, since farmers with small plots are able to work their land alone in a rather short time. This is probably of minor importance for the analysis since average land holdings are controlled for in the regression models even though we do not know the average number and hence size of the plots.

to impose monetary fines nor the organization of commonly or privately owned land, give a significant interlinkage effect with *Work-exchange*. Further, the coefficient for *Work-exchange* is again significant at less than 10% and is hence robust to the inclusion of these interlinkage variables. Interlinkage with the share of maize or potato of agricultural income on the other hand, gives significant effects. But choice of crop is endogenously set by the natural conditions and the availability of inputs, and would hence just steal explanation power from the basic inputs already included in the regression model. The introduction of maize-share or potato-share as separate effects does not yield significant coefficients.

If work exchange were more efficient than working alone, there would be more production for the same amount of basic input factors. This liberates resources that can actually be used to produce more inputs in order to increase production. Regression models explaining alternate *Land* and *Water* give no significant effect of *Work-exchange*. It hence seems like work exchange does indeed have a direect effect on income rather than an indirect effect through other explanatory variables in the regression model.

3.2.4 Household cross-section and community panel data

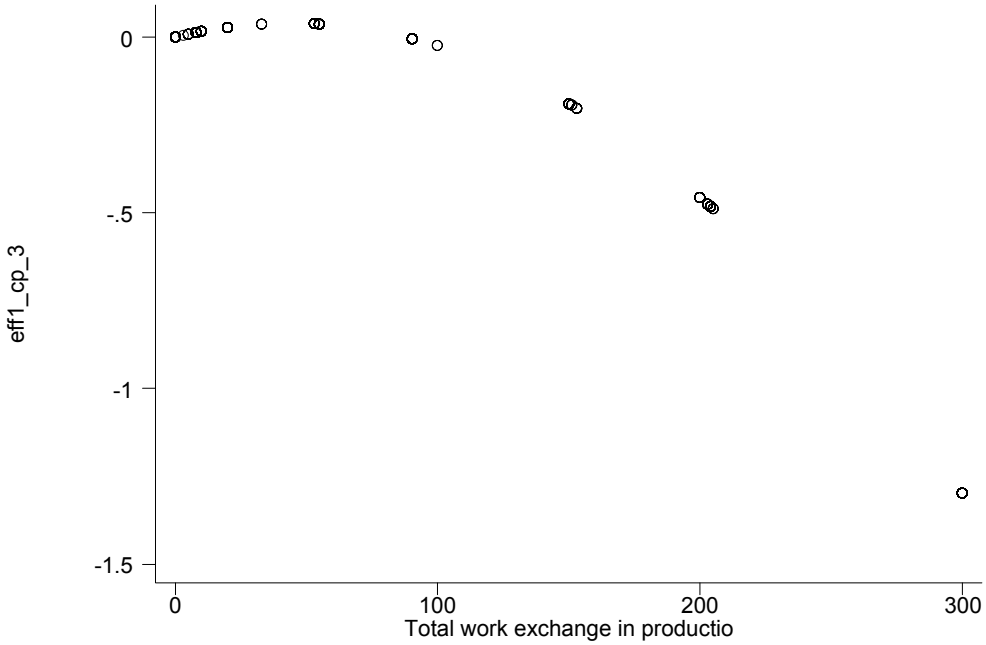
I have seen that average agricultural income of the community first increases with the average number of days spent in work exchange schemes and then decreases when those collective efforts become very common. The choice of work exchange probably reflects general norms and perceptions in the actual community, and this differs substantially within the same geographical district of Tambo. Average community values of control variables like land and irrigation hide variations at the individual level. The Central Bureau of Statistics in Peru (INEI) have given access to individual observations from the Agricultural census covering all households in the area in 1994. The same hump-shaped quadratic effect of work exchange also appears in this data set as reflected in the estimated coefficients of table 2 below.

Tambo was severely affected by the war between the Shining Path guerrilla and the Peruvian military in the 1980s and 1990s. Many communities where hence deserted when the survey took place. I have been able to cross information for 26 of the communities in my own survey with 1300 households in the same communities from the INEI survey. The underlying causal factors for *Work-exchange* like norms, natural conditions, etc. is not expected to change radically over the rather short time span of 8 years between the INEI survey and my own. By comparison, Williamson (2000) assesses that it takes 100 years to change the fundamental characteristics of norms in a society. In this context it seems acceptable to use *Work-exchange* in 2002 as a proxy for the same type of cooperation in 1994. The new data set opens for richer econometric model, as it is possible to include more causal factors due to the availability of such information and the higher number of degrees of freedom. The INEI data contains data of hectares of irrigated and rain-fed land, but no details on the amount of water available. I hence denominate the former variables as *Irrigated* and the latter as *Dry*, and their relative productivity β is estimated in the non-linear estimation procedure.

Variables/Models	Full sample			No outliers		
ln(*Agri Income)*	Coef.	t	P>|t|	Coef.	t	P>|t|
Constant	7.23	32.03	0.0%	7.48	34.43	0.0%
Irrigated	1.45	22.61	0.0%	1.19	22.75	0.0%
ln(Dry+β·Irrigated)	0.98	43.69	0.0%	0.98	45.38	0.0%
Fertilizer	0.0059	0.14	89.0%	-0.0217	-0.54	59.1%
Plough-oxen	0.0166	0.35	72.9%	0.1311	2.84	0.5%
ln(*Age)*	-0.1468	-2.68	0.8%	-0.1251	-2.37	1.8%
Sex	0.0048	0.12	90.8%	-0.0635	-1.59	11.2%
Literacy	-0.0151	-0.49	62.3%	0.0051	0.18	86.0%
Work-exchange	0.0017	2.21	2.7%	-0.0034	-3.32	0.1%
Work-exchange^2	-0.00002	-6.62	0.0%	-0.000003	-0.66	51.0%
N	1300			1173		
R^2	67.2%			68.9%		
Adjusted R^2	66.9%			68.7%		

Table 2: Non-linear estimation of household cross-section data set. The estimated coefficient for "*Irrigation*" is the relative productivity of irrigated land compared to rain fed lands (β) which constitutes a part of the next variable ln("Dry"+β·"Irrigated") which is the weighted aggregation of dry and irrigated land. The full sample includes all observations, outliers with 0 or 300 days a year of work exchange are taken out in the reduced sample. "Fertilizer" is a positive dummy if the peasants apply chemical fertilizers, "Plough-oxen" is similar for ploughing technique, "Age" is the age of the household head, the dummy "Sex" is positive for male household heads, "Literacy" is positive if the household head knows how to read and write and "Work-exchange" is numbers of days during the year working in work exchange schemes.

The coefficients in the quadratic model of *Work-exchange* are significant and the result is a hump-shaped effect on income also in the household sample. The negative effects of work exchange seems to overshadow the positive (see Graph 2 below) and the estimated total effect on income reaches the peak at 88 days when the contribution is hardly positive and the negative contribution to the logarithmic income level is substantial for households that live in communities where work exchange is more frequent.



Graph 2: The total effect of days under work exchange schemes on the logarithmic transformation of agricultural income, full household sample.

The negative effect becomes even more pronounced when the outliers are taken out of the sample. These results at household level support the hypothesis that Social Capital induced work exchange might have a negative effect on income, but the results should be used with caution due to following weaknesses of this sample; (i) Several communities were not included in the sample in 1994 since they had not yet returned after the guerrilla war. (ii) The indicator of work exchange from 2002 is an imperfect representation of the same variable eight years earlier and (iii) Work exchange is the only community level variable in the model, and hence incorporate other community level effects that might be correlated with this variable. Anyhow, the results show a similar pattern as in the community sample and hence support the conclusions given in the preceding analysis.

The detailed information on household level from 1994 makes it possible to construct community averages of the variables from the community survey of 2002. The result is a panel data with 26 observations. The advantage of this rather small data set is the possibility of cleaning up the analysis of unobservable community characteristics applying a within-estimation technique (assuming these community characteristics are constant over time). The results are as follows:

Variables/Models	**OLS**		
Δ $Agri-income$	Coef.	t	P>|t|
$Const.$	0.3672	0.88	38.7%
$Agri-income_{94}$	-0.0002	-1.55	13.7%
Δ $Land$	0.0688	1.15	26.3%
Δ $Population$	-0.0144	-1.52	14.5%
$Work-exchange$	-0.0047	-0.75	46.0%
$Work-exchange^2$	0.000025	0.33	33.8%
N	26		
R^2	30%		
$Adjusted\ R^2$	13%		

Table 3: Panel data regression model of change in agricultural income between 1994 and 2002 "ΔAgri-income". Explanatory variables are the income level in 1994 "Agri-income"; change in farm land area "ΔLand"; change in community population ΔPopulation" and a quadratic function of the level of work exchange "Work-exchange".

Work-exchange is a level variable of 2002. One possible interpretation is that it constitutes a proxy for the work exchange level in 1994. A positive effect then implies that cooperation has enabled the inhabitants able to earn more at a later stage, for example by sharing knowledge and contacts in order to exploit the integration to the market economy. If work exchange changes over time, it seems reasonable that high levels of *Work-exchange* indicate an increase in the variable since 1994 while low levels indicate a possible decrease. Then *Work-exchange* can be interpreted as a change variable in the panel regression in table 3. The estimated coefficients are insignificant, and are hence not incompatible with the results from the level regression models.

4 Conclusions

A regression model based on a sample of 49 peasant communities in the Peruvian highland gives a significant hump-shaped effect of reciprocal work exchange on agricultural income. The marginal effect of more work exchange is positive at low levels of such cooperation, but negative at high levels. This represents a break with much of the existing Social Capital literature, which generally concludes that "the more cooperation, the better". Trust and trust inducing phenomena can actually make traditional societies cooperate more than what is economically optimal. Norms and institutions in traditional societies often do not keep up with rapid transformation from isolated enclaves to integrated parts of the market economies and modern society. They might induce collective solutions when working individually has become more efficient, and pressures of conformity can further represent obstacles for individual development. This notion of cooperation friendly but economically harmful traditional norms and institutions is more in line with the early development economists of the 1950s. The so-called Modernization theory, represented for example by Rostow (1990), then regarded resistance to modernization to be based on superstition, low levels of knowledge and irrational beliefs. Traditions hence represent roadblocks on the path to modernity

and development that had to be surpassed or overrun. The truth probably lie somewhere inbetween the now-a-days politically correct positive view of traditional cooperation in the Social Capital literature and the old-fashioned negative view on traditional ways of organizing the society.

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5 Appendix

Variable	Mean	St.dev	Min	Max
ln(*Agri-income*)	4.9	1.03	1.9	6.86
Agri-income	210	206	7.2	955
Animal-income	161	124	0	719
Other-sales	32	60	0	366
Labor-income	31	48	0	259
Total-income	436	279	41	1468
Households	60	37	12	180
Population	277	224	50	1200
Work-exchange	90	78	0	300
Ecology	1.74	0.57	1	3
Land	0.52	0.62	0.008	2.665
Road	0.48	0.50	0	1
Irrigation*	0.08	0.13	0	0.76