Economy and Environment Program
for Southeast Asia
22 Cross Street
#02-55 South Bridge Court
Singapore 048421
Tel: (65) 6438 7877
Fax: (65) 6438 4844
E-mail: eepsea@idrc.org.sg
Web site: www.eepsea.org

RESEARCH REPORT

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Cooperative Behavior, Social Capital and Development: Evidence from the Mekong River Delta in Vietnam

Mr. Pham Khanh Nam
Faculty of Development Economics
Ho Chi Minh City
1A Hoang Dieu Street,
Phu Nhuan District, Ho Chi Minh City
Tel: +84 8 38448222
Fax +84 8 38453897
E-mail: khanhnam@ueh.edu.vn

In developing communities, good governance is recognized as a key tool to tackle climate change and drive rural development. To shed light on this important issue, a new EEPSEA study from Vietnam has looked at two 'good governance' practices – leveraging social influences and social capital– to see whether they are appropriate policy tools for the country. The research is the work of a team led by Pham Khanh Nam from the Faculty of Development Economics at the University of Economics Ho Chi Minh City and the Environmental Economics Unit at the University of Gothenburg.

The study finds that social influence has a significant and substantial effect on the amount of money people are willing to contribute to a specific rural development project. This shows that using social influence is a good way to facilitate policy implementation. The study also finds that, in general, social capital at the individual level does not affect how farmers adapt to the climate change challenge. In Vietnam, there are only limited resources available to tackle development challenges. This study shows how good governance can be best used to address existing financial and human resource constraints.

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Pham Khanh Nam

(with Fredrik Carlsson and Olof Johansson-Stenman)

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Comments should be sent to: Mr. Pham Khanh Nam
Faculty of Development Economics, Ho Chi Minh City University of Gothenburg
1A Hoang Dieu Street, Phu Nhuan District, Ho Chi Minh City
Tel: +84 8 38448222
Fax +84 8 38453897
E-mail: khanhnam@ueh.edu.vn

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Pham Khanh Nam

(with Fredrik Carlsson and Olof Johansson-Stenman)

EXECUTIVE SUMMARY

In developing communities, good governance has become imperative to both responses to the emerging climate change problems and rural development. Getting good governance requires improvements in all dimensions of the public sector, e.g., democratic government, empowerment of the poor, access to market and participatory development. The good governance agenda, largely defined by international development communities, however, can overwhelm the developing countries' weak and imperfect institutions. Advocating good governance, thus, has been facing the question of what governance practices are applicable to the developing communities' contexts. This research report examines two governance practices that are potentially suitable for developing countries' institutions: social capital and nudging, i.e. using social influences, for development.

The present research report consists of two self-contained papers. The first paper examines the role of social influence in voluntary contributions to public goods. The second paper investigates the role of farmers' social capital in the adaptation to climate change.

The first focus of the present research report is about how institutions affect cooperative behavior. Elinor Ostrom and co-authors have carefully investigated the effects of different institutional settings for the abilities of local societies, in particular in developing countries, to effectively handle social dilemma-type situations; see e.g. Ostrom (1990). Yet, little has been done in this area regarding the direct effects of social influence on individuals' behavior. Such effects have instead been carefully analyzed in the rapidly growing literature on charitable giving (see, e.g., Soetevent, 2005; Landry et al., 2006; Alpizar et al. 2008; Shang and Croson, 2009; Soetevent, 2011). However, the extent to which these insights are transferable to the issue of contribution to real public goods, i.e. strategic interaction settings, in a developing country context is far from obvious. In the first paper, using a threshold public good experiment in a natural setting, we examine two types of social influence: *i*) conditional cooperation, i.e., that people may be more willing to cooperate if others cooperate, and *ii*) the effects of a default alternative, i.e., that people are often found to be influenced by a default alternative presented to them in the choice situation (see, e.g., Thaler and Sunstein, 2008). We find significant and substantial effects of both kinds of social influence. For example, by either giving the subjects the additional information that one of the most common contributions by others is 100,000 dong (a relatively low contribution), or by introducing

a zero contribution default alternative, the average contribution decreases by about 20% compared to the baseline case.

The second paper relates social aspects of individual i.e. social capital to a development issue – adaptation to climate change in Vietnam. Chinvanno *et al.* (2008) report that in order to cope with the impacts of climate change, rice farmers in the Mekong River Delta in Vietnam have mainly used their own household resources and have concentrated their adaptation actions within their farm boundaries. Faced with limited financial capability, instead of investing in costly defensive efforts such as small scale irrigation, farming households have used alternative adaptation strategies such as adjusting the crop calendar or using alternative crops and seed varieties. Studies on to what extent social capital determines households' choice of these adaptation measures may have distinct policy relevance since available resources such as social capital can be used up given chronic problems of human and financial resource constraints. In the fourth paper, we construct a set of social capital indexes that cover formal and informal social networks, trust, and cooperativeness. The first three social capital indexes are based on survey responses. The measure of cooperativeness is based on actual behavior of farmers in the public good experiment presented in the first paper. We then examine how these social capital indexes are associated with farmers' choice of private adaptation to climate change. We find that, in general, social capital at the individual level does not affect farmers' behavior with respect to private adaptation. Some forms of social capital such as formal and informal institutions, however, are weakly associated with the choice of different climate change adaptation measures in farming activities.

PAPER 1

FUNDING A NEW BRIDGE IN RURAL VIETNAM: A FIELD EXPERIMENT ON CONDITIONAL COOPERATION AND DEFAULT CONTRIBUTIONS

Fredrik Carlsson

Olof Johansson-Stenman

Pham Khanh Nam

ABSTRACT

The ability to provide public goods is essential for economic and social development, yet there is very limited empirical evidence regarding contributions to a real local public good in developing countries. This paper analyzes a field experiment where 200 households in rural Vietnam could make real contributions to an archetypical public good, a bridge. In particular, we study the role of two kinds of social influence: *i*) conditional cooperation, i.e., that people may be more willing to cooperate if others do, and *ii*) the effects of the default alternative, i.e., that people are influenced by the default alternative presented to them in the choice situation. We find significant and substantial effects of both kinds of influence. For example, by either giving the subjects the additional information that one of the most common contributions by others is 100,000 dong (a relatively low contribution) or introducing a zero-contribution default alternative, the average contribution decreases by about 20% compared to the baseline case.

1.0 INTRODUCTION

The ability to handle social dilemma-type situations, such as providing an adequate amount of public goods, and the corresponding free-rider problems is crucial for economic and social development (Hall and Jones, 1999; La Porta et al., 1999; Ostrom, 2009). In the present paper, we analyze experimentally the role of social influence, in terms of modified information about others' contribution and provision of default alternatives, for real contributions to an archetypical public good, a bridge (cf. Dupuit, 1844), in rural Vietnam. We conducted a field experiment designed as a threshold public good experiment. The subjects, consisting of the household heads of all households in the village, were asked to make voluntary contributions for the construction of a bridge in

their village. If a sufficient amount of money was contributed by the village members, the bridge would be built.

Most poor countries have weak or badly functioning governments, meaning that a large share of public goods have to be provided privately with the help of local institutions and mechanisms. Elinor Ostrom and co-authors have carefully analyzed the effects of different institutional settings for the abilities of local societies, in particular in developing countries, to effectively handle social dilemma-type situations; see, e.g., Dietz et al. (2003), Ostrom (1990, 2009), and Ostrom et al. (1992). Yet, little has been done in this area regarding the direct effects of social influence on individuals' behavior. Such effects have instead been carefully analyzed in the rapidly growing literature on charitable giving (see, e.g., List and Lucking-Riley, 2002; Landry et al., 2006; Shang and Croson, 2009; Alpizar and Martinsson, 2010; Soetevent, 2011). However, the extent to which these insights are transferable to the issue of contribution to real public goods in a developing country context is far from obvious. First, the charitable giving literature has primarily focused on relatively rich people's contribution, implying for example that the contributions have typically been small relative to the subjects' income. Second, the subjects' direct benefit of the good provided by the charity has typically been negligible, except for the warm glow effects of contributing to a good cause (cf. Andreoni, 1989, 1990).

In the present paper, we focus on two types of social influence: *i*) conditional cooperation, i.e., that people may be more willing to cooperate if others cooperate (see, e.g., Gächter, 2007), and *ii*) the effects of a default alternative, i.e., that people are often found to be influenced by a default alternative presented to them in the choice situation (see, e.g., Thaler and Sunstein, 2008). To find out whether and to what extent these kinds of social influence matter for people's voluntary contributions to local public goods is important from a policy perspective. For example, the choice of frame for a particular policy implementation can be modified to some extent by aid organizations, NGOs, and local decision makers at the village level.

Many experimental results can be interpreted in terms of conditional cooperation. For example, Fischbacher et al. (2001) found, based on the strategy method, that about 50% of the subjects increase their contribution in a one-shot public good game if others do so as well. Fischbacher and Gächter (2010) concluded that conditional cooperation appears to be the main reason behind the typically observed pattern of decreasing cooperation rates in repeated public goods games. For our purpose, evidence from the field is particularly interesting. Frey and Meier (2004) analyzed the behavior of students in Zurich who had the opportunity to contribute to two social funds every semester. The contributions were higher when they were informed that many other students were contributing, although the effect was not statistically significant. In a field-experimental setting, Alpizar et al. (2008) investigated people's voluntary contribution to a natural park. When the subjects were told that the typical contribution of others was $2 (a small contribution), the probability of a contribution increased and the conditional contribution decreased, compared with no provision of reference information. Providing a high reference level ($10) increased the conditional contribution, whereas the probability of contribution remained unaffected. The overall effects of the reference information were quite modest. Shang and Croson (2009) investigated how information about a typical

contribution to a radio station affects subject contributions and found that the highest reference amount ($300) yielded a significantly higher contribution than no provision of any information. The direction for smaller amounts ($75 and $180) was the same, although not statistically significant.

There is also much empirical evidence that a default alternative matters for actual choices in many areas such as pension savings (Madrian and Shea, 2001; Choi et al., 2004; Cronqvist and Thaler, 2004), car insurance (Johnson et al., 1993), and health clubs (DellaVigna and Malmendier, 2006). With respect to pro-social behavior, Johnson and Goldstein (2003) compared countries with different organ donation rules and found that countries where people by default *are not* donors, i.e., people have to opt-in to become donors, had a significantly and substantially lower fraction of people donating compared to countries where people by default *are* donors, even though they had the same freedom of choice in both cases.[1] Pichert and Katsikopoulosa (2008) showed that "green" defaults could have significant effects on the choice of green electricity; when customers had to opt-out in order to buy non-green electricity many more customers bought green electricity. On the other hand, Löfgren et al. (2010) did not find any default effects on the choice of CO_2 offsets for air transport using a sample of experienced subjects.

Yet, as far as we know, no previous studies have tried to quantify the treatment effects of information about the contributions of others or of default alternatives on voluntary contributions to a real local public good – let alone in a developing country where this is presumably more important. This is the task of the present paper, of which the remainder is organized as follow: Section 2 provides the background of the Giong Trom village in rural Vietnam and its need for a new bridge. Section 3 presents the theoretical model, Section 4 the field-experimental design, and Section 5 the corresponding results. Finally, Section 6 concludes the paper.

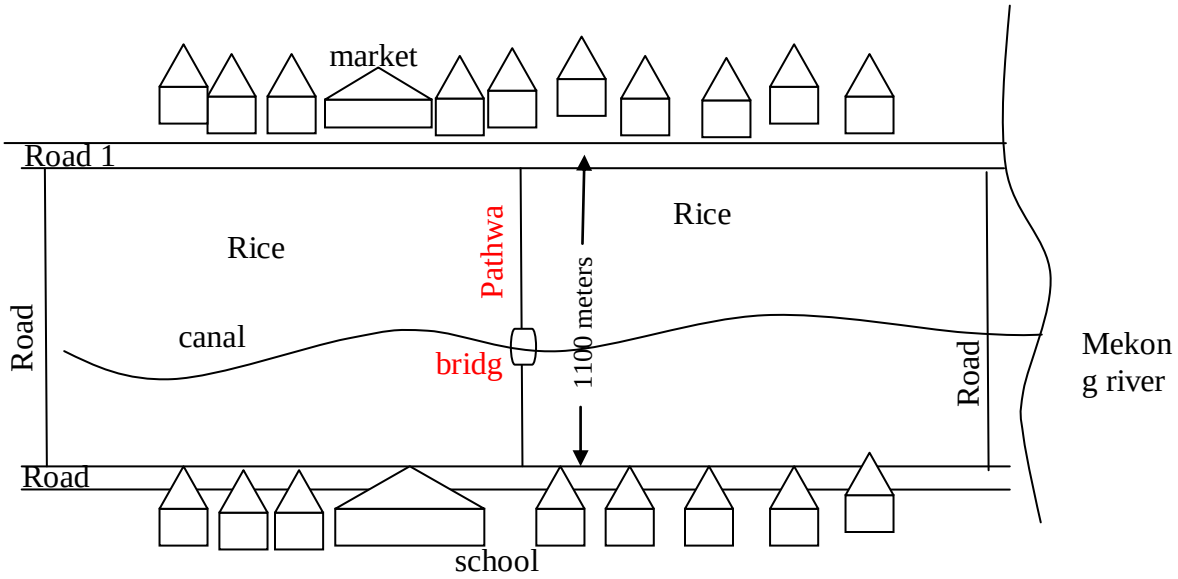
2.0 THE VILLAGE AND THE NEED FOR A NEW BRIDGE

The field experiment was undertaken in Giong Trom village in the Mekong River Delta in Vietnam in 2009.[2] Most households in the village are engaged in rice cultivating activities. The village suffers one of the problems typical of the Mekong River Delta: the lack of a basic infrastructure such as rural roads, bridges, and irrigation canals. The government only provides larger public goods such as roads between villages. The small-scale infrastructure within a village is considered to be the responsibility of the village.

The field experiment concerns funding of a bridge for the village. At the time of the experiment, there was a wooden bridge about two meters wide and 14 meters long, made in 2005. People living along the two roads in the village used the pathway and the bridge to go through the rice fields (see Figure 1). Some villagers used the bridge to go to the market, visit friends, or go to schools if the bridge was in good condition. If they do not use the bridge, they have to use alternative routes, either road A or road B, which are

[1] However, it should be noted that there might be some endogeneity problems here, since the rules may in part reflect different donation attitudes among the countries.
[2] A village is a small commune or part of a commune and usually consists of 100-300 households.

located parallel to and about 1,200 meters from the bridge's pathway; see the map in Figure 1. The wooden bridge was highly degraded and could not be used by tractors or motorbikes. In 2005, the households in this village actually contributed to build the bridge. Since the contributions were not enough for a concrete bridge, a wooden one was built. There are about 200 households on both sides of the bridge and they would all clearly benefit from a concrete bridge. All village households were included in our experiment.



The wooden bridge

Figure 1: Map and picture of the field situation

In order to build a new bridge, a sufficient amount of money had to be collected from the villagers. This is where the experiment comes in: We devised a threshold public good game, in which villagers received an endowment from us and had the option to either keep the money themselves or contribute some or everything to the funding of the bridge. The concrete bridge is a public good in the sense that irrespective of whether the participants wanted to contribute to the public account, they would have the right to use the bridge free of charge. Table 1 reports background statistics of the households.

Table 1. Household characteristics

Variables	Definition	Mean	Std. dev.
Household size	Number of household members	3.84	1.61
Age	Household head age; in years	49.0	13.8
Male	= 1 if male household head	0.62	
Education	1 = No schooling (5%); 2 = Grade 1-5 (53%); 3 = Grade 6 – 9 (32%); 4 = Grade 10 – 12 (9%); 5 = Vocational school (1%) for household head	2.47	0.77
Monthly income	Monthly household monetary income in hundred thousand dong	18.13	12.78
Uses the bridge daily[3]	= 1if uses bridge every day	0.19	
Uses the bridge weekly	= 1 if uses bridge around 1 – 3 times a week	0.10	
Uses the bridge twice a month	= 1 if uses bridge around 2 times a month	0.17	
Uses the bridge once a month	= 1 if uses bridge around 1 time a month	0.30	
Cost of social events	Monthly expenditures for "social events," e.g., weddings, and different kinds of ceremonies in hundred thousand dong	1.96	1.38
Member of the communist party	= 1 if at least one household member is a member of the communist party	0.10	
Association	= 1 if at least one household member is a member of a local association	0.49	
Punish	How likely is it that people who do not participate in community activities will be criticized or sanctioned? = 1 very unlikely … = 5 very likely	2.41	1.51
Rice land	Total size of rice land currently being cultivated; in congs (1 cong = 1/10 hectare)	4.54	3.23
Saturday	= 1 if experiment was conducted on Saturday afternoon (first session)	0.57	0.49

[3] The options for the question regarding the current use of the bridge were: 1 = Every day, 2 = Around two to three times a week, 3 = Around once a week, 4 = Around twice a month, 5 = Around once a month or less, 6 = Currently do not use the bridge at all. Since relatively few answered options 2 and 3, we merged them in the descriptive statistics and in the analysis.

The mean monthly income of about 1.8 million dong corresponds to about 95 USD, which is less than one USD per household member and day. The average household in the study is thus poor and the average education level is very low. The average size of the land a family is currently cultivating rice on is also rather small, approximately half of a hectare. Although the current bridge is degraded, it is still used by almost half of the households at least twice a month, and almost 20% use it every day.[4] The large average amount spent on social events, around 200 thousand dong per month or 13% of the total monthly household expenditure, reflects the importance of such events, including weddings and funerals. This cost may perhaps also reflect the social coherence of the family with the community. Around 10% of subjects are members of the communist party and approximately half of the families are members of at least one local association such as the Farmers', Women's or Veteran's Associations or the Youth Union. These variables are included in our analysis in order to test for possible associated social capital effects of belonging to these organizations on voluntary contributions. The variable Punish is included in order to test whether people's subjective perceptions of the strength of the social norms regarding free-riding affect actual contributions. This was assessed with the question "How likely is it that people who do not participate in community activities will be criticized or sanctioned?"

Based on *t*-tests, proportion tests, and chi-square tests, we cannot reject the hypothesis of equal distributions of household characteristics among the five different treatments, with one important exception: Although the five treatments (defined below) were randomly assigned to the households, the share of subjects who used the bridge often is significantly (and substantially) higher in treatment 3 than in all other treatments. Since this turns out to be an important explanatory variable for actual contributions, it will of course have implications for how to best analyze our data.

3.0 THE THRESHOLD PUBLIC GOOD GAME WITH A REFUND POLICY AND PROPORTIONAL REBATE RULE

The experiment is based on a threshold public goods game[5] (Isaac et al., 1989; Bagnoli and McKee, 1991; Cadsby and Maynes, 1999; Croson and Marks, 2000; Rondeau et al., 2005) with a refund policy and proportional rebate rule framework (e.g., Marks and Croson, 1998). In such a game, an identical endowment E is provided to each of N subjects; in our case E = 400,000 dong and $N = 200$. Each subject i decides privately how much x_i of the endowment to contribute to the public good. When the total contribution is larger than the threshold T, the public good will be provided; in our case, the bridge would be built if the total contributions would exceed 40,000,000 dong,

[4] In the analysis, we will assume that the current use of the bridge is a good indicator of the use of the new bridge. For most households, this is most likely a reasonable assumption.

[5] This framework relates closely to the lump-sum matching setting discussed in several papers (e.g., Baker II et al., 2009), where total contributions often are greater than with a standard voluntary contribution mechanism. However, if, in the matching setting, the contributions to the public goods do not meet the minimum requirement, those contributions still generate earnings for the subjects. In this threshold public good game setting, if the threshold cannot be reached, the refund policy is applied.

corresponding to an average contribution of 200,000 dong. In this case, subject *i*'s net payoff would equal the sum of the net private consumption after contributing x_i, which hence equals $E - x_i$, the own benefit from the public good G_i, and a share of the excess contributions in proportion to the magnitude of the own contribution relative to the total contributions. Individual *i*'s payoff function π_i is then given by the first line on the right-hand side below:

$$\pi_i = \begin{cases} E - x_i + G_i + \left(\sum_j^N x_j - T\right)\frac{x_i}{\sum_j^N x_j} & if \sum_j^N x_j > T \\ E & if \sum_j^N x_j < T \end{cases}$$

If, on the other hand, the total contributions fall below the threshold *T*, the public good will not be provided; in our case, the bridge would not be built. In this case, all contributions would be returned to the subjects, such that the payoff for each subject would simply equal the initial endowment *E*, as given by the second line on the right-hand side above.

It is clear that there are an infinite number of Nash equilibria in this game. In addition to the ones where no bridge is built and where each individual does not contribute anything, we have a continuum of Nash equilibria where the total contributions exactly equal the threshold level. Note that this is of course true regardless of whether the actual distribution of contributions is symmetric; for further details see Palfrey and Rosenthal (1984) and Bagnoli and Lipman (1989).

However, in our case we have that *N* is rather large (200),[6] implying that the probability that the individual contribution decision will be decisive for whether the bridge will be built or not is small. It is easy to show that the condition for when an individual's choice has the potential of being decisive is that $\frac{N-2}{N-1} < \frac{x_{-i}}{T/N} < \frac{N}{N-1}$, where x_{-i} is the average of the others' contribution. In our case, where N = 200 and T = 40,000,000 dong, an individual can affect the decision of whether to build the bridge when 198,995 < x_{-i} < 201,005, where x_{-i} denotes the average contribution when disregarding *i*'s contribution. This is clearly a narrow range. When x_{-i} is sufficiently low, i.e., smaller than 198,995 dong, the individual contribution does not matter at all, since the individual will receive *E* regardless of his/her own contribution. When x_{-i} is sufficiently large, i.e., larger than 201,005 dong, the bridge will be built regardless of how much the individual contributes. Moreover, in this case the unique best response of the individual is to contribute nothing, i.e., to free-ride. Given this narrow range where the individual contribution matters for the decision of whether to build the bridge, and given the large range where the unique optimal response, based on conventional self-interested preferences, is to contribute nothing, we believe it is reasonable to interpret the

[6] In our case, it is realistic to assume that the group size is known and certain for the subjects since it was stated explicitly in the contribution agreement signed by the subjects, and they are well aware that all households in the village use the bridge; see de Kwaadsteniet et al. (2008) for discussions on uncertain group size impacts on cooperation.

individual contribution as a measure of the strength of social preferences, or cooperative behavior. Yet, one could argue that the unique symmetric efficient equilibrium where each household contributes 200,000 dong could serve as a focal point for the subject; cf. Schelling (1960). We will return to this issue in the results section.

4.0 EXPERIMENTAL DESIGN

Our experimental design includes two stages. The first stage consisted of the field experiment with 200 households in Giong Trom village in Vietnam, while in the second stage, conducted four weeks after the experiment, a team of experimenters visited the same households to collect socio-economic data and other information that can help explain the experimental results.

4.1 Stage 1. The Field Experiment

In collaboration with an NGO we conducted the field experiment that involved five treatments: (1) a standard treatment with no reference contribution level and no default option, (2) a treatment with a high reference contribution level (300,000 dong) and no default option, (3) a treatment with a low reference contribution level (100,000 dong) and no default option, (4) a treatment with no reference contribution level and a default option at zero contribution and (5) a treatment with no reference contribution level and a default option at full contribution of the endowment. In all treatments, the contributions were anonymous to everybody except the experimenter. For ethical and practical reasons, the endowment of 400,000 dong was, following standard practice, a windfall gain for the subjects.[7]

Following Alpizar et al. (2008), the treatments with different reference contribution levels were conducted by providing the subjects with information about a typical previous contribution of others. The typical contribution levels were obtained from the first no reference contribution treatment during the first day, i.e., from the treatment where we did not tell the subjects anything regarding others' contributions. Subjects were told that "we have interviewed other households in this village and one of the most common contributions has been 300,000 [100,000] dong." This statement reveals information about the typical behavior and not about any individual contributions. Thus, this conveys more information about the social norm than just stating the contribution of one other person.

The default option treatments were conducted using a metal card with different contribution levels. Zero dong was at the bottom of the metal card, 400,000 dong was at the top of the card, and there were in total 9 amounts on the metal card. A magnetic token

[7] The empirical evidence on windfall gains in public good games is not clear. Cherry et al. (2005) and Clark (2002) find no evidence of a windfall-gain effect on contributions, while Kroll et al. (2007) find significant differences in a public good experiment with heterogeneous endowment. Yet, while it is certainly possible that windfall gains affect behavior in a non-negligible way, our main interest is in the comparison between treatments and not in the absolute values, and we have no particular reason to believe that windfall gains would affect behavior differently among the treatments.

was put at the 0 dong level or at the 400,000 dong level. Subjects in the corresponding treatments were asked to move the token to the amount that they wanted to contribute to the public good. There are several potential reasons why the default alternative could affect the subjects' choices. First, they might interpret the default alternative as indicative of the experimenter's expectations, in our case the expectations of the project. Second, they could interpret it as information about what others do. Third, it could serve as a simple anchoring effect.

Several considerations were made when deciding the size of the endowment and the threshold. The endowment couldn't be higher than the cost of building the bridge. Furthermore, a too high endowment could make subjects feel coerced to contribute some money and a too low endowment could seem unrealistic to the subjects, making us unable to observe sufficient variation in contribution levels.

Since we wanted the contribution decisions to be reasonably well informed and reflective, we felt it was necessary to provide some information about the possibility of building a bridge before the actual experiment took place. Specifically, we asked local officials to ask villagers about alternatives for the bridge, and whether they wanted a new bridge. One week before the experiment we held a meeting with local officials and some representative households, where we went into more details about funding options for the establishment of the bridge. One of the options mentioned at the meeting was the possibility of a matching fund mechanism, in which villagers would contribute some proportion of the bridge costs and external donors would contribute the rest. At the meeting, we also discussed that a project team would visit households in the village in the next few weeks to ask about the "demand for the bridge" for the donors to decide whether or not a bridge should be built. Thus, the targeted group was given the possibility to absorb the information about a potential new bridge systematically over a relatively long time, such that they were not surprised when someone approached their home asking about contribution to the bridge. However, they did not know the details regarding funding and their own role until this information was given to them as part of the experiment instructions. Furthermore, it was in no way decided that the bridge would be built. The information was not detailed enough to enable the households to agree on a response before the experiment. These pre-experimental tasks also helped us achieve a 100% participation rate and assure credibility of the experiment. It should also be noted that local public goods are funded in a similar fashion from time to time in the area, and that the old bridge was actually funded by voluntary contributions of households in the village.

With the help of local officials, we were able to set up a list of household subjects. We then randomly allocated these to our experimenters. The five treatments were also randomly distributed among the experimenters. To make the subjects feel as accustomed as possible to the situation, we did not conduct the experiment in a common venue where participants came to make decisions, as seen in standard public good games. Instead, the subjects made contribution decisions in their own homes. This approach created an environment similar to other investment decisions that the families make in daily life and helped limit communication in our group of 200 subjects. Another advantage of this was

that it facilitated, in most cases, joint family decisions[8] rather than decisions made by single family representatives.

In the experiment, the experimenter initially introduced himself or herself as a member of the bridge project team who would like to know the demand for the bridge in order to make a final decision on the construction of the bridge. The experimenter proceeded by reading the experimental instructions and showing the subject the example cards (see Appendix 2). The threshold was explained with the following sentences.

> "The concrete bridge will be established if all families together contribute at least 40 million dong. This means that if the total contribution is equal to or above 40 million dong, the project will use this money, add more funding in order to meet the costs of the bridge, and take the responsibility to build the bridge. If the total amount of money collected exceeds 40 million dong, the excess amount will be returned to your family according to the proportion you contributed.
>
> If the families are unable to contribute a total of 40 million dong, your contribution will be returned to you, and the concrete bridge will not be built."

The actual cost of building the bridge was around 80 million dong, but since we did not have an exact cost estimate at the time of the experiment, we did not mention an explicit amount. Moreover, although there is always a non-negligible degree of uncertainty regarding the actual cost in a decision such as the present one, the supporting money meant that we could specify exact conditions for when the bridge would and would not be built. After this part, the experimenter presented the agreement. The agreement stated that the endowment of 400,000 dong would belong to the household. It also summarized the rules of the contribution framework[9] as well as stated a date of payment, and had spaces for the signatures of the household and project representatives. Once the household had decided about its contribution, the amount was written on two photocopies of the agreement, which were then signed by the household representative. Each party kept one copy of the agreement. We could not pay them the cash directly, since the payment depended on the behavior of others.

Conducting the experiment at the individual households' homes presented two major challenges. First, we faced the risk that the information could spread among village members before all subjects had made their decisions. Such a spread of information could take place mainly through two channels: villager-to-villager and local officials-to-villagers. We were more concerned about the latter channel since local officials naturally wanted the bridge and could choose to visit the villagers and pressure them to contribute at least the level of the symmetric threshold efficient equilibrium, i.e., 200,000 dong. In order to reduce the risk of information spread, we had to use a larger number of

[8] One story told by an experimenter was that after listening to the context and reading the agreement, a husband told us that his family would like to contribute 300,000 dong to the bridge. Then the experimenter saw the wife kick her husband's leg under the table, and finally they decided to contribute 100,000 dong.

[9] In the agreement, it was made clear that the project and not the local government would be responsible for building the new bridge if the threshold could be reached. This helped avoid possible problems with distrust in the government.

experimenters than in a standard experiment. After balancing several factors such as number of experimenters, time requirement for a decision, and risk of information spread, we decided to conduct the experiment on a Saturday afternoon and on the following Sunday morning using 15 experimenters. Another purpose of choosing Saturday and Sunday was to limit the observation or intervention of other local government officials since they were off work. Using 15 experimenters meant that we could conduct the experiment at 15 households at time. The experiments were conducted in such a way that each household's closest neighbors conducted the experiment at the same time, in order to reduce the risk of information spread. Finally, we used the fact that the bridge was severely degraded and conducted the experiment on one side of the bridge on Saturday and on the other side on Sunday.

This set-up of the experiment required the 15 experimenters to each make 13 to 14 visits. Each visit took on average 20 minutes. Due to the challenge of experimenter bias, we took great care in the process of recruitment and training. The experimenters were recruited via advertisements at the University of Economics in Ho Chi Minh City. We selected only those who met our requirements regarding personality and ability to talk with farmers, e.g., those with the appropriate dialect. The selected persons went through extensive training in the classroom and in the field. They spent nearly one week practicing the experiment in role-play pairs and for pilot interviews with farmers. Moreover, before the experiment, the experimenters had spent more than one month in a similar rural area in connection with another survey, so they understood well what to do and what not to do when visiting a household. We also prepared a list of questions and answers related to the project, and to the establishment of the bridge in particular, so that the experimenters would have similar answers to common questions. During the training and practice sessions, the experimenters were repeatedly told about the importance of using the exact prescribed wording of the experiment scenarios. They were also required to repeat the scenario until the subject understood it without any further explanation.

4.2 Stage 2. The Household Survey

Four weeks after the experiment, all the households were visited by a group of enumerators (not the same ones as we used in the experiment). The enumerators said that they came from the university to collect data for research purposes. This survey was part of a larger research project concerning villagers' adaptation to climate change. The part of the questionnaire that relates to this project includes a socio-economic demography section (e.g., income, assets, age, education etc.) and a section on social capital (e.g., association social capital indexes, trust questions etc.). There were two questions regarding the household's current use of the bridge. The purpose of these questions was to classify bridge users into two groups: low and high demand for the bridge.

5.0 RESULTS

5.1 Descriptive Results

In total, 200 households participated in the experiment. The overall average contribution was substantial, 270,000 dong, and a large majority (78%) of the subjects contributed the threshold level or more. These are extremely large contribution levels compared to most contribution levels observed in threshold public good games; see Croson and Marks (2000) for a review. The levels are particularly striking as there is evidence that thresholds, if anything, tend to reduce contributions (Rondeau and List, 2008; Rauchdobler et al., 2010). Yet the results are consistent with previous findings on contribution levels among poor Vietnamese households; Carpenter et al. (2004 a, b) found average contribution levels of around 70% of the endowment in a public good game conducted with poor Vietnamese households. Moreover, Cardenas and Carpenter (2008) found large cooperation rates more generally in various kinds of field experiments conducted in developing countries.

It is also likely that many of the households would greatly benefit from building the bridge, even though each household would of course financially benefit even more from free-riding. In all five treatments, the average contribution is above the threshold of 200,000 dong. Consequently, the bridge was actually built; see Figure 3 for a picture of the new bridge. The Appendix presents the basic results of the experiment. However, since, as mentioned, the randomization procedure unfortunately did not result in similar distributions among the sub-samples with respect to a key explanatory variable, the use of the bridge, we will focus our analysis on the results from a regression analysis.

Figure 2. The new bridge

At the end of the experiment, the subjects were asked to guess how much they believed other households would contribute. This question was not incentivized, since we wanted to avoid them thinking of the visit as part of a research study.[10] Twenty-two

[10] There are potential problems with eliciting beliefs, although the major problem of learning does not concern our experiment since it is a one-shot game (see, e.g., Rutström and Wilcox, 2010). In addition, Gächter and Renner (2010) show that incentivized beliefs increase belief accuracy in a 10-period public

percent of the subjects said they could not make a guess, and they were not forced to do so.[11] Figure 3 presents own contribution and the guessed contribution of others; we include all observations from all five treatments and the size of a bubble corresponds to number of subjects.

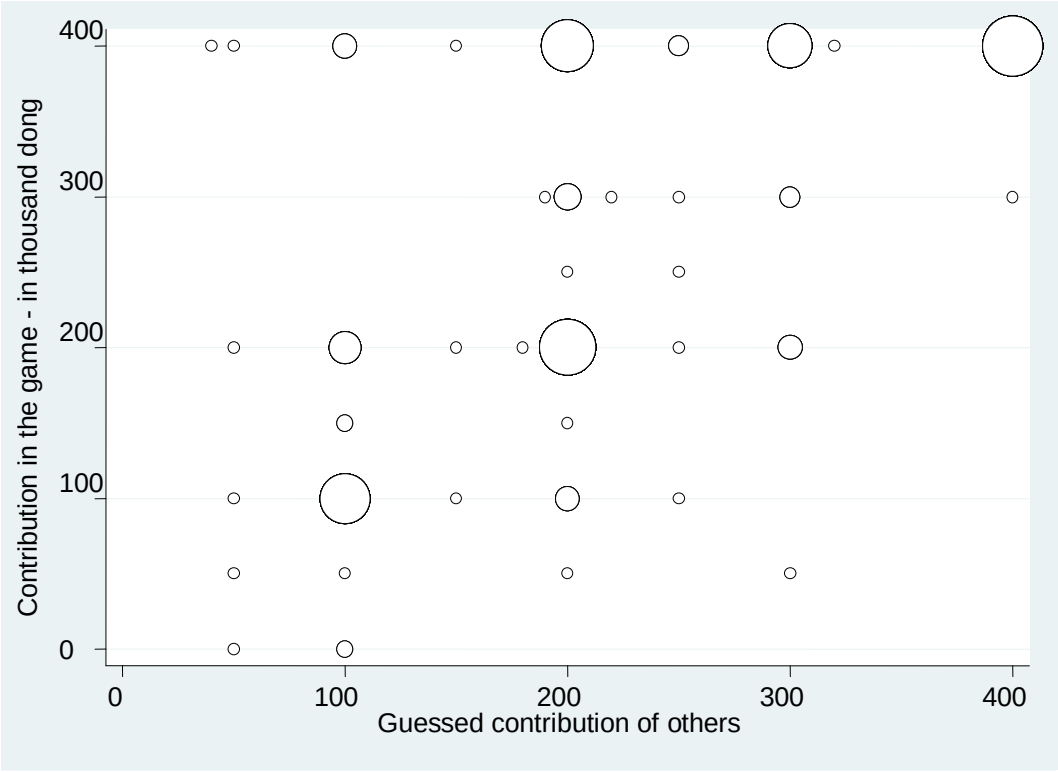


Figure 3. Plot of own contribution and guessed contribution of others

There is a strong correlation between own contribution and the guessed contribution of others; the correlation coefficient is 0.62. A large proportion of subjects who donated 400,000 believed that others would contribute 300,000 or 400,000 dong, and a large proportion of subjects who donated 100,000 dong believed that others would contribute 100,000 or 200,000 dong. The graph suggests that there are three main categories of subjects, where the categories are not exclusive: *i*) Conditional cooperators, i.e., those who contribute the same amount as they guess that others on average would contribute, can be illustrated in Figure 3 as the 45-degree line through the origin; 45 percent of the subjects are consistent with conditional cooperation according to this

good game, whereas beliefs in the first periods in incentivized and non-incentivized treatments are not affected. Moreover, the relationships between beliefs and contribution are identical in incentivized and non-incentivized treatments.

[11] There could be a number of reasons for someone not to make a guess, ranging from simply not having any idea about what others are responding to wanting to avoid an explicit comparison with own contribution. We estimated a binary probit model where the dependent variable is one if the subject did not make a guess. None of the treatment effects are significant. The only significant effects we find are that older subjects are more likely not to make a guess, and that subjects were more likely to make a guess on the first day of the experiment.

definition. *ii*) Those who contributed the full amount irrespective of how much they thought others would contribute. This group can thus be seen as the horizontal line at the top of the graph; 45 percent are consistent with this contribution pattern. *iii*) Those who contributed their fair share regardless of their expectation about others' contribution. This group can be illustrated by a horizontal line at the contribution level 200; 25 percent are consistent with this pattern. At the same time, in some of the treatments, subjects received information about others' behavior. This might not only affect their behavior, but also the expectations about others' behavior. However, the treatment effects on the guesses regarding others' contribution behavior are surprisingly small, and in all cases, the average guess is lower than in the reference treatment. The Appendix presents the results of a simple regression model with the guessed contribution of others as the dependent variable. All coefficients of the treatments are negative, yet insignificant.[12]

As discussed in Section 3, a public good game has a unique symmetric efficient equilibrium, where each household would believe that all other households would contribute 200,000 dong, and thus they also would contribute 200,000 dong. However, Figure 3 shows that although a substantial fraction (34%) of the subject believed that others would contribute 200,000 dong, this is still a minority. Moreover, many of those who expected others to on average contribute 200,000 dong did not contribute this amount themselves. Overall, only 14% both contributed 200,000 dong and expected others to on average contribute this amount.

5.2 Econometric analysis

Since there are some rather substantial differences between the samples in terms of their use of the bridge, it is important to control for the effect of the socio-economic characteristics. The first model we estimated is a standard OLS model where the dependent variable is the level of contribution; we also estimated a Tobit model with censoring at zero and 400,000, and the results are very similar to the ones of the OLS model.[13] We also estimate two probit models: In the first model, the dependent variable is equal to one if the contribution was 100,000 or less, whereas in the second model the dependent variable is equal to one if the contribution was 300,000 or more. Thus, these probit regressions reflect the determinants of contributing a small or a large amount, respectively. In addition, we estimate all three models with and without two important variables that could be correlated with the socio-economic characteristics and the treatment effects: *i*) the variable measuring whether they think it is likely that people who do not participate in community activities are punished and *ii*) the expectation regarding others' contributions. The results are presented in Table 2. In all models, we include dummy variables for the experimenters.

The regression results show that when controlling for household characteristics, there is a significantly lower average contribution in the treatment with a low reference

[12] This result is roughly in line with Altmann and Falk (2009), who found that the differences in beliefs between two default treatments and the base case were not significant, although the descriptive results show an increase in the expected sum of contributions by other group members from the default at zero contribution treatment to the default at full contribution treatment.

[13] These results are available from the authors upon request.

contribution than in the treatment without any reference information. At the bottom of the table, we also report F-tests of the hypothesis of equal treatment coefficients, and this reveals that there is a significantly lower average contribution in the treatment with a low reference contribution than in the treatment with a high reference contribution. On average, subjects contributed 67,000 dong less – from an endowment of 400,000 dong – in the low-reference contribution treatment than in the treatment without any reference information (in the first regression model). However, there is no significant difference between the standard treatment and the high-reference contribution treatment. Note also that if the respondents were to act strategically based on pure self interest, we would if anything be observing that people contributed less if they believed that others were going to contribute more. Consequently, to the extent that such a strategic effect exists, the measured effects of social influence are underestimated. If people are informed that one of the most common contributions by others is 100,000 dong, they tend to contribute around 67,000 dong less themselves, whereas if they are told that one of the most common contributions by others is 300,000 dong there is no difference compared to not saying anything about others' contribution. Given that the overall average contribution in the experiment (270,900 dong) is not very far from 300,000 dong, this result is not surprising.

Similarly, the two probit models reveal that it is more likely (around 27 percentage points more likely) that subjects give 100,000 dong or less and less likely (around 24 percentage points less likely) that they give 300,000 dong or more when they are told that a common contribution is 100,000 dong; both of these effects are significant. However, just as in the OLS model on the level of contribution, there are no significant effects of the high reference contribution treatment.

For the default treatments, we find that the zero-contribution default has a larger effect than the full-contribution default. Yet, similar to the reasoning above regarding the effect of reference contribution levels, this need not mean that a full-contribution default does not have an effect in general, since in our experiment the contribution levels are on average very high. A zero-contribution default, compared to no default, reduces the contribution by about 54,000 dong, which is a substantial amount corresponding to about 20% of the average contribution. A comparison of the full-contribution and zero-contribution defaults reveals that the difference in contributions is only significant in the second model. Moreover, the two probit regressions reveal that it is less likely (around 20-28 percentage points less) that subjects give 300,000 dong or more with the zero-contribution default than with no default contribution. There is however no significant effect on the likelihood of giving 100,000 dong or less.

Among the household characteristics, how much the household used the bridge is an important determinant of the amount of money contributed to the bridge. In the model where we do not include the expected contribution of others, households that used the bridge every day contributed, on average, around 115,000 dong more than households that did not use the bridge (the reference category). There are, however, no significant effects of age, gender of household head, level of education, size of land, or household income on contribution. Among the variables intended to measure social capital, only the social events variable is significant. Households with high monthly expenditures for social events contributed significantly more than other families.

Table 2. OLS regressions on contribution and probit models on low and high contributions; reference contribution and default treatments

	OLS: Contribution in thousand dong		Probit:= 1 if contribution ≤ 100,000		Probit: = 1 if contribution ≥ 300,000	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
High reference contribution	-14.737 (27.717)	3.348 (21.992)	-0.002 (0.086)	0.001 (0.028)	0.001 (0.124)	0.106 (0.158)
Low reference contribution	-67.093** (28.297)	-54.077** (22.802)	0.271** (0.132)	0.302* (0.156)	-0.240** (0.124)	-0.277* (0166)
Default at full contribution	-15.220 (27.638)	-7.351 (22.105)	0.007 (0.089)	0.012 (0.036)	-0.026 (0.127)	0.062 (0.173)
Default at zero contribution	-54.275* (28.285)	-55.724** (22.430)	0.120 (0.111)	0.151 (0.119)	-0.193 (0.123)	-0.284* (0.155)
Household size	4.811 (5.883)	2.960 (4.710)	-0.007 (0.017)	-0.002 (0.005)	0.025 (0.025)	0.020 (0.038)
Age	0.174 (0.756)	-0.289 (0.612)	-0.002 (0.002)	0.000 (0.001)	0.002 (0.004)	0.002 (0.005)
Male	-7.453 (18.717)	-12.824 (14.872)	0.011 (0.053)	-0.007 (0.017)	-0.048 (0.087)	-0.088 (0.114)
Education	12.607 (13.840)	-2.297 (11.071)	-0.031 (0.043)	0.008 (0.013)	0.086 (0.069)	0.060 (0.095)
Income	0.263 (0.812)	0.706 (0.650)	-0.002 (0.002)	-0.001 (0.001)	0.002 (0.004)	0.004 (0.005)
Rice land	0.304 (3.069)	-0.493 (2.430)	-0.016* (0.010)	-0.003 (0.003)	-0.002 (0.014)	0.008 (0.019)
Communist party member	24.087 (31.863)	45.331 (25.316)	-0.003 (0.111)	-0.013 (0.018)	0.102 (0.143)	0.244 (0.155)
Association	9.805 (19.708)	13.661 (15.600)	0.011 (0.057)	0.002 (0.017)	0.042 (0.090)	0.151 (0.120)
Social events	16.39** (7.264)	20.77*** (5.815)	-0.026 (0.023)	-0.009 (0.010)	0.066 (0.033)	0.150*** (0.044)
Use the bridge daily	115.001*** (27.763)	80.583*** (22.221)	-0.159*** (0.041)	-0.037 (0.026)	0.483*** (0.080)	0.535*** (0.088)
Use the bridge weekly	75.956** (35.632)	78.431*** (28.187)	0.077 (0.078)	-0.014 (0.020)	0.374*** (0.107)	0.459*** (0.086)
Use the bridge twice a month	64.336** (28.015)	34.362 (22.368)	-0.012** (0.048)	-0.018 (0.017)	0.308*** (0.105)	0.244* (0.145)
Use the bridge once a month	29.417 (24.716)	35.251* (19.556)	0.103 (0.078)	0.039 (0.039)	0.223** (0.108)	0.385*** (0.129)
Saturday	-16.426 (19.002)	-21.459 (15.543)	-0.031 (0.055)	-0.003 (0.017)	-0.147** (0.086)	-0.240** (0.119)
Punish		20.558*** (4.954)		0.009 (0.008)		0.137*** (0.042)
Guessed contribution of others		0.722*** (0.081)		-0.001* (0.001)		0.006*** (0.001)
No guessed contribution of others		151.746*** (26.502)		-0.087** (0.043)		0.729*** (0.069)
Constant	102.574 (71.771)	87.504 (60.913)	1.336 (1.018)	1.950 (1.475)	-2.390*** (0.897)	-5.677*** (1.695)
	F-test (p-value)	F-test (p-value)	F-test (p-value)	F-test (p-value)	F-test (p-value)	F-test (p-value)
H_o: High reference = low reference contribution	3.40 (0.067)	6.32 (0.013)	5.64 (0.018)	8.76 (0.003)	3.40 (0.065)	4.84 (0.028)
H_o: Default at full = default at zero	1.89 (0.171)	4.61 (0.033)	1.27 (0.259)	3.66 (0.056)	1.69 (0.194)	3.85 (0.050)
Experimenter dummy var.	Included	Included	Included	Included	Included	Included
No. of obs.	200	200	200	200	200	200
Adj. R2 / Pseudo R2	0.119	0.446	0.227	0.497	0.209	0.506

*, **, and *** denote that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

In the second set of models, we include expectations about others' behavior and a variable capturing the subjective risk of punishment if one does not contribute to local public goods. There is also a strong positive correlation between own contribution and the expected contribution of others. The coefficient is 0.72, meaning that a one dong increase in the expectation of others' contribution increases the own contribution by 0.72 dong. This is fairly consistent with what others have found; for example Gächter and Renner (2010) found in a repeated public good game that a one unit increase in beliefs increases contributions by 0.54 tokens in the last period of the game (when there are no strategic motives to act as a conditional cooperator). Subjects who did not provide a guess contributed around 150,000 dong more than other subjects.

One should be careful not to draw too strong casual conclusions from the results regarding the link between guesses and contributions. As mentioned, the question about others' contribution was not incentivized, and it is not at all clear that subjects were able to separate their own preferences from what they thought others were doing. Moreover, the causality may in part go from own contribution to state expectations, rather than the other way around.[14] However, it is interesting that the expectations about others' behavior do not affect the other parameter estimates to any large extent, with the exception that the impact of the current use of the bridge is reduced somewhat, and that membership in the communist party now has a weakly significant and positive effect on the contribution level. In particular, the coefficients for the various treatments are still of the same order of magnitude and remain significant. Consequently, if the guessed contribution of others captures conditional cooperation, then the effects of, e.g., a zero default contribution or a low reference contribution level is something different from conditional cooperation.

The punishment variable has a significant effect on contribution behavior. Subjects who thought they would be more likely to be punished if they did not contribute to local public goods (in general) gave more to the public good in our experiment, which follows intuition.

6. CONCLUSIONS

In this paper we analyze a field experiment with real contributions to an archetypical public good, a bridge, in rural Vietnam. In particular, we study the role of two types of social influence: *i*) conditional cooperation, i.e., that people may be more willing to cooperate if others do and *ii*) the effects of the default alternative, i.e. that people are often found to be influenced by the default alternative presented to them in the choice situation. Numerous studies have analyzed the role of conditional cooperation in laboratory experiments (see, e.g., Fischbacher, 2001; Fischbacher and Gächter, 2010) and for charitable giving (see, e.g., Alpizar et al., 2008; Shang and Croson, 2009) as well as the effects of defaults for the choice of private goods (see, e.g., DellaVigna and Malmeinder, 2006). Yet, as far as we know, no previous studies have tried to quantify the

[14] There are at least two plausible psychological mechanisms behind such reversed causality: The false consensus effect, i.e., the tendency to overestimate the degree of agreement that others have with them (Ross et al., 1977), and simple cognitive anchoring effects *(Tversky* and *Kahneman, 1974*).

treatment effects of conditional cooperation and default alternatives on the voluntary contributions of a real local public good. We find significant and substantial effects of provision of reference information about what others are doing and of default alternatives, which is in line with previous findings in laboratory experiments and for charitable giving. For example, if people were informed that one of the most common contributions made by others was 100,000 dong (a relatively low contribution), they tended to contribute around 67,000 dong (or about 25%) less compared to when not saying anything about others' contribution. Similarly, a zero default contribution, compared to a treatment with no default contribution, reduced the contribution by about 54,000 dong, which is a substantial amount corresponding to almost 20% of the average contribution. These findings are important as they contribute to our general understanding of the determinants of contributions to a real public good, in particular in developing countries. This is important since there is much evidence that the ability to provide an adequate amount of public goods is crucial for economic and social development. The results are also potentially important from a more direct policy perspective at different levels. In Vietnam, many local public goods are funded by the villages themselves. Our experiment suggests that a matching fund voluntary contribution mechanism could be a useful instrument. Moreover, our results reveal that the behavior and contribution of subjects depend on the framing of the questions asked. However, from the perspective of the 200 households in the Giong Trom village in Vietnam, the most important result of this study is clearly that they now have a new and well-functioning concrete bridge in place.

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APPENDICES

Appendix 1.

Table A1. Descriptive results of the field experiments

Treatment	Obs.	Mean contribution in 1,000 dong (std. dev.)	Share of contributions				
			= 0	= 100	= 200	= 300	= 400
Reference treatment	40	287.5 (199.7)	0.000	0.125	0.275	0.075	0.475
Low reference contribution	41	247.6 (132.3)	0.025	0.244	0.268	0.073	0.366
High reference contribution	39	284.6 (108.9)	0.000	0.128	0.282	0.205	0.385
Default at zero	38	245.3 (130.4)	0.0400	0.132	0.263	0.079	0.342
Default at full	42	288.1 (141.3)	0.071	0.119	0.167	0.024	0.500

Table A2. Distribution of contributions for each treatment

Contribution	Reference	High reference contribution	Low reference contribution	Default zero contribution	Default full contribution
0	0	0	1	0	3
20	0	0	0	1	0
50	1	0	1	3	0
100	5	5	10	5	5
150	0	0	0	2	2
200	11	11	11	10	7
250	1	0	0	1	0
300	3	8	3	3	1
400	19	15	15	13	24
Total	40	39	41	38	42

Table A3. OLS regressions on guessed contribution of others

Variable	Coefficient	P-value
High reference contribution	-21.330	0.453
Low reference contribution	-48.919	0.088
Default at full contribution	-34.087	0.220
Default at zero contribution	-11.615	0.683
Household size	-2.363	0.671
Age	0.869	0.262
Male	1.551	0.936
Education	24.976	0.076
Income	0.041	0.957
Rice land	0.012	0.997
Communist party member	-38.557	0.265
Association	-11.764	0.562
Social events	0.011	0.880
Use the bridge 1	51.725	0.069
Use the bridge 2	-9.096	0.801
Use the bridge 3	39.504	0.163
Use the bridge 4	-8.767	0.725
Day of experiment	-4.370	0.825
Constant	103.721	0.141
Experimenter dummy variables	Included	
No. of obs.	155	
Adj. R2	0.02	

Appendix 2. Experimental instructions

Hello, as you may be aware, the Environmental Economics Unit of the Ho Chi Minh City University of Economics is considering several alternatives in constructing a concrete bridge in this village. My name is……I am a representative of this organization and would like to ask you about your opinions on the construction of the bridge.

You and your neighbors will decide whether to build the concrete bridge or not. We are giving money to households and letting them decide how to use it. We are asking households to contribute from this money to fund the bridge construction. We will respect the choice of every villager. We won't evaluate whether your choice is right or wrong.

Now I would like to briefly introduce the bridge project. A new concrete bridge is being considered to be built to replace the degraded Cầu Kinh Giữa. The new bridge would be a concrete bridge that will last about 20 years. The bridge would be 2 meters wide so even tractors can use the bridge. The bridge is a common asset, so everyone who is living in or out of the commune has the right to use it without paying any fee.

Now we would like to know your opinion about the possible construction of the concrete bridge. We are also talking with all other households in your village. The project will give 400,000 dong to each family in this neighborhood, which includes 200 families. Here is the agreement saying that 400,000 dong belongs to your family.

Note that you are in the group of 200 families living in this neighborhood and only these families are financially supported by the project. And now your family, together with other 199 families, has to decide whether the bridge should be built or not. Here is the information you need to consider to make your decision:

- Each family has 400,000 dong provided by the project.
- We would like to ask how your family would want to use this money. You can choose any amount to allocate to the construction of the bridge, from 0 dong to 400,000 dong.
- The concrete bridge will be established if all families together contribute at least 40 million dong. This means that if the total contribution is equal to or above 40 million dong, the project will use this money, add more funding in order to meet the costs of the bridge, and take the responsibility to build the bridge. If the total amount of money collected exceeds 40 million dong, the excess amount will be returned to your family according to the proportion you contributed.
- If the families are unable to contribute a total of 40 million dong, your contribution will be returned to you, and the concrete bridge will not be built."
- Your family is under absolutely no obligation to contribute any money to the concrete bridge, as the money is yours. Even if your family is not willing to contribute or is willing to contribute only a small amount, if the bridge goes into operation you will have the full right to use the bridge since the bridge is common property.

- No one in the commune, not even the officials, will know about your decision. We will keep your contribution information secret.

If the households are able to contribute 40 million dong in total, our project in cooperation with the Farmers' Association will start the construction in the next few months. I will give you several examples of the decision rule. Please look at the poster here.

[Example posters]

Example 1: Suppose your family contributes 100,000 dong to the concrete bridge. Also suppose that there is a total of 30 million dong contributed to the concrete bridge. Because the community did not meet the 40 million dong requirement, the concrete bridge is not built. The 100 000 dong your family contributed to the concrete bridge is not lost; it is simply returned to you. You will have 400,000 dong.

Example 2: Suppose your family contributes 200,000 dong to the concrete bridge. Assume the total contribution to the concrete bridge is 45 million dong. At this point, the concrete bridge will be built, regardless of who contributes what to the construction. The 5 million in excess of the contribution requirement will be returned to your family in proportion to your contribution. The return will be (0.2/45) × 5 million = 22,000 dong. In total, your family will have 400,000 – 200,000 + 22,000 = 222,000 in cash and the concrete bridge will be built.

Example 3: Suppose your family contributes 100,000 dong to the concrete bridge. Assume the total contribution to the concrete bridge is 40 million dong. At this point, the concrete bridge will be built, regardless of who contributes what to the construction. In this case, your family will have 400,000 – 100,000 = 300,000 dong in cash and the concrete bridge will be built.

I hope you clearly understand the way you can contribute to the concrete bridge. We will keep your contribution decision anonymous. This means that no one in the village, not even the people working with us in the Farmers' Association, will know about your contribution.

Treatment 1

Of the 400,000 dong you are provided and that becomes your own asset, how much is your family willing to contribute to construction of the concrete bridge?

_____dong.

Finally, we would like to ask you one more question. How much do you think other families will contribute on average? _____dong. Your guess will be kept anonymous. No one will know your estimation.

Treatment 2

We have interviewed other households in this village and one of the most common contributions has been 300,000 dong.

[Experimenter: stop here for 1 minute so that the subject can think about the meaning of this information. You should not need to explain further if there is no query]

Of the 400,000 dong you are provided and that becomes your own asset, how much is your family willing to contribute to construction of the concrete bridge?

_____dong.

Finally, we would like to ask you one more question. How much do you think other families will contribute on average? _____dong. Your guess will be kept anonymous. No one will know your estimation.

Treatment 3

We have interviewed other households in this village and one of the most common contributions has been 100,000 dong.

[Experimenter: stop here for 1 minute so that the responder can think about the meaning of this information. You should not need to explain further if there is no query]

Of the 400,000 dong you are provided and that becomes your own asset, how much is your family willing to contribute to construction of the concrete bridge?

_____dong.

Finally, we would like to ask you one more question. How much do you think other families will contribute on average? _____dong. Your guess will be kept anonymous. No one will know your estimation.

Treatment 4

[Experimenter: show the Card T4]

Of the 400,000 dong you are provided and that becomes your own asset, how much is your family willing to contribute to construction of the concrete bridge? Please move the token to the amount your family is willing to contribute.

_____dong.

Finally, we would like to ask you one more question. How much do you think other families will contribute on average? _____dong. Your guess will be kept anonymous. No one will know your estimation.

Treatment 5

[Experimenter: show the Card T5]

Of the 400,000 dong you are provided and that becomes your own asset, how much is your family willing to contribute to construction of the concrete bridge? Please move the token to the amount your family is willing to contribute.

_____dong.

Finally, we would like to ask you one more question. How much do you think other families will contribute on average? _____dong. Your guess will be kept anonymous. No one will know your estimation.

PAPER 2

SOCIAL CAPITAL AND PRIVATE ADAPTATION TO CLIMATE CHANGE: EVIDENCE FROM THE MEKONG RIVER DELTA IN VIETNAM

Pham Khanh Nam

ABSTRACT

Farmers in developing countries often face capital constraints in adapting to climate change. Can farmers' own social capital be utilized to facilitate the adaptation? This study uses four components of social capital – formal institutions, informal institutions, trust, and cooperativeness – to examine whether social capital is systematically linked to adaptation to climate change. The results suggest, in general, that social capital at the individual level does not affect farmers' private adaptation to climate change. Yet, some forms of social capital are significantly associated with the choice of some particular adaptation measures.

1.0 INTRODUCTION

Climate change is occurring in the low-lying Mekong River Delta of Vietnam (Wassmann *et al.*, 2004; Dasgupta *et al.*, 2007) and households in the area have developed their own adaptation strategies (Chinvanno *et al.*, 2008). Adaptation is an important way in which farmers respond to climate change (Adger *et al.*, 2003; Bradshawn *et al.*, 2004; Barbier *et al.*, 2008). The way in which affected farmers will adapt determines the scale of climate change impacts and hence their farming production and livelihoods. Knowledge of adaptation measures and factors affecting farmer households' portfolio of adaptation is important for policy makers' ability to facilitate relevant conditions for households' adaptation. Previous research on determinants of households' adaptation behavior has mainly focused on perceptions of impacts of climate change (Blennow and Persson, 2009), incentives and the ability to adapt (Hoffmann *et al.*, 2009), and environmental factors (Seo and Mendelsohn, 2008). The role of social capital in adaptation behavior has still not been investigated comprehensively (Pelling and High, 2005).

Chinvanno *et al.* (2008) report that in order to cope with the impacts of climate hazards, rice farmers in the Mekong River Delta in Vietnam have mainly used their own household resources and have concentrated their adaptation actions within their farm boundaries. Faced with limited financial capability, instead of investing in costly defensive efforts such as small scale irrigation, farming households have used alternative

adaptation strategies such as adjusting the crop calendar or using alternative crops and seed varieties. Studies on to what extent social capital determines households' choice of these adaptation measures may have distinct policy relevance since available resources such as social capital can be used up given chronic problems of human and financial resource constraints.

We define social capital as social networks and social skills owned by the individual and used to facilitate particular actions.[15] We construct a set of social capital indexes that cover formal and informal social networks, trust, and cooperativeness. The first three social capital indexes are based on survey responses. The measure of cooperativeness is based on actual behavior of farmers in a public good experiment. We then examine how these social capital indexes are associated with farmers' choice of private adaptation to climate change.[16]

Social capital is multi-dimensional in nature. We attempt to understand how different dimensions of social capital affect the choice of adaptation measures. A number of qualitative studies have suggested that social capital is critical to adoption decisions in mitigating exposure to climate shocks (e.g., Adger, 2003; Pelling and High, 2005; Wolf *et al.*, 2010). Most previous quantitative studies on the relationship between social capital and adaptation have used groups and networks as indicators for social capital (e.g., Deressa *et al.*, 2009; Di Falco and Bulte, 2009b). Impacts of other dimensions of social capital such as trust and cooperation on climate change self-protection measures remain largely neglected. The present study contributes to the adaptation literature by providing empirical evidence on whether social capital in the form of trust and cooperation affects farmers' adaptation decisions. Almost previous studies have used social capital in the form of a single dimension or an aggregate index and were therefore not able to show how different components of social capital can have different effects on adaptation behavior. We explore how four components of social capital can explain farmers' adaptation behavior.

Our study suggests that in general, social capital at the individual level does not affect farmers' behavior with respect to private adaptation. Some forms of social capital such as formal and informal institutions, however, are weakly associated with the choice of different climate change adaptation measures in farming activities. We find that experimentally-measured social capital in the form of cooperativeness is negatively associated with the choice of private adaptation to domestic water shortage, although the magnitude of the correlation is small.

[15] This definition of social capital is in line with studies that view social capital as a person's social characteristics (Glaeser *et al.*, 2002; Carpenter *et al.*, 2004; Karlan, 2005). However, social capital can also be defined as the common property of a group that facilitates collective action for the mutual benefit of group members (Putnam, 2000; Krishna, 2004).

[16] It can be argued that social networks per se can be a measure of adaptation to climate risk. Households may invest in social relationships, which in turn can act as an informal safety net mitigating the consequences of climate change, for example by risk sharing principles. However, we model social capital as an input in the adaptation process. The treatment of social capital as an adaptation measure is complicated (for example due to endogeneity problems) and is an interesting topic for future research.

2.0 HOW CAN SOCIAL CAPITAL AFFECT PRIVATE ADAPTATION TO CLIMATE CHANGE?

By adaptation we mean any private investment to reduce potential net damage due to climate change.[17] Farmers use self-insurance efforts to reduce the adverse effects of climate change if it occurs. An individual's adaptation behavior is triggered by his or her recognition of the need to adapt (Fankhauser *et al.*, 1999), perceived climate risk, costs of adaptation, and potential reduction in damage (Kane and Shogren, 2000). Farmers' assets of social networks and social skills can possibly affect these determinants of their adaptation behavior.

Social networks can facilitate the exchange of information about possible climate change effects, facilitate the diffusion of adaptation innovations, and therefore help reduce adaptation costs. Deressa *et al.* (2009) showed that informal institutions such as peer networks may help increase people's awareness of climate change and its effects and promote sharing of experiences of adaptation options. The authors found that having access to farmer-to-farmer extension, the service in which trained farmers act as the extension agents to the neighboring farmers, can increase the likelihood of using specific adaptation measures such as "different crop varieties" and "planting trees." Social networks can also provide a channel to informal financial sources that relax farmers' credit constraints on investments in adaptation. Individuals' strong social ties can help speed up disaster responses and reduce exposure to external risks (Carter and Maluccio, 2003).

Does trust, a farmer's social skill, affect the choice of private adaptation measures? In the present study, trust is defined, broadly, as a belief that other people are generally trustworthy and as a social orientation toward other people (Glaeser *et al.*, 2000). Trust in information from local organizations can facilitate the recognition and understanding of climate changes. A trustworthy person, or a reciprocal person, is more likely to receive information or help from his or her peer network, therefore trustworthiness[18] can facilitate the knowledge acquisition and guarantee a safety net that people can rely on to e.g. borrow money or assets in times of climatic variation or weather shocks. There have been, however, no empirical studies on links between trust and the choice of private adaptation measures.

Although social capital can facilitate collective action to overcome social dilemmas in joint adaptation projects, only a few studies have discussed this role (e.g., Adger 2000, 2003). Adger (2000) demonstrated that community social capital in the form of voluntary labor contribution has evolved to facilitate collective adaptation practices such as sea dike maintenance in the absence of governmental supports in Vietnam. It is, however, not clear how a farmer's cooperativeness affects his or her choice of private adaptation measures.

[17] This definition is from Kane and Shogren (2000) and Mendelsohn (2000). Adaptation can also refer to actions that take advantage of new opportunities that climate change creates. In the context of this study, however, we ignore this part of the definition.

[18] Trustworthiness is assumed to imply reciprocity (Fehr and Gächter, 2000; Ostrom and Walker, 2003).

Social capital may have negative effects on adaptation in two different ways: strong social ties may create investment disincentives and strong networks may hinder adaptation through distribution of false information. Di Falco and Bulte (2009) provided evidence of negative effects of kinship linkages on investment in adaptation. The authors found that the number of kinship links is negatively and significantly associated with the probability to invest in soil conservation. The kin network functions as an informal safety net and thus reduces the need to adapt. The network also contains a sharing norm and therefore reduces the incentives for adaptation. Also Agrawal *et al.* (2008) suggested that strong institutional norms such as the labor sharing norm in farming activities may attenuate the incentive to adopt individual adaptation measures such as crop diversification or migration. Strong social networks may act as a conduit for misperception of the climate change effects – false information is easily spread in a strong network. Wolf *et al.* (2010), for example, suggested that strong bonding networks could potentially raise the vulnerability of elderly people in the UK to the effects of heat waves.

3.0 THE VILLAGE AND ITS CLIMATE CHANGE PROBLEMS

The survey and experiment were undertaken in Giong Trom village in the Mekong River Delta in Vietnam in 2009. Table 1 summarizes the socio-economic characteristics of the sampled households. Most households in the village are engaged in rice farming. A typical farmer's household has around four members, where on average less than three members are in their working age. The average household head 49 years old and has only elementary education. The average size of the land a family is currently cultivating is also small, approximately half of a hectare. The average monthly household monetary income of about 95 USD per month is less than one USD per household member per day. About 30% of the surveyed farmers claimed to be moderately informed about climate change and its impacts. More than 60% of the surveyed farmers believed that climate change will have substantial effects on their farming practices and way of life.

The low-lying land of the village is subject to tidal flooding and saltwater intrusion from the coastline and the Mekong River. The village is also vulnerable to tropical storms and cyclones. Rural households within the study site have been severely affected by climate change (Oxfam, 2008) partly because of their dependency on climate-based resources such as domestic water, irrigation water, and soil for cultivation. The impacts of climate change on rice farming in the studied area could be severe in the dry season by the prolonged midseason dry spell (Chinvanno *et al.* 2008) or saline water intrusion because of sea level rise and low flow in the Mekong River, which can result a reduction of about 25% of rice yield (Khang *et al.* 2008).[19]

[19] While Yu *et al.* (2010) projected a decline in rice yield by 4.3- 8.3 percent by 2050 for the whole Mekong River Delta, mainly because of a higher sea level rises and changes in temperature and precipitation.

Table 1. Households' characteristics description

Variable	Definition	Mean (std.dev.)
Income	Household monetary income in million dong per month	1.81 (1.27)
Income ratio	Dependence on farming income, i.e., ratio of monetary income from farming over total monetary income	0.35
Labor	Numbers of household members who can provide labor	2.72 (1.45)
Land size	Size of farming lands in "cong" (1 cong = 1/10 hectare)	4.68 (3.12)
Age	Age of household head in year	48.90 (13.84)
Education	Highest level of education attained: 1 = No schooling (5%); 2 = Grade 1-5 (54%); 3 = Grade 6 – 9 (31.5%); 4 = Grade 10 – 12 (9%); 5 = Vocational school and above (0.5%)	2.46 (0.76)
Head	Dummy = 1 if household head is male	0.62
Children	Number of children living in household	0.57 (0.75)
Awareness	Level of information about climate change and its impacts: 1=very poorly informed (21%); 2=poorly informed (24%); 3=moderately informed (30.5%); 4=well informed (21%); 5=very well informed (3.5%)	2.62 (1.14)
Belief farming	Dummy=1 if believe that climate change will cause a decrease in rice productivity within the next 20 years	0.68
Belief water	Dummy=1 if believe that climate is changing to such an extent that it will substantially affect the family's ways of life	0.64

4.0 MEASUREMENT OF SOCIAL CAPITAL AND ADAPTATION CHOICES AND ECONOMETRIC APPROACH

4.1 Adaptation Variables

The study focuses on private adaptation measures adopted in farming practices and domestic water usage. We separately examine impacts of social capital on each practice. The division is necessary because of crucial differences between these activities: the motivations for adaptation in productive activities may differ from those related to domestic water usage efforts. One practical challenge was to disentangle the responses to the climate stimulus from those linked to other stimuli such as the market, family condition, and public policy. We tackled this by asking farmers to report only measures their family had implemented in response to climate change in the past 5 years. The three questions asked were: "What have you done to adapt to unpredictability of weather and unusual timing of the seasons?", "What have you done to adapt to longer periods of

drought?", and "What have you done to adapt to saline intrusion?"[20] Enumerators had a list of possible adaptation options, but to avoid framing bias, they did not present it to the respondents. Instead, the respondents verbally described their adaptation measures and the enumerators checked the corresponding options in the list.

Table 2 presents the statistics of the main adaptation measures.[21] A household can take several measures in response to climate change. We are able to identify three main adaptive responses in farming practices.[22] The most common response is "Different planting dates," which consists of activities such as varying planting or harvesting dates by adjusting planting techniques and use of water and fertilizers to ensure that critical growth stages do not coincide with uncomfortable climate conditions. The "Different varieties or crops" measure is a set of activities such as growing a number of different crops to reduce the risk of crop failure or using several varieties that are drought-tolerant or resistant to saline water. "Changing management practices" includes activities such as changing the use of capital, labor, chemicals, and fertilizers, or increasing the use of water conservation techniques. For domestic water issues, the climate change problems of the studied area relate mainly to the shortage of water in the dry season because of a prolonged drought period and intrusion of saline water. Villagers respond to the pressure by investing more in water storage equipment or changing water use practices.

Table 2. Main adaptation measures

Variables	Description	Mean
Farming practices		
Different planting dates	Dummy = 1 if adopted "Different planting dates" measure; 0 otherwise	0.60
Different varieties or crops	Dummy = 1 if adopted "Different varieties or crops" measure; 0 otherwise	0.43
Changing management practices	Dummy = 1 if adopted "Changing management practices" measure; 0 otherwise	0.40
Domestic water usage		
More water storage	Dummy = 1 if adopted "More water storage" measure; 0 otherwise	0.74
Changing water use practices	Dummy = 1 if adopted "Changing water use practices" measure; 0 otherwise	0.51

[20] To identify adaptation measures adopted in farming practices, enumerators asked these three questions. However, adaptation measures adopted in domestic water usage, they did not ask the question "What have you done to adapt to unpredictability of weather and unusual timing of the seasons?" since unpredictability of weather and unusual timing of the seasons do not affect domestic water usage.

[21] All these measures are individual, meaning that all implementations, costs, and benefits are made, borne, and gained by individual households.

[22] The observed adaptation pattern is consistent with Chinvanno *et al.* (2008), who surveyed adaptation measures adopted by farmers in the Mekong River Delta in Vietnam in 2005. The seven-month long rainy season in the studied area allows for flexibility in adjusting the crop calendar. The two-crop cycle allows farmers to be flexible when selecting rice varieties.

4.2 Social Capital Indicators

We define social capital as the social networks and social skills possessed by individuals and used to facilitate particular actions. In particular, social networks or associational social capital are defined as a person's social relationship that enables him or her to benefit from interactions with others. Social skills, or behavioral social capital (Carpenter *et al.*, 2004; Grootaer *et al.*, 2004), are propensities of individuals to trust and cooperate with other individuals for mutual benefits. We use four indexes to reflect the multidimensional concept of social capital: a formal institution index and an informal institution index as associational social capitals, and a trust index and a cooperativeness index as behavioral social capital. We conducted a survey to measure social capital in the form of social networks and trust, and an economic experiment to measure social capital in the form of cooperativeness. We also used the survey to collect data on adaptation measures, farmers' awareness of and beliefs about climate change, and socio-economic characteristics of the farming households.

Formal institution index

The formal institution index captures the extent of a household member's participation in various types of non-governmental local organizations.[23] A person's participation in formal institutions may help him or her access formal information on climate change or new adaptation technologies. The diversity of membership, i.e., the number of formal associations participated in by family members, is used as a proxy indicator for formal institution in the estimation of adaptation in domestic water usage, whereas membership in the Farmers' Association is used as a proxy indicator for formal institution in the estimation of adaptation in farming practices.

Informal institution index

We use the size and usefulness of the network to proxy informal institution (Grootaer *et al.*, 2004). We asked a question addressing the size of the network, "About how many close friends do you have these days? These are people you feel at ease with, can talk to about private matters, or call on for help," and a question to assess the usefulness of the network, "If you suddenly needed a small amount of money enough to pay for expenses for your household for one week, how many people beyond your immediate household could you turn to who would be *willing* to provide this money?" The answers to the question on the usefulness of the network strongly correlate with number of close friends in the question on the size of the network, so we decided to choose the number of close friends as an indicator of informal institution in the econometric analysis.

Trust

We measure trust based on respondents' level of agreement on a 5-point scale with each of the following statements: "Most people who live in this village can be

[23] Formal institutions in the surveyed area include the Farmers' Association, the Women Association, the Red Cross, the Veterans' Association, the Elderly' Association, the Youth Union, and microcredit and religious groups.

trusted," "Most people in this village are willing to help if you need it," and "In this village, people generally do not trust each other in matters of lending and borrowing money." The first statement focuses on generalized trust and the other two on the extent of trust in the context of specific transactions. Later in the econometric analysis, since these three indexes of trust are strongly correlated and yield similar results, we only report generalized trust, i.e., responses to the statement "Most people who live in this village can be trusted." Trust in this study, therefore, implies a generalized trust in people living relatively nearby.

Cooperativeness

Cooperativeness in this study can be understood as the degree to which a participant in an experiment contributes voluntarily to the provision of public goods. To measure social capital in the form of cooperativeness, we use results of the natural field experiment in Carlsson *et al.* (2010). The experiment concerned funding a bridge for the village, devised as a threshold public good experiment in which villagers received an endowment from us and could opt to either keep the money or contribute some or everything to the bridge. There are about 200 households on both sides of the bridge that would probably benefit from the concrete bridge construction. They were all included in the experiment.

The public good experiment presents a social dilemma for the participating households since they have monetary incentives to free ride on the contributions of others. In standard public good experiments, contribution levels are normally considered as measurement of the cooperative behavior of participants. In the experiment, we need to control for heterogeneous demands for the public goods and for different contextual factors. We therefore construct the cooperativeness variable by running a regression on actual contributions against experimental context factors and household traits; see equation (1). Residuals of the regression, which equal actual contributions minus predicted contributions, will contain all components of the cooperation behavior. We use the residual values [24] as a measure for cooperation behavior or cooperativeness ($\hat{\varepsilon}$ in equation (2)).

$$x_i = \alpha + \beta G_i + \varepsilon_i \qquad (1)$$

$$\hat{\varepsilon_i} = x_i - \hat{x_i} \qquad (2)$$

where x_i is the contribution of household i in the experiment and G_i is a set of parameters controlling for the contexts of the experiment such as treatments, experimenters, and days of the experiment and for the socio-economic characteristics of household i. Included in G are variables representing household i's demand for the public good in the experiment. The full list of variables in (1) and their parameters can be seen in the Appendix. The descriptive statistics of social capital indicators and their correlations can be seen in Tables 3 and 4.

[24] To be consistent with other social capital indicators in the analysis, we rescaled the residual values into a range from 0 to 10.

Table 3. Descriptive statistics of social capital indicators

Variables	Description	Mean	Std. dev.	Min	Max
Formal institution					
Number of institution	Number of formal associations participated in by family members	0.91	1.09	0	6
Farmers' Association	Dummy = 1 if a member of the household is a member of the Farmers' Association	0.12	0.32	0	1
Informal institution	Number of close friends	3.91	5.05	0	40
Trust	Trust in people who live in the same village	3.18	1.21	1	5
Cooperativeness (scaled)	Scaled cooperativeness	5.50	2.28	0	10
Cooperativeness (raw)	Contribution residuals before scaled	-8.4e-07	111.56	-269.82	220.36

Table 4. Correlation coefficients of social capital indicators

	No. of institution	Famers' Association	Informal institution	Trust	Coop. (scaled)	Coop.(raw)
Number of institution	1.00					
Farmers' Association	0.36	1.00				
Informal institution	0.19	0.08	1.00			
Trust	0.07	0.07	0.07	1.00		
Cooperativeness (scaled)	-0.12	0.03	0.01	-0.12	1.00	
Cooperativeness (raw)	-0.12	0.03	0.01	-0.12	1.00	1.00

4.3 Sampling and Eeconometric Approach

Our data is a combination of experimental data and survey data. Subjects who participated in the economic experiment were also respondents in the survey. The experiment and the survey were conducted with all 200 households in the village.

As discussed in Section 2, an individual's adaptation behavior is determined by his or her knowledge of impacts of climate change and adaptation technology, perceived climate risk, costs of adaptation, and potential damage reduction. We can express the relationship in the simple model: $x^j = f(K^j, z^j, e)$, where x^j is the adaptation level of

farmer *j*, $K^j$is his or her knowledge function, z^j represents the farmer's ability to adapt, which implies a cost of adaptation, and *e* is an environmental factor. In turn, knowledge is a function of social capital and other socio-economic characteristics $K^j = g(sc^j, s^j)$,[25] and ability to adapt is also a function of social capital and household characteristics $z^j = h(sc^j, s^j)$. Combing the equations yields a reduced form $x_j^* = f(sc^j, s^j, e)$.[26] We assume that the functional form of *x* is linear in the explanatory variables and that the error term ε^j is identically and independently distributed as the normal distribution over the population, i.e.,

$$x^j = \alpha + \sum_{i=1}^{4} \beta_i sc_i^j + \sum_{i=1}^{8} \gamma_i s_i^j + \varepsilon^j \quad . \qquad (3)$$

We estimate two models: one for adaptation in farming practices where the dependent variables are "Different planting dates," "Different varieties or crops," and "Changing management practices" and one for adaptation in domestic water usage where the dependent variables are "More water storage" and "Changing water use practices." In each model, we estimate two sub-models: a model with social capital variables as shown in equation (3) and a model with awareness and belief variables replacing social capital variables. The purpose of the second sub-model is to confirm the robustness of results in the first sub-model through the direct effects of knowledge on adaptation behavior.

We estimate the models using a multivariate probit model, which allows unobserved disturbances in adaptation measures to be freely correlated by simultaneously modeling different adaptation choices as a function of a common set of explanatory variables.[27]

5.0 RESULTS

Table 5 provides estimated results of multivariate probit models for farming practices, and Table 6 is for domestic water issues. [28, 29] To quantify the marginal effects

[25] See Isham (2002) for a detailed model on how social capital enters in knowledge functions.

[26] Climate-related variables such as temperature and salinity can be inevitable arguments in the adaptation function. We, however, will not include these variables in the regressions since the sampled households in this study are in the same village and have relatively similar climate conditions.

[27] A binary choice model such as a probit or a logit model may be used. Each adaptation measure is modeled individually as discrete choice dependent variables and acts as a function of a set of explanatory variables. The approach is based on the assumption that discrete choices are competing, i.e., a farmer cannot choose two adaptation measures at the same time. Table 2, however, shows that a farmer household can choose more than one measure, so a binary choice model may not be appropriate.

[28] We also estimated univariate probit models for each of the adaptation measures. We then use the log-likelihood values of the multivariate and univariate probit models to do likelihood ratio tests and cannot reject the hypothesis of error correlations ($\chi^2(3)=42.71$, p-value<0.001, and $\chi^2(3)=12.54$, p-value<0.005, for the multivariate models for farming practices and domestic water in Tables 5 and 6).

[29] For each model, we first estimate a model with all forms of social capital and then another model without social capital in the forms of institutions and trust that could be correlated with the cooperativeness. The

of each social capital indicator and other explanatory variables on each of the unconditional probabilities of adaptation, we use the formula $\partial E(y_i|\boldsymbol{x})/\partial x_j = \varphi(\boldsymbol{x}'\widehat{\beta_i}) \times \widehat{\beta_{ij}}$ (Greene 2003, p. 668), where φ is the univariate standard normal density function and $\widehat{\beta_{ij}}$ is the coefficient estimate of variable x_j on each adaptation measure y_i. Standard errors of marginal effects are calculated using the delta method. To gain insight on cross-adaptation relationships, we also calculated marginal effects of the explanatory variables on joint and conditional probabilities of adaptation. The estimated marginal effects are not consistently different from those for the unconditional probability. For the sake of simplicity, we do not report the marginal effects of the cross-adaptation.[30]

The bottom part of Table 5 shows that all correlation coefficients between each of the three adaptation measures in farming practices are statistically significant, positive, and substantial in both model 1 and model 2, suggesting that the null hypothesis of independence across error terms of the three latent equations can be rejected. Specifically, in model 1, the error terms for "different planting dates" and "different varieties and crops" have the correlation coefficient of 0.52; for "different planting dates" and "changing management practices" it is 0.41 and for "different varieties and crops" and "changing management practices" it is 0.33. The significant correlation coefficients also mean that unobservable factors that increase the probability of adapting "different planting dates" also increase the probability of adapting "different varieties or crops" or "changing management practice."

The multivariate probit estimation results show that social capital in various forms does not explain adaptation to climate change. The formal institution index, i.e., participation in the Farmers' Association, is not associated with choosing "different planting dates" and "changing management practices." The informal institution index does not explain the choice of "different planting dates" and "different varieties and crops." Trust does not affect the choice of adaptation measures either. Social capital in the form of cooperativeness does not influence the likelihood of farmers choosing a specific adaptation measure in their farming activities. However, we still observe that the "different varieties or crops" measure is more likely among farmer households who belong to the Farmers' Association; i.e., they possess more social capital in the form of formal institution. The average marginal effect suggests that if family members join the Farmers' Association, the probability of adopting "different varieties or crops" increases by approximately 24%. Households that possess more informal social capital are more likely to adopt the "changing management practices" measure. For each additional friend that family members have, the probability of adopting "changing management practices" increases by approximately 2%.

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results are similar in two regressions so we only report results of the full model, which contains all social capital indicators. Correlation coefficients of social capital indicators can be seen in Table 4.

[30] The estimated marginal effects can be provided upon request.

Table 5. Multivariate probit estimate of adaptation in farming practices

Dependent variable	Model 1			Model 2		
	Different planting dates	Different varieties or crops	Changing management practices	Different planting dates	Different varieties or crops	Changing management practices
	Marg. Effect (std. err.)	Marg. Effect (std. err.)	Marg. Effect (std. err.)	Marg. Effect (std. err.)	Marg. Effect (std. err.)	Marg. Effect (std. err.)
Social capital						
Farmers' Association	0.164 (0.131)	0.243** (0.121)	0.018 (0.124)	-	-	-
Informal institution	-0.011 (0.008)	-0.009 (0.008)	0.020** (0.009)	-	-	-
Trust	0.027 (0.033)	-0.027 (0.033)	0.026 (0.033)	-	-	-
Cooperativeness	-0.030* (0.017)	-0.017 (0.017)	-0.025 (0.017)	-	-	-
Awareness and beliefs						
Awareness	-	-	-	-0.010 (0.036)	0.028 (0.036)	0.010 (0.035)
Belief farming	-	-	-	0.013 (0.085)	0.207** (0.086)	-0.044 (0.082)
Socio-economic characteristics						
Income ratio	0.390** (0.152)	0.198 (0.152)	0.288* (0.147)	0.287* (0.147)	0.176 (0.151)	0.261* (0.145)
Income	0.057 (0.035)	0.017 (0.033)	0.027 (0.033)	0.043 (0.033)	-0.002 (0.033)	0.029 (0.032)
Land size	-0.009 (0.015)	-0.023 (0.016)	-0.007 (0.015)	-0.001 (0.015)	-0.021 (0.016)	-0.005 (0.015)
Labor	0.070** (0.030)	0.096*** (0.029)	0.015 (0.029)	0.076*** (0.029)	0.110*** (0.030)	0.017 (0.028)
Age	0.004 (0.003)	0.005 (0.003)	0.004 (0.003)	0.004 (0.003)	0.006* (0.003)	0.003 (0.003)
Education	0.099* (0.059)	0.097* (0.057)	-0.005 (0.056)	0.094 (0.057)	0.072 (0.055)	0.033 (0.055)
Head	0.001 (0.083)	-0.102 (0.083)	-0.045 (0.083)	-0.012 (0.084)	-0.135 (0.086)	-0.052 (0.083)
ρ_{12} = 0.524***				ρ_{12} = 0.545***		
ρ_{13} = 0.407***				ρ_{13} = 0.392***		
ρ_{23} = 0.332***				ρ_{23} = 0.317***		
Likelihood ratio test of dependence: 33.026				34.211		
p-value: 0.000				0.000		
Number of obs. = 182; Number of draw = 200						

The choice of adaptation measures in farming activities is statistically significantly associated with several socio-economic characteristics of farmers' households. Adoption of "different planting dates" and "changing management practices" such as change in use of fertilizer or pesticide is more likely among farmers who depend

on income from farming activities to a large degree. The number of available laborers in the household positively and significantly affects the likelihood of choosing "different planting dates" and "different varieties or crops." For each additional laborer in a household, the probability of adopting "different planting dates" and "different varieties and crops" increases by approximately 7% and 10%, respectively. Education level of the household head has a positive and significant impact at the 90 percent confidence level on the likelihood of choosing "different planting dates" and of choosing "different varieties and crops."

The pattern of the results of model 2, where the social capital variables are replaced with awareness and belief variables, is similar to the results of model 1. In general, knowledge variables do not influence the choice of adaptation measures. Only the belief variable is significantly associated with the "different varieties or crops" measure. More specifically, if farmers believe that climate change will cause a decrease in rice productivity within the following 20 years, their households are more likely to adapt the "different varieties or crops" measure. The magnitude of the effect is close to the effects of membership in the Farmers' Association on the choice of "different varieties or crops" in model 1.

Table 6 reports multivariate probit estimation results for adaptation related to domestic water shortage. The estimated correlation coefficients, i.e., unobserved factors influencing the decision to adopt "more water storage" and "changing water use practices," are significantly correlated at the 5% level in both model 1 and model 2. The correlation between these unobserved factors is positive and statistically significant, implying that the unobserved factors that increase the probability of adopting "changing water use practices" will also increase the probability of adapting "more water storage" or vice versa. The correlation also suggests that multivariate probit is a better model for the domestic water issue data. Most of the social capital measures cannot explain the choice of adaptation measures related to domestic water shortage problems. However, cooperativeness is negatively associated with "more water storage" at the 5% level. Choosing this adaptation measure is less likely among farmer households with a higher propensity to cooperate. The estimated marginal effects suggest that on a 10-unit scale, for every 1 unit increase in cooperativeness the probability of adopting the "more water storage" measure decreases by approximately 3.5%. Most of the socio-economic variables have insignificant impacts on the likelihood of adopting a measure, yet number of children is negatively associated with "changing water use practices." In model 2, neither knowledge variable is associated with choice of adaptation measures, confirming the results for model 1 – The forms of social capitals that are expected to facilitate knowledge accumulation do not influence private adaptation.

Table 6. Multivariate probit estimate of adaptation in domestic water usages

Dependent variable	Model 1		Model 2	
	More water storage	Changing water use practices	More water storage	Changing water use practices
	Marg. Effect (std. err.)	Marg. Effect (std. err.)	Marg. Effect (std. err.)	Marg. Effect (std. err.)
Social capital				
Number of institutions	0.025 (0.035)	-0.011 (0.039)	-	-
Informal institution	0.003 (0.007)	0.008 (0.008)	-	-
Trust	0.001 (0.025)	0.019 (0.031)	-	-
Cooperativeness	-0.035** (0.014)	-0.016 (0.017)	-	-
Awareness and beliefs				
Awareness	-	-	0.015 (0.029)	0.046 (0.034)
Belief water	-	-	-0.006 (0.068)	-0.054 (0.081)
Socio-economic characteristics				
Income ratio	-0.028 (0.112)	-0.214 (0.136)	-0.060 (0.112)	-0.203 (0.137)
Income	0.033 (0.031)	-0.010 (0.034)	0.033 (0.031)	-0.016 (0.033)
Land size	0.001 (0.012)	-0.001 (0.014)	0.004 (0.012)	-0.001 (0.014)
Labor	0.029 (0.024)	0.017 (0.027)	0.033 (0.024)	0.018 (0.027)
Age	0.001 (0.003)	-0.000 (0.003)	0.001 (0.003)	-0.001 (0.003)
Education	0.059 (0.050)	0.015 (0.055)	0.060 (0.049)	0.029 (0.054)
Head	-0.017 (0.067)	-0.025 (0.080)	-0.019 (0.067)	-0.034 (0.080)
Children	-0.043 (0.045)	-0.154*** (0.055)	-0.035 (0.045)	-0.153*** (0.054)
		ρ_{12}= 0.303**	ρ_{12} = 0.304**	
Likelihood ratio test of dependence:		5.932	6.261	
p-value:		0.015	0.012	
Number of obs. = 200				
Number of draw = 200				

6.0 DISCUSSION AND CONCLUSION

Our study suggests that social capital at the individual level generally does not affect farmers' private adaptation to climate change. We, however, do observe that some forms of social capital are associated with some particular adaptation measures in farming activities and in domestic water issues. The magnitudes of these significant social capital coefficients are small, except the effect of Farmers' Association membership on "Different varieties or crops."

Our findings raise a question: Why do a number of social capital measures not explain the choices farmers make with respect to private adaptation measures? As discussed in Section 2, the main roles of social capital in private adaptation are to facilitate information transfer and labor/financial transfer. We argue whether these roles depend on the nature of adaptation measures. If the adaptation requires only low-end technology or less effort, social capital may not be an important factor. Our research results support this argument. Saline intrusion that affects household's domestic water usage is relatively easy to detect. Implementation of adaptation measures such as "more water storage" and "change water use practices" is not a matter of high-end technology such that a household relies on a formal organization for instructions or needs a friend network to confirm the reliability of the measure. In addition, these adaptation measures require only limited labor and money. In farming practices, since the "changing varieties or crops" measure may require some special expertise, formal institutions appear to play a role. "Changing management practices," which involves changes in the use of capital and labor, may require the ability to network to share capital and labor – in our case proxied by the number of close friends. Otherwise, social capital in the form of formal and informal institutions does not play an important role in private adaptation.

We also show that trust, defined in this study as the extent to which one trusts people in general, is not associated with farmers' choice of any private adaptation measures in farming practices or in domestic water issues. We propose some reasons for the rejection of the null hypothesis that trust can facilitate both the recognition of changes in the climate and an understanding about climate risk. The choice of adaptation measures is a process that depends on the recognition of the need to adapt, the incentive to adapt, and the ability to adapt (Frankhauser *et al.*, 1999). The recognition element of the adaptation decision, where trust is hypothesized to play a role, is empirically proven to be affected by social capital in the form of social networks. Since networks and trust seem to be associated, possible effects of trust on the adaptation decision become blurred. In addition, whether trust is associated with adaptation also depends on the nature of the adaptation measures. Besides the role of trust or cooperation in the recognition element, the propensity to trust and cooperate is often needed for joint adaptations. In the present study, adaptation investments in farming practices are undertaken to secure private income. It is privately rational to respond to climate change also in the absence of social skills such as trust and cooperation. As the present study does not measure trustworthiness, the relationship between trustworthiness and the choice of private adaptation is open for future research.

Empirical research related to collective action and climate change adaptation has suggested that cooperation is necessary for joint adaptation measures to occur (Adger, 2003). So far, however, there has been little discussion about the role of cooperativeness in individual adaptation choices. We show evidence that a farmer's higher propensity to engage in cooperation, which is measured by a public good experiment, in some specific contexts can deteriorate the likelihood of choosing an individual adaptation measure; in our case it slightly reduces the probability of adopting the "more water storage" measure in response to domestic water shortage due to a salinity problem. In our specific case, we observe that joint adaptation solutions to the problems of domestic water shortage can potentially be achieved by using collective action to build a common water storage tank or to dig to find water for a public well.[31] We argue that a person with a higher cooperativeness index may have a stronger belief in joint adaptation solutions and therefore reduce investments in private measures. Our measure of cooperativeness is context free since we took out the experimental context effects such as the effects of treatments and demand for the public good when constructing the cooperativeness index. The result is in the line with a set of empirical evidence about adverse effects of social capital on economic behavior (Anderson and Francois, 2008; Baland *et al.*, 2009; Di Falco and Bulte, 2009a, b). While these studies elaborated the concept of "extended family," which is one of the key components of social capital in developing countries, our results provide evidence regarding another key form of social capital – individuals' propensity to engage in cooperation. However, these negative sides of social capital do not imply that it is useless in adaptation management processes. It clarifies to policy makers which types of incentives to use in attempting to cope with future changes in climate. For example, in villages where villagers are prone to engage in collective action, i.e., they have a high propensity to engage in cooperation, incentives should target joint adaptation measures rather than private solutions.

Although private adaptation is a key measure in dealing with climate change, this paper's findings do not support the arguments for developing rural institutions in order to enhance private adaptation to climate change in rural Vietnam, especially with low-end adaptation technologies.

[31] The village's ground water geology makes private wells almost impossible to build due to high costs.

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APPENDIX

Table A1. OLS estimate of equation (1)

Variable	Coeff.	P-value
High social information (treatment dummy)	-15.45	0.58
Low social information (treatment dummy)	-66.37	0.02
Default at full contribution (treatment dummy)	-19.35	0.48
Default at zero contribution (treatment dummy)	-53.59	0.06
Household size (number of people living in the household)	5.21	0.38
Age (age of household's head)	0.12	0.87
Education (years in school of household's head)	15.89	0.25
Income (household monthly income in million dong)	8.10	0.30
Land size (size of farming land in "cong", 1 cong = 1/10 hectare)	0.93	0.76
Communist party member (=1 if being a member, 0 otherwise)	32.59	0.31
Association (=1 if a member in an association, 0 otherwise)	12.78	0.52
Gender of household head (=1 if male)	-7.58	0.68
Use the bridge (=1 if everyday)	118.65	0.00
Use the bridge (=1 if maximum 3 times a week)	81.37	0.02
Use the bridge (=1 if 2 times a month)	65.12	0.02
Use the bridge (=1 if 1 time a month or less)	32.35	0.19
Day of experiment (treatment dummy)	-15.88	0.41
Constant	107.44	0.14
Experimenter dummy variables	Included	Included
No. of obs.	200	
Adj. R2	9.35%	