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Trust as a Proxy for the Ability to Produce Local Public Goods: Testing Different Measures*

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Abstract

The ability to produce local public goods and services such as sharing savings, risk, insurance, sanitation and educational services, is a key factor for development. This ability, however, varies greatly across communities (Ostrom 1990; Khwaja 2009). Considering that this ability depends critically on members' willingness to act collectively, this paper investigate whether the level of trust among people measured in different ways can predict the amount of public good produced. I find that (i) trust, as measured by survey questions, has poor predictive power, while (ii) the results from our version of Trust Game are much better predictors of local public-good production.

Keywors: Trust, Collective Action, Provision of Local Public Goods, Trust Game.

JEL Classification Numbers: C93 H41 D71

Résumé:

La capacité à produire des biens et des services publics locaux (les systèmes d'épargnes mutuelles, de crédit ou d'assurance informels, ou les services sanitaires) est un facteur clé de développement. Cependant, une large littérature s'accorde sur le fait que cette capacité varie considérablement d'une communauté à une autre. Dans ce papier, je considère que cette capacité, pour une communauté donnée, dépend de la volonté de ses membres d'agir collectivement. Je teste si le niveau de confiance entre les gens, mesurée de différentes façons, permet de prédire la quantité de biens publics produite. Je trouve que (i) la confiance, telle que mesurée par les questions d'enquêtes, a un mauvais pouvoir prédictif, tandis que (ii) les résultats de la version du "jeu la confiance" a un bien meilleur pouvoir predictif.

Mots-clés: Confiance, Action Collective, Provision de Biens et Services Locaux, Trust Game.

1. Introduction

Inefficiencies in the provision of public goods are considered to be one of the important causes of underdevelopment. States usually provide basic public goods using tax revenue, but are not always able to mobilize the resources necessary to finance them. In these cases, local communities are often called upon to organize the production of the local public goods and services that they need themselves. The problem with the voluntary provision of public goods is, however, the temptation to free-ride, which affects the capacity of groups to carry out collective actions and, thus, the ability of communities to produce local public goods.

Evidence from field research has shown that the capacity to cooperate varies greatly across communities: while some communities are unable to perform joint activities, there are many examples of communities that do engage successfully in collective action to manage local resources (Ostrom, 1990; Khwaja, 2009). For example, the 2009 Nobel Prize winner Elinor Ostrom has documented a number of cases in which communities cooperate successfully in the management of common interests. One of the factors Ostrom highlights as being behind this success is the importance of communities' shared norms and rules in improving cooperative behavior. These findings have inspired new interest in the role of shared norms in group performance.

Amongst these different norms, trust has attracted particular attention in Social Science. First analyzed in Sociology and Psychology, Economists have paid greater attention to trust since Arrow (1972) affirmed that "much of economic backwardness in the world can be explain by a lack of mutual confidence". In particular, it is considered that trust can reduce transaction costs, encourage respect for contracts (Akerlof, 1970; Holmstrom, 1979) and facilitates cooperation (Hardin (2002); Hardin (2006); Fehr and G$\acute{}$achter (2002)) and conflict resolution (Ostrom, 1990).

The rapid growth of work on social capital over the past two decades has also gone hand-in-hand with renewed interest in trust. Social-capital researchers consider trust as a fundamental norm facilitating collective action and thus economic performance. Putnam (1993), for example, considering the differences in the development

of Northern and Southern Italy, concludes that the stronger trust relationships in the North explain its economic success. Similar conclusions are reached by Knack and Keefer (1997) and Bornschier (2000). This has encouraged the emergence of a large literature appealing to trust to explain the pattern of economic development.

However, trust is anything but a simple concept, both in terms of definition and, thus, its measurement. There is no unified and widely-accepted definition of trust in empirical work: varying and sometimes conflicting measurement methods are applied (Narayan and Pritchett, 1999; Karlan, 2002;Knack and Keefer, 1997; La Porta et al., 1997; Knack and Zak, 2003).

Trust measurement methods are of two kinds: survey and experimental. Survey measures, the most common, include asking individuals directly about their trust attitudes towards others such as "most people", "neighbors" or "strangers". A widely-used trust survey question is that in the World Values Survey (WVS): "Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?". This question also appears in the American General Social Survey, amongst others. However, survey questions regarding trust are open to criticism. A number of researchers have argued that trust questions are too abstract (Glaeser et al. (2000), Nannestad, 2008, and Sturgis and Smith, 2010) and are not good measures of the underlying construct.

An alternative is to carry out experiments. The most widely-used experiment is the trust game, initially developed by Berg et al. (1995). In this game, two players, a sender and a receiver, are both given an endowment of X dollars. The sender has then to decide whether to send part of his endowment (of X dollars) to an anonymous receiver. The sender is informed that the amount sent is tripled (3X) by the experimenter on the way to the receiver. The receiver then decides how much of the money to keep (Y) and, how much to return to the sender (3X - Y). The amount sent by the first mover (the sender) is interpreted as a manifestation of trust and the second mover's transfer a manifestation of trustworthiness. The trust game has been used by Glaeser et al. (2000), Fehr et al. (2003), Danielson and Holm (2005) and Cardenas et al. (2008) to test the validity of attitudinal trust questions, with mixed results. Using a sample of Harvard students, Glaeser et al. (2000) compare

attitudinal questions to behavior in the Trust game. They find that the trust measured by the attitudinal questions is not correlated with the level of trust in the trust game. Unlike Glaeser et al. (2000), Fehr et al. (2003) use a sample of German households, and find that attitudinal trust is correlated with behavior in the trust game. Danielson and Holm (2005) observe similar differences in the relationship between the two trust-measurement methods in Sweden and Tanzania.

The purpose in this paper is, thus, to address the problem of trust measurement by investigating the extent to which different measures of trust are connected to a community's ability to produce local public goods. If this ability depends critically on members' willingness to act collectively, the predictive power of different measures of trust regarding the local levels of public goods can be tested. This paper is not able here to explain the fundamental causes of trust. It is instead interested in determining which trust measurement method is better in explaining how heterogeneous individuals manage to engage in joint activities, despite the associated problem of free-riding. This paper is also a contribution to the literature testing whether the trust measured in experiments is linked to real decisions in non-laboratory settings (including Karlan (2002) in Peru, Cardenas et al. (2008) in six South American countries and Etang et al. (2010) in Cameroon).

Trust measurement is addressed by comparing a version of Trust Game in which subjects are matched with a random anonymous member of the community (the *"Community Condition*" of the Trust Game (CCT))[1] to a number of survey trust questions. The analysis is carried out in three parts.

The first question is to know how individuals understand the different trust questions and whether these various trust measures are correlated with replies in the WVS trust question and experimental behavior. This permits me to provide an overview of the different trust measures. The results indicate that the WVS trust question was understood to mean trust in strangers, while the experimental design captured a particular form of trust regarding people who live in the respondent's local area, the CCT. The results further show, unlike Fehr et al. (2003), that the

[1]This procedure is similar to that in Buchan et al. (2000), which is called the *society condition* (of the Trust Game)

CCT as a measure of trust is not correlated with the replies on the WVS trust question or any other survey-based trust measures.

In the second step, I test whether measurement can be used in a social-interaction context. Measuring trust in social contexts is difficult, especially via survey questions which have been shown to produce responses that vary according the interpretation given to the question (Naef and Schupp, 2009, Sturgis and Smith, 2010). The problem is to know whether the data obtained are comparable when it does not clear if individuals define trust in the same way, and more importantly, have the same thing in mind when they refer to groups such as "most people", "neighbors" or "strangers". This may reflect that individuals identify themselves with a specific group to which they belong as a function of their social status (such as by gender, race, or profession) or regard others according to their social position. The results show that social category membership is indeed correlated with replies to the survey-based measures and the WVS trust questions, while the amount sent in the trust game is independent of social categorization. Results thus suggest that unlike, survey questions, experimental results can be more easily compared across communities, despite any differences in their social structure.

Third, the different trust measures are correlated with the individual's voluntary decision to participate in the provision of the local public goods *tontine* (it provides collective insurance for many African villages communities) *credit association* (an alternative to the formal financial system, which latter is inaccessible to the poor) and *animation* (social-cohesion activities, such as the organization of sporting activities, cleaning the village, and environmental-protection activities). Results show that survey trust measures have only poor predictive power, while the results from the trust game (using the *CCT* trust-measurement method) are better able to predict individual participation in local public good provision.

The remainder of the paper is organized as follows. The details of the methodology including the survey procedure and experimental design appear in Section 2. Section 3 describes the data from the survey and experiment, and Section 4 tests which trust measure best explains participation in the provision of local public goods. Last, Section 5 concludes.

2. Methodology

This section describes the context of this study and the sample, and then discusses survey implementation and the experimental design.

2.1. Context

The data here come from a survey and experiment conducted in May 2010 in three villages in Mbour department in West Senegal. Since the early 1980s these villages, like most Senegalese villages, have faced drought and falling prices for groundnuts, their main crop. After several failed policies aimed at reviving the agricultural sector, the government decided, with the support of international institutions, to adopt a strategy of giving greater responsibility to the local population. This led to a reduced government presence and the promotion of local organizations that were supposed to be more flexible and responsive. These local organizations contributed greatly to poverty alleviation by enabling people to access a certain number of basic public goods and services at lower cost. Several types of local public goods and services such as training, banking, the management of irrigation, input supply (such as fertilizer), sanitation services and agricultural advice and training are provided by the local population.

The goal is to use this framework to compare different measures of trust in terms of their explanatory power of individuals' voluntary decisions to participate in collective action. Three types of activities used to finance or produce local public goods and services are considered: monitoring savings (*tontine*), monitoring credit (*credit association*) and social-cohesion activities (*animation*).

Tontine refers to an association of individuals who meet at more or less regular intervals in order to pool their savings. Participants make a fixed contribution at each meeting to a common fund. The total sum contributed at each meeting is allocated to one of the participants, generally by lot. These winners then pay back the loan over a period of time. Over the cycle each participant is guaranteed to win this

loan exactly once. Tontine[2] allows collective insurance systems to be implemented in the community. As this system functions via the mechanisms of mutual guarantee and monitoring, *tontine* is not, however, at risk from abusive and opportunistic behavior.

Credit Association is an alternative to the formal financial system, which latter is inaccessible to the poor. This funds local projects ranging from small businesses to village agricultural projects. The fund is managed by a committee which is composed of individuals who are considered to be trustworthy. As with the *tontine*, *Credit Association* funds are reserved for members only. However, participation is open to the entire village.

Animation covers social-cohesion activities, such as the organization of sporting activities, cleaning the village, environmental-protection activities and work on collective fields. Collective-field activities refer to private land that members of the group cultivate collectively, in turn for the families of each group member.

2.2. The survey

The villages in the survey are involved in public-good provision activities that are typical of African villages. While the villages were chosen for this reason, the households surveyed in the village are randomly selected to provide a representative sample. In each selected household, the household head is asked to either participate or send a representative. The survey and experiment covered a sample of 164 individuals in the communities. The survey was conducted via face-to-face interviews with participants. The questionnaire had two parts. The first covered household characteristics and the relationship with other people living in the neighborhood. Table 1 provides a brief description of these characteristics.

The second part of the questionnaire concerned the trust questions. Respondents are asked to state their trust levels with respect to particular types of people: neighbors, individuals participating in experiments, and strangers. The questions concerning trust in strangers were split up into four types: strangers met for the first

[2]In a recent paper, Etang et al. (2010) provide evidence that trust is very high among members of ROSCAs, a more complex form of *tontine*, in Cameroon.

Table 1: The characteristics of sample participants

	Mean	Std Dev	Min	Max
Number of observations	164			
Household expenditure in dollars (per day)	2.5	16.46	0.55	7.78
Age	36.17	14.40	18	75
Household Size	10.51	5.47	2	21
Education (years)	2.78	3.76	0	14
Female	44.1%		0	1
Married	81.71%		0	1
Christian	20.73%		0	1

Note: Household expenditure per day is in dollars (1 dollar = 450 CFA).
Source: Field survey data.

time, foreigners who regularly trade with villagers, strangers from the same ethnic group as the respondent, and strangers from a different ethnic group. Respondents answer the trust questions on a one to four scale (1 = Not at all; 2 = A little; 3 = Somewhat and 4 = A lot). The trust data is summarized in Table 2

The question which is the most frequently used to measure trust: "Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?" is added. Respondents reply either "Most people can be trusted" or "Can't be too careful when dealing with people". Another group of questions concerns trust in the village authorities. Table 2 summarizes the various measures of trust as described above.

Table 2: Description of trust variables

Variables	Description	Mean	Std. Dev.
Villagehea	Trust in traditional leaders	3.39	1.00
Neighbors	Trust in neighbors	3.38	0.90
Group members	Trust in group members	3.23	1.07
Co-ethnics	Trust in people of your ethnic group	3.06	0.95
Traders	Trust in foreign traders	2.75	0.98
Otherethnic	Trust in other ethnic groups	2.53	1.09
Strangers	Trust in strangers	2.27	1.01
WVS	WVS trust question	0.44	0.49

Note: Replies are on a one-to-four scale (1 = Not at all; 2 = A little; 3 = Somewhat; and 4 = A lot.); For the WVS, the roportion of respondents who say that "Most people can be trusted" is reported in the table. *Source*: Field survey data.

2.3. The Trust Game

The behavioral measure of trust is a version of the investment game in Berg et al. (1995), where two players, a sender and a receiver, are both allocated an endowment of 1000 CFA (2.23 dollars). The sender then has to decide how much of the 1000 CFA endowment to send to an anonymous receiver. The sender is informed that the amount sent is tripled by the experimenter on the way to the receiver. The receiver then decides how much of this tripled amount to keep (Y) and how much to return to the sender (3X1000 CFA - Y). The amount sent by the first mover (the sender) is interpreted as a measure of trust and the second mover's transfer a measure of trustworthiness.

The experiment was implemented by first explaining it clearly (repeated as often as necessary) to the subjects. After providing some examples and asking questions about the game to be sure that it was understood, all participants received their endowment of one thousand CFA.[3] Participants were not allowed to communicate with each other during the game.

All participants belonged to the same village and knew each other (at least each participant knew the others by name). A key element of the design is that each participant knew that he was randomly matched to a member of his own community, but did not know his opponent's identity. This procedure is similar to that in Buchan et al. (2000), which they call the *society condition* (of the Trust Game). The Senders, when they play with their own community members as responders, are faced with the dilemma of whether to send any amount or not. With this design of the trust game, we expect to capture the level of trust (as measured by the amount sent by the first player, which I call CCT trust) that explains whether subjects participate (or not) in the provision of public goods.

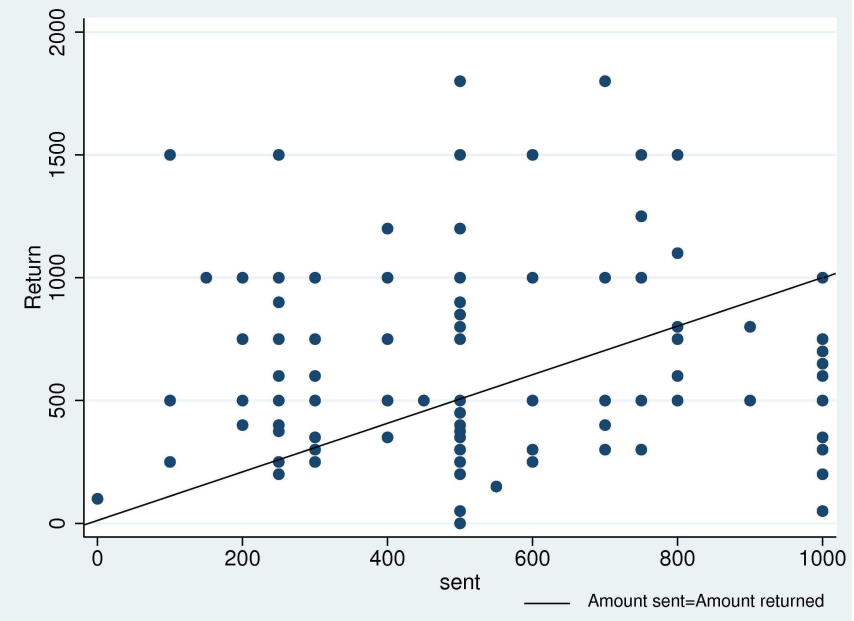
The subjects were given an identification code before privately making their decisions that they put into an envelope. Following the senders' decisions the experimenter multiplied the amount and the envelopes were randomly assigned to receivers. The receivers then decided how much to send back, and the game ended.

Figure 1 presents the distributions of the amounts sent and returned by the play-

[3]This is greater than the local daily wage

ers. While the sub-game perfect prediction is to send zero, subjects send, on average, more than the half of their endowment and only one percent of receivers sent back zero. On average, first movers send 53 percent of their endowment, which is consistent with the results in Caster and Castillo and Carter (2003) for South Africa (for a comparison with the results of experiments conducted in developing countries see Cardenas and Carpenter (2008). This, however, is a larger figure than that observed in laboratory experiments in Western countries (see Buchan et al. (2000)).

Figure 1: The amount sent and returned in the Trust Game



Note: this figure refers to all 164 participants. There are only around ninety points in the figure as a number of the former refer to multiple individuals.

3. The analysis of the survey and experimental data

In this section, the relationship between the trust measures is analyzed and then the consistency of trust-measurement methods via social relations is investigated.

3.1. The relationship between the different trust measures

This section aims to examine how individuals in the sample interpreted the different trust questions and see how these are related to the WVS trust question and trust behavior in the Trust Game. To do so, a classification of the particular trust questions according to the respondents' answers is established. The specific trust questions concern trust in people ranging from neighbors to strangers met for the first time.

In Figure 5 the mean level of trust in others falls with social distance. In other words, individuals report higher levels of trust for individuals or groups who are closer to them. This result, similar to that in Cardenas (2003) and Etang et al. (2011), is used to classify the questions as referring to trust in relatives and trust in strangers. The Spearman rank correlation between the different survey trust measures is presented in Table 5: this confirms the dichotomous classification. Those who exhibited greater levels of trust in group members also trusted their neighbors more (Spearman rank correlation coefficient = 0.42, $p < 0.000$), as well as village authorities ($p < 0.000$). On the other hand, individuals ranked trust in strangers, co-ethnics and other ethnic groups in the same way. However, trust in foreign traders was somewhat ambiguously ranked, being classified by respondents as similar to both trust in strangers ($p < 0.05$), trust in group members ($p < 0.05$) and trust in neighbors ($p < 0.05$).

Now, the relationship between these two trust categories and other measures such as the WVS trust question and the *CCT* is considered. Table 6 shows the results of a logistic regression of WVS measure on the specific trust questions. One common criticism of the WVS question is that it is too abstract (Glaeser et al., 2000). The question is therefore to know how it was understood by responders: Is this a trust question regarding relatives, strangers or simply the whole society? Here it seems that the WVS trust question was interpreted as referring to trust in strangers. The regression results show that while there is no correlation between trust in neighbors and WVS measure, the latter is positively and significatively correlated with trust in strangers met for the first time ($p < 0.001$). WVS measure is also correlated with

trust in foreign traders, and trust in people from other ethnic groups. The WVS measure of trust is therefore correlated with all of the scales of trust in strangers. This is consistent with the suggestion in Glaeser et al. (2000) that questions referring to trust in strangers are more precise than non-specific trust questions such as that in the WVS measure.

I turn now to the relationship between the *CCT* measure and the survey. An OLS regression of the amount sent by the first player in the Trust Game on each of the replies to the direct question on trust shows that the *CCT* is negatively correlated with trust in strangers. This suggests that, as opposed to the WVS trust question, the amount sent measures specific trust in members of the community in the experiment. These regressions also show that there is no significant relationship between the *CCT* and the other survey trust measures, including trust in group members and neighbors. The correlation between the *CCT* and the response to the WVS measure of trust is not significant, as in Glaeser et al. (2000).

In sum, only one of the seven survey trust measures is related to trusting behavior in the Trust Game, the *CCT*. The question is then to know whether these measures are largely uncorrelated because they measure different types of trust, or simply because they are not all valid trust measures. The following section therefore focuses on the ability of these various measures to provide effective evaluations of trust.

3.2. Evaluating the consistency of trust-measurement methods via social relations

This section questions the validity of the survey questions and experiments in measuring trust in the sample. While the quality of trust measured by questions and experiments has been widely discussed in the literature (Berg et al. (1995), Glaeser et al. (2000), and Sapienza et al. (2007)) it is only rarely presented in a real-world social-interaction context.

3.2.1. Addressing survey trust questions via social interactions

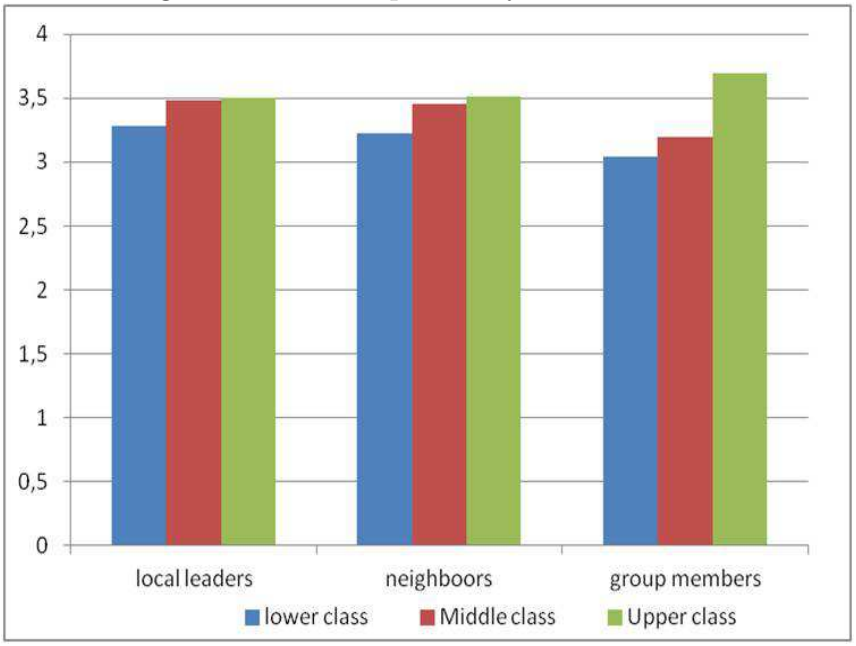
Measuring trust in social contexts is difficult, especially via survey questions which have been shown to produce different responses according to the interpretation given to the question (Sturgis and Smith (2010)). In surveys, it is difficult to know if individuals define trust in the same way, and more importantly, have the same thing in mind when they refer to groups such as "most people", "neighbors" or "strangers". This may reflect that individuals identify themselves with a specific group to which they belong as a function of their social status (such as by gender, race, or profession) or regard others according to their social position. Furthermore, Gächter et al. (2004) find that the socio-economic background affects trust attitudes. I thus conjecture that responses to trust questions are correlated with social position.

To test this idea, the variance in reported trust across social classes is compared. This reveals that social groups are statistically significantly correlated with survey trust. For example, there are significant differences across income classes with respect to trust in group members (Kruskal-Wallis test coefficient = 9.793, p-value < 0.007), neighbors (Kruskal-Wallis test Coefficient = 3.330, p-value < 0.100) and traders (Kruskal-Wallis test coefficient = 6.095, p-value < 0.05).

The response to the WVS measure is the only one which is sensitive to the size of household. This may show that this question captures, in addition to trust, the degree of open-mindedness of responders. Tables 7 and 8 show the results from Wilcoxon-Mann-Whitney tests for different social classes. There are significant differences between individuals according to the strength of their ties with village traditional leaders with respect to trust in group members and village authorities (respectively p=0.07 and p=0.009). These results suggest that the responses to trust questions can be considered as a proxy for community social structure. This finding has important implications in terms of inter-community and international comparisons. As stressed by Naef and Schupp (2009) and Sturgis and Smith (2010), the comparison the level of trust across communities or countries may be problematic, and can be viewed instead as a comparison of these communities or countries' social

structures.

Figure 2: Mean responses by income classes.



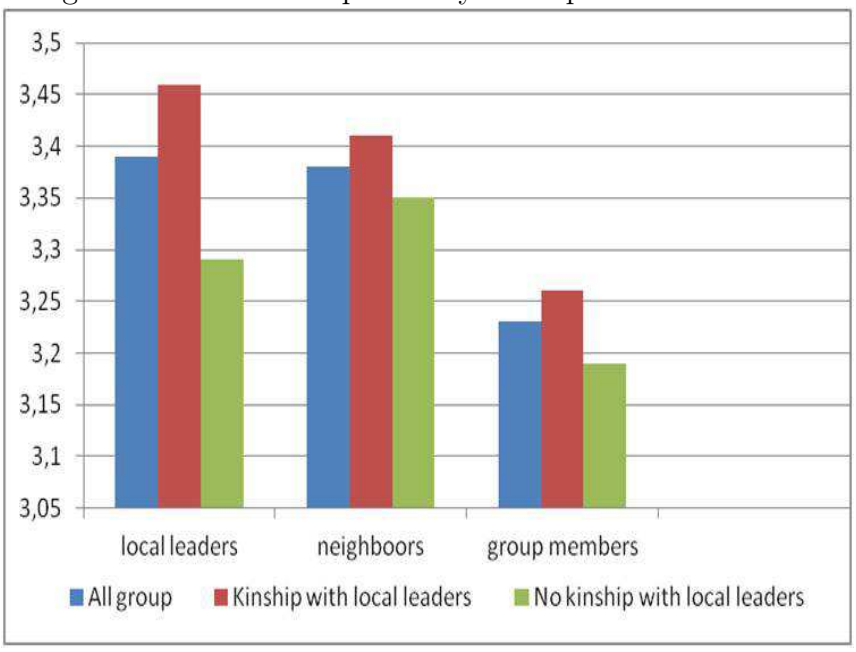
Source: Field survey data

Figures 2 and 3 depict the mean responses to the trust questions by social class. Trust responses are higher for those who are more integrated into the community: those with higher social positions or kinship with local leaders trust more. Social position in the community thus needs to be taken into account for the measurement of trust. This requires the researcher to spend time in such communities in order to understand the complexity of the norms and rules within each community.

3.2.2. Behavior in the Trust Game

The design of the *CCT* overcomes the problems encountered with survey questions. While subjects know that they are randomly matched with another group member, they do not know their opponent's identity. The aim here was to capture the subject's trust in a random person from the community independently of the social position. The analysis of the amount sent in the *CCT* shows that, as expected, the experiment captures a broader level of trust which is independent of the social position of subjects and thus the social structure of the community. The tests of the

Figure 3: Means of responses by kinship with local leaders



Source: Field survey data

variances were insignificant, with the p-values from the Wilcoxon-Mann-Whitney tests being well over the five percent level, showing that experimental trust was not affected by social position.

However, the principal problem of the Trust Game as a measure of trust is, as shown by Cox (2004), Karlan (2002) and Schechter (2007), that the first player's action may reflect preferences other than trust, such as risk or altruism. To determine the first player's motivation in the experiment, subjects was asked to state how much they expected in return when sending money to their opponent. Results show a highly positive relationship between the amount sent and the amount expected. This result can be interpreted in the light of Sapienza et al. (2007), who suggest that trust has a belief and a social-preference component. As expectations regarding the amount to be returned by the second player explain 88 percent of the amount sent by the first player, first-player behavior reflects, at least for the largest part, a belief-based component of trust. While first-player behavior may be affected by other-regarding preferences such as risk or altruism, these latter would therefore seem to be only secondary.

4. Using Trust To Predict Participation In Local Public-Good Production

The next step in comparing the various measures of trust is to see how they are correlated with a real-world problem of the production of local public goods. In particular, analysis will focus on the public goods and services produced in the villages: monitoring of savings (*tontine*), monitoring credit (*Credit Association*) and social-cohesion activities (*animation*).

4.1. Model specification

Using information collected by interviews with staff members, I can establish which individuals participate in *tontine* and the *Credit Association*. Information on participation in *animation* activities is collected directly from household interviews about their implication in a list of social-cohesion activities, such as the organization of sporting activities, cleaning the village, and environmental-protection activities. Over 57 percent of households in the experiment are members of the *tontine*, 45 percent have already contracted a loan from the *Credit Association*, and 56 percent have already carried out *animation* activities.

De Janvry and Sadoulet (2004) identified a number of individual characteristics which determine participation in collective activities in Senegal, such as income, household size and age. Analysis here will focus on the role of trust in the provision of public goods. This can be modeled using a discrete-choice equation such as:

$$Prob(Z_{ij}) = F(Trust_{ij}, X_{ij}, Y_{ij}) \tag{1}$$

where *Prob(participate)* is the probability that household i participates in the provision of public goods j, $Trust_{ij}$ is a measure of trust, X_{ij} is a vector of individual characteristics and Y_{ij} a vector of community dummies. The binary latent variable Z_j equals 1 if household i participates in the provision of the public good and 0 otherwise, where j = *1, 2, 3* denotes the three local public goods. The reduced

formed to be estimated can be represented as:

$$Tontine = \gamma_{11}\, Trust_i + \gamma_{12} X_i + \gamma_{13} Y_i + \varepsilon_{1i} \tag{2}$$

$$Credit = \gamma_{21}\, Trust_i + \gamma_{22} X_(i) + \gamma_{23} Y_i + \varepsilon_{2i} \tag{3}$$

$$Animation = \gamma_{31}\, Trust_i + \gamma_{32} X_i + \gamma_{33} Y_i + \varepsilon_{3i} \tag{4}$$

The following logistic model is estimated:

$$P_i = P(Z_{ij} = 1 | X = x_{ij}, Y = y_i) = \frac{e^{(\gamma_{j1} Trust_{ij} + \gamma_{j2} x_{ij} \gamma_{j3} Y_i + \varepsilon_{ji})}}{1 + e^{(\gamma_{j1} Trust_{ij} + \gamma_{j2} x_{ij} \gamma_{j3} Y_i + \varepsilon_{ji})}} \tag{5}$$

where γ_{ji} are the model parameters.

4.2. Empirical strategy

The analysis begins by introducing each trust measure into each of the three equations defined above. For each public-good equation, for example, there are four models corresponding to the *CCT* trust in the Trust Game (CCT Model), the WVS measure (WVS Model), trust in neighbors (NEIGHBOR Model), and trust in strangers (STRANGERS Model). The aim is to investigate which of these models is the best at predicting public-good participation.

The strategy is based on the comparison of the log-likelihood LL of models, given by:

$$LL(\gamma_{ji}) = log \left\{ \prod_{n}^{i=1} ((P_i)^{z_i} + (1 - P_i)^{(1-z_i)}) \right\} = \sum_{n}^{i=1} (z_i log(P_i) + (1 - z_i) log(1 - P_i)) \tag{6}$$

Parametric and non-parametric criteria are used. The parametric approach consists in comparing the Akaike Information Criterion (AIC) obtained from the logistic regression of the different models. The AIC selects models according to how close the fitted values are to a certain expected value, by minimizing the value of $-2LL + 2\rho$, where ρ is the number of parameters in the estimated model.

The non-parametric test relies the area under the receiver operating characteristic (ROC) curve (AUC). The AUC tests the model's ability to discriminate between

those who participate in public-good provision and those who do not. The ROC curves are constructed by calculating the sensitivity and specificity for consecutive cut-off points according to the predicted probabilities. The greater is the area under the curve, the better is the model. I test whether the AUC's of the two models are significantly different from each other. After comparing models, the effect of each of the estimated trust coefficients is assessed. The Likelihood Ratio Test (L-R Test) is used here. The L-R statistic tests whether certain model parameters are zero by comparing the log likelihood of the fitted model ($LL_{(\gamma)}$) to the likelihood of a simpler model without the trust variable in question (LL_0). The ratio of the likelihoods is given by: L-RT $= -2(LL_0 - LL_{(\gamma)})$. In practice, the trust variable is excluded from each full model to obtain a simpler model. The difference in the log likelihoods of the full and simpler models is distributed χ^2, and reveals the effect of the trust variable to the model likelihood.

4.3. Results

Before analyzing the results, I test whether the explanatory variables used in the participation equation are satisfactory in terms of the estimation. The Hosmer-Lemeshow goodness-of-fit statistic, which is based on the distance between the predicted and observed values is used. The resulting χ^2 statistic is at least 1.5, indicating that they are properly calibrated. There are four candidate models for each of the three public-good equations.

The models for each equation are first compared using the AIC criterion. The ensuing test results are shown in Table 3. The AIC statistics for *Tontine* (equation 2) suggest that the CCT model, using the behavioral measure of trust, best predicts participation in *Tontine*. The AIC of the CCT model is 216.39, while the other AIC figures are 225.14 (NEIGHBORS), 223.17 (STRANGERS) and 223.25 (WVS).

The results for *Credit* (equation 3) lead to the same conclusions. The CCT model explains *Credit* the best, according to the AIC criterion. The results from the estimation of *Animation* (equation 4) are different, as here it is the WVS model which performs the best: the AIC value for the WVS model is lower than those from the other models.

Table 3: Table of AIC values with rank in parenthesis

	CCT	**NEIGHBORS**	***STRANGERS***	**WVS Trust**
Tontine	216.69 (1)	225.14 (4)	223.17 (2)	223.25 (3)
Credit	222.88 (1)	232.63 (2)	233.78 (4)	233.76 (3)
Animation	210.37 (2)	217.15 (3)	216.08 (4)	208.69 (1)

These AIC results then show that *CCT*, behavioral trust, provides the best fit of *Tontine* and *Credit*, while the WVS measure works best for *Animation*. These results are confirmed by the use of the AUC as the selection criterion. The AUC reported in Table 4 confirms that the *CCT* works best for the *Tontine* and *Credit* equations. The *CCT*'s AUC values are 0.6881 and 0.6765 in *Tontine* and *Credit* respectively, while trust in neighbors and strangers produce respectively values of only 0.6310 and 0.6426 for *Tontine*, and 0.5908 and 0.6032 for *Credit*. For *Animation*, the highest AUC value was obtained for the model using the WVS measure (AUC = 0.7348). According to both the AIC and AUC criteria, the *Tontine* and *Credit* equations are best fit by the *CCT*, whereas *Animation* is best explained by WVS measure.

Table 4: Difference in AUC between the *CCT* measure of trust and survey measures one. (H0: area(CCT) = area(NEIGHBORS))

	Obs	Diff	p-value
Tontine			
CCT-NEIGHBORS	164	+ 0.0575	0.100
CCT-STRANGERS	164	+ 0.0450	0.221
CCT-WVS trust	164	+ 0.0480	0.068
Credit			
CCT-NEIGHBORS	164	+ 0.0857	0.043
CCT-STRANGERS	164	+ 0.0730	0.105
CCT-WVS trust	164	+ 0.0901	0.036
Animation			
CCT-NEIGHBORS	164	+0.0196	0.329
CCT-STRANGERS	164	+0.0194	0.361
CCT-WVS trust	164	- 0.0036	0.900

The question is now to know to what extent these trust variables explain the different equations. A first reading of the tables of results reveals that the estimated

coefficients on all of the trust variables are, as expected, positive, so that trust and participation are positively correlated in the provision of public goods.

The likelihood-ratio test shows the contribution of each trust variable to the model likelihoods. In the *Tontine* equation, only behavioral trust, CCT, made a significant contribution to the likelihood (log-likelihood ratio = 7.5, p-value < 0.001), while the contributions of the other three measures are not significant. Equally, the results in the second part of the same table show that only the CCT has a significant effect in the estimation of the *Credit* Equation.

These results are in line with those from the comparison of models via the AIC and AUC criteria. To estimate participation in *Animation*, the AIC and AUC criteria suggest that the WVS measure question produces the best results, but the likelihood-ratio tests reveal that both WVS measure and the CCT make a significant contribution to the estimation of this equation.

4.3.1. Summary and interpretation of results

The aim of this paper is to establish which trust measure best explains participation in three different local public goods: *tontine*, *credit association* and social cohesion activities or *animation*. I designed an experimental measure of trust and compared it a number of survey trust questions. The relationships between these different trust measures are first examined. The results show, as in Glaeser et al. (2000), that trust as measured by the CCT is not correlated with replies to the WVS trust question. Further results show that WVS measure is correlated with trust in strangers in the sample, while the Trust Game, played by people in the same community, captures the level of trust within the community, the CCT. However, this does not explain why trust in neighbors and experimental trust, the CCT, are not correlated, and in particular why CCT is not correlated with trust in neighbors.

These results lead to test the reliability of trust measurements via social relations. Responses to trust questions are correlated with respondents' social positions and, furthermore, are proxies for the individual's integration into the community. Trust measured this way is higher when the individual is well-integrated socially. By way of contrast, the CCT seems to capture the "mean" level of individual trust in

community members, regardless of social structure. Results show that the amount sent by the first player in the Trust Game, the CCT, is correlated at the 88 percent level with the expectations of the amount that will be sent back by the anonymous second player, who is randomly chosen from members of the community.

Results from the different trust measures thus answer the main question of this paper: which of these trust measurements explains the best participation in the three collective actions in the communities of *tontine*, the *credit association* and *animation*. Trust measured by the CCT has good explanatory power while survey questions only poorly explain participation in these public-good activities. The weak explanatory power of survey trust questions may reflect that these are determined by the social structure of respondents' communities, as shown in Section 3.2.1., and therefore capture heterogeneity in the nature of social relations of respondents which have negative effects on the provision of public goods (Banerjee et al., 2005; Alesina et al., 1999; Alesina and La Ferrara, 2000). The replies on WVS trust question has no significant predictive power for participation in the *Tontine* and the *Credit Association* but works better than the other measures in predicting involvement in *animation* activities. This can be explained by the fact that the WVS question seems, at some level, to capture the open-mindedness of the respondents in addition to capturing trust in strangers. This may explain why it captures, unlike the other survey questions, individual participation in Animation activities, the benefits of which go to the entire group, in contrast to tontine and credit activities, the benefits of which are private. Apart from the immediate financial implications, the amount sent in the CCT measure, in addition to measuring the respondent's trust in a randomly-chosen person from the community (Section 3.2.1.), mirrors the real-life provision of public goods. These results differ from those obtained in Karlan (2002), in which only the second-player's behavior is correlated with real-world activities. This difference can be explained by the fact that in Karlan (2002)'s Trust Game there is no anonymity among opponents and, more importantly, the repayment loan is not effectively explained by trust but only by trustworthiness.

5. Conclusion

This paper discusses the strengths and weaknesses of different forms of trust measures. The main objective is to see which of these measures explain why some individuals carry out joint activities. To do so, a version of the Trust Game, the *CCT*, was implemented in a small village community in Western Senegal. The results are compared to survey trust questions: the WVS trust question and specific questions regarding trust in neighbors and trust in strangers. I find that trust, as measured by survey questions, has poor predictive power, while the results from a simple *CCT* are much better predictors of public-goods production.

These results have important policy implications, in particular for the promotion of community organizations based on social capital. Survey trust questions yield greater trust scores for individuals in higher social positions or with kinship with local leaders. If this correlation with respondents' social status is not taken into account, the results may be biased in favor of groups with higher social status and thus exclude certain individuals from full participation in the social and economic life of the community. This may in particular increase inequality in access to opportunities. Survey trust questions thus fail to capture trust in the face of diversity, and furthermore fail to explain sufficiently trust levels that allow individuals with different social statuses to carry out collective activities despite their heterogeneity. To determine this latter level of trust, it is necessary to understand the social structure of the community group and identify respondents' social positions. This requires that the researcher spend time in such communities in order to understand the complexity of community norms and rules. However, given the diversity and complexity of these latter, this will be difficult, especially when diversity is not easily observable. This paper suggests a straightforward way of overcoming this problem by showing that an adequately-designed Trust Game constitutes an effective tool to measure the trust behind individual decisions to carry out joint activities.

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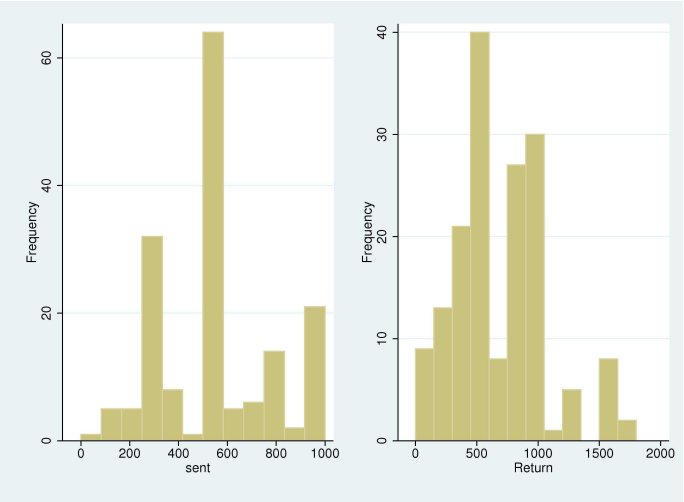
Appendices

Figure 4: histograms of amount sent and returned in the Trust Game.



Source: Field survey data

Table 5: Spearman correlation coefficients of the different survey trust measures

	Group members	Neighbors	Local leaders	Traders	Co-ethnics	Other ethnics	Strangers
Group members	1.00						
Neighbors	0.42***	1.00					
Local lead	0.36**	0.24***	1.00				
Traders	0.16**	0.24***	0.18**	1.00			
Coethnic	0.24***	0.21***	0.25***	0.22***	1.00		
Other ethnic	0.10	0.20**	-0.05	0.38***	0.21***	1.00	
Strangers	0.00	0.09	-0.04	0.27***	0.05	0.29***	1.00

* Significant at 90%, ** Significant at 95% and *** Significant at 99%.

Table 6: Estimation results of WVS trust question as a function of trust questions

Variable	1	2	3	4	5	6	7
Gmembers	0.161						
	(0.166)						
Neighbors		0.236					
		(0.192)					
Local.lea			0.030				
			(0.157)				
Traders				0.298†			
				(0.175)			
Coethnic					0.481*		
					(0.192)		
Otherethnic						0.430**	
						(0.160)	
strangers							0.459**
							(0.171)
Intercept	-0.557	-0.781	-0.603	-0.813	-1.136	-1.730	-1.650
	1.789	(1.809)	0.207	(1.816)	(1.886)	(1.877)	(1.860)
N	164	164	164	164	164	164	164
Log-likeli.	-108.413	-108.115	-108.87	-107.408	-105.115	-105.115	-105.097
$\chi^2_{(6)}$	6.92	7.516	6.006	8.929	12.636	13.516	13.553
$Prob > \chi^2$	0.3283	0.2757	0.4225	0.101	0.0815	0.0355	0.0351

Significance levels : $\dagger$: 10% $*$: 5% $**$: 1%

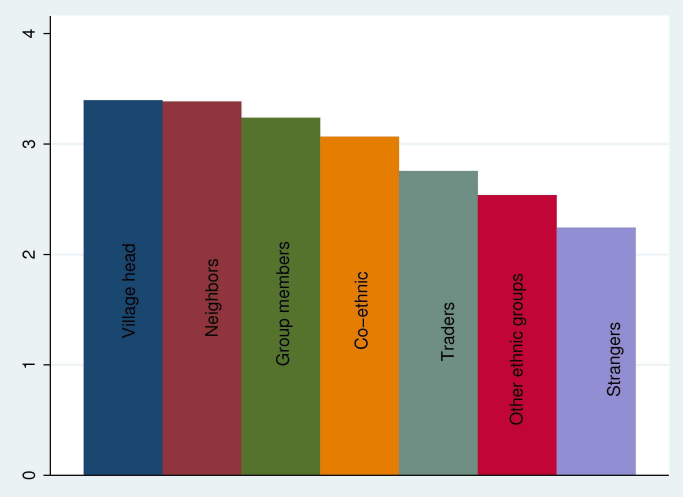
Note:

Estimations with individual controls such age, age-squared, income, education and village dummies.

Table 7: Wilcoxon-Mann-Whitney Test (with significant values in bold)

		G. members	**Neighb.**	**Local leaders**	**WVS trust**	**CCT**
Female	Coef	0.007	**2.050**	**1.798**	0.8990	0.2440
	pvalue	0.9940	**0.040**	0.8386	**0.072**	0.8075
Married	Coef	**-1.713**	**-2.496**	**-3.146**	0.7910	0.1120
	pvalue	**0.0868**	**0.0126**	**0.0017**	0.429	0.9111
Christian	Coef	**1.681**	**1.693**	1.008	1.3810	-0.2370
	pvalue	**0.0927**	**0.0905**	0.3137	0.1672	0.8125
No school	Coef	-0.683	-1.5310	**-2.039**	1.0860	0.1710
	pvalue	0.4944	0.1257	**0.0414**	0.2773	0.8643
Respons.	Coef	-0.556	-0.9900	-0.390	-0.738	0.9000
	pvalue	0.5782	0.3221	0.6966	0.460	0.3682
Large family	Coef	**1.333**	0.516	0.592	**1.800**	-1.000
	pvalue	**0.1025**	0.6060	0.5536	**0.0719**	0.3172

Figure 5: Stated trust and social distance



Source: Field survey data

Table 8: Wilcoxon-Mann-Whitney Test (with significant values in bold)

		Traders	**Own ethnic group**	**Other eth, group**	**Strangers**
Female	Coef	1.2130	-0.8090	-0.1160	0.1410
	pvalue	0.2250	0.4185	0.9074	0.8880
Married	Coef	-0.9440	**-1.8540**	0.5160	0.2530
	pvalue	0.3450	**0.0637**	0.6057	0.8001
Christian	Coef	1.1380	**1.8540**	**2.3560**	**2.1540**
	pvalue	0.2550	**0.0637**	**0.0185**	**0.0312**
No school	Coef	-0.5850	1.1770	-1.6050	0.2690
	pvalue	0.5589	0.2391	0.1085	0.7876
Respons.	Coef	-0.6790	-0.9900	-0.1440	-0.2580
	pvalue	0.4972	0.1169	0.8855	0.7961
Large family	Coef	1.333	-0.147	2.110	0.788
	pvalue	0.1825	0.8830	0.0349	0.4306
Consider poor	Coef	0.2330	**3.3920**	1.2650	-0.6970
	pvalue	0.8155	**0.0007**	0.2059	0.4857