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ABSTRACT

This paper analyzes free-riding and coordination problems in microinsurance. We model demand for health insurance in microcredit groups that typically share risk through joint liability as a social dilemma. Less risk averse clients are tempted to free-ride and forgo individual insurance while the more risk averse face a coordination problem. Group insurance binds both types to the social optimum. Microinsurance games played with microcredit clients in Tanzania confirm the free-riding hypothesis and demonstrate limited coordination failures under individual insurance. Group insurance increases demand in the games. These findings provide a potential solution for low uptake of microinsurance.

1. INTRODUCTION

Limited access to formal insurance induces the poor to adopt informal ways to manage risk. A commonly adopted coping strategy is to share risk with other households (Townsend, 1994; Fafchamps and Lund, 2003). Informal risk- sharing networks however provide only partial protection from shocks (Udry, 1994; De Weerdt and Dercon, 2006). Although microinsurance schemes have the potential to enhance welfare, enrollment typically remains at low levels (De Alle- gri et al., 2009; Thornton et al., 2010; Cole et al., 2010). We argue that demand for microinsurance may be suboptimal precisely because it is offered to individu- als who also participate in informal risk-sharing networks, resulting in free-riding and coordination problems.

This paper uses a framed laboratory experiment in the field to study whether the health insurance decision in microcredit groups entails a social dilemma. Illnesses and injuries are among the most important nprotected risks in developing countries (Gertler and Gruber, 2002) and health shocks are a major reason for default in microcredit groups. Such groups pool risk of individual members since microcredit is typically offered through group-based lending. Jointly liable clients can continue borrowing only if the full group loan is repaid[2]. Thus, group members have dynamic incentives to contribute for peers who cannot repay (Besley and Coate, 1995). Risk-pooling within the group offers only partial protection though, given that a default will occur if too many group members cannot repay. Health insurance in this context may therefore be welfare-improving.

Informal risk-pooling can however crowd out formal insurance (Arnott and Stiglitz, 1991). We theoretically show that the decision to take individual health insurance in jointly liable credit groups is subject to free-riding and coordination failure. First, since ill clients can rely on their fellow group members' contributions, an individual may be tempted to forgo individual insurance while she would have bought insurance in the absence of informal support. Second, even if nobody is free-riding, demand can be suboptimal due to a coordination failure. A client who fears that her peers remain uninsured may decide not to enroll because an insured client bears the double burden of the premium as well as contributions for ill peers.

The binding nature of group insurance provides a solution to these social dilemmas. Health insurance offered at the group level requires a unanimous decision to enroll and either none or all group members enroll. Thus, a group member unwilling to join also bars her fellow group members from insurance, which in-creases the own risk of contributing for peers and the group default risk. Clients can only avoid loan termination with certainty by enrolling themselves.

We distinguish between two types of group members: clients with low versus high levels of risk aversion. Because profitable lending is terminated if the group defaults, both types are better off when all group members enroll than when nobody enrolls. As a result, we predict that both types will take insurance when

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2 Although Grameen Bank has moved to individual liability and more institutes are expected to follow, group-based lending is still the predominant way to bank the poor.

offered at the group level. In contrast, when offered at the individual level, the type with low risk aversion is tempted to free-ride and high risk averse types - although not free-riding - may fail to coordinate on the social optimum. Only by conditioning enrollment on peers' prior insurance decisions, clients can commit free-riding peers to enroll.

We test this framework by means of a framed field experiment (Harrison and List, 2004), played with 355 members from a microfinance institution (MFI) in Dar es Salaam, Tanzania. Our experiment is a public good game framed to resemble the decision-making context of jointly liable microcredit clients who face health risk. Depending on the treatment, participants are offered welfare-improving insurance either at the individual or group level.

Framed field experiments offer several advantages over alternative empirical approaches. First, the experimental design provides a controlled setting where distortions of initial wealth, health and informal networks do not play an en-dogenous role. Equilibrium strategies can thus be identified for different types of players. Second, the experiment offers insights into the dynamics of repeated insurance decisions within a short time span. It is hence possible to test whether conditional cooperation evolves over time. Third, participants face real monetary incentives based on their decisions during the games, which elicits behavior that differs from hypothetical survey questions (Holt and Laury, 2002).

The experimental findings provide evidence of substantial free-riding and some coordination failure. A large number of clients with low risk aversion forgoes individual insurance. Group insurance solves this free-riding problem as even players with low risk aversion opt in majority for insurance in that treatment. Group insurance also facilitates coordination and raises demand among high risk averse clients, but only when communication is allowed.

This study contributes to the existing literature in three distinctive ways. First, we provide and test a mechanism to explain why members of risk-sharing networks are likely to forgo microinsurance even when such insurance is welfare-improving. Prior literature has focused mainly on the reverse effect that formal insurance might crowd out informal transfers (Attanasio and Rios-Rull, 2000).

Second, we highlight a crucial difference between individual and group insurance schemes that is currently ignored in the literature. The binding nature of group insurance does not only limit adverse selection (Browne, 1992), improve understanding and reduce the administrative burden of such schemes, but also solves commitment and coordination problems. This finding is relevant for microinsurance programs that are struggling to increase their low enrollment rates.

Third, we develop a microinsurance game that extends the experimental literature on strategic behavior in jointly liable microcredit groups (Abbink et al., 2006; Cassar, Crowley and Wydick, 2007; Gine et al., 2010). The microinsurance games mimic real-life decisions for a population that differs from the usual participant, a university student, in many respects (Cardenas and Carpenter, 2008). As such, this study sheds light on the replicability of findings from public good games in conventional lab experiments to the field.

The experiment was framed within the context of catastrophic health shocks. However, the experiment is equally applicable to other commonly occurring idiosyncratic shocks such as business failure or livestock disease. Moreover, our findings are relevant not only for the provision of insurance in a microfinance setting. The potential of group insurance to solve free-riding and coordination failure may generalize to other informal risk-sharing networks such as villages, cooperatives or informal saving groups.

The remainder of the paper is structured as follows. The next section models the insurance decision in a jointly liable microcredit group. Section 3 describes the framed field experiment that was developed to test this theoretical framework, including the experimental design, empirical strategy and procedures. Section 4 describes the study population and participants, and tests whether their characteristics are well balanced over the different treatments. Results on demand for insurance are discussed in Section 5. Section 6 addresses policy implications as well as the external validity of the findings. The final section concludes.

2. THEORY

2.1 THE MODEL

We model the insurance decision as a repeated public good game for jointly liable microcredit group members who face health risk. A group of n microcredit clients jointly borrows nl in every loan cycle $t \in \{1, \ldots, \infty\}$. Ill group members incur health expenditures and cannot repay their share of the group loan. Their fellow group members (henceforth peers) contribute to loan repayment but if too many members fall ill, the group defaults and lending is terminated. If instead the full group loan is repaid, the group will continue to the next loan cycle. Group members can decide to take health insurance as a protection against health expenditures, reducing the group default risk.

Figure 1 presents the game graphically. The left-hand block in the figure indicates profits before contributing for ill peers. Clients invest their loan l and earn e net of loan repayment. Prior to repayment, each group member risks an IID health shock that occurs with probability p for every group member[3]. Ill group members incur catastrophic health expenditures $h \in (e, e+l]$ and repay $e+l-h<l$. These delinquents earn 0 in the present loan cycle.

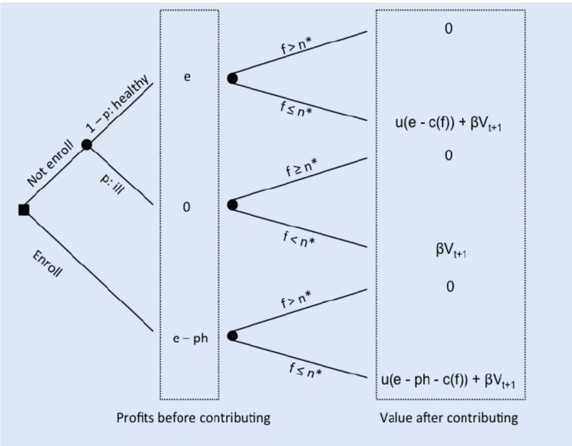

FIGURE 1. GAME TREE.
CLIENTS RECEIVE A LOAN l AND EARN $e+l$ BEFORE LOAN REPAYMENT. THE SYMBOL p REPRESENTS THE HEALTH SHOCK PROBABILITY, e EARNINGS, $h \in (e, e+l]$ HEALTH EXPENDITURES, $n^* \in \{1, ..., n-1\}$ THE MAXIMUM NUMBER OF MEMBERS FOR WHICH A GROUP CAN CONTRIBUTE, $c(f) = f(h-e)/(n-f)$ THE CONTRIBUTION FOR f DELINQUENT PEERS, $\beta < 1$ THE DISCOUNT RATE AND V_{t+1} THE VALUE OF CONTINUING TO THE NEXT LOAN CYCLE.

The right-hand block indicates a client's value after contributing for delinquent peers. Risk-pooling is imperfect. If too many group members cannot repay their share, the group is unable to repay the full loan. Define $n^* \in \{1, ..., n-1\}$ as the maximum number of members for which a group can contribute without default and f as the number of delinquent peers. If more than n^* peers fail to repay, $f > n^*$, group members contribute as much as possible to loan repayment but this is insuficient to avoid a group default. Lending is terminated and nothing is earned from present nor future loan cycles.

If n^* or less peers fail to repay, $f \le n^*$, the group jointly contributes $h-e$ for each delinquent. Thus, every repaying client contributes:

$$c(f) = \frac{f}{n-f}(h-e) \text{ if } f \le n^* \tag{1}$$

Lending continues and the discounted value of continuation to the next loan cycle is βV_{t+1}, where $\beta < 1$ is the discount rate.

Three key assumptions are made. First, individuals always repay and contribute for others when possible. For tractability, the model does not include a discretionary contribution decision. This assumption reects the dynamic incentives related to continued access to credit, as well as the repayment pressure due to the financial and social sanctions observed within most MFIs (Armendariz and Morduch, 2010).

Second, the analysis focuses on the interplay between formal insurance and informal risk-sharing. Earnings from previous loan cycles cannot be used to repay. This assumes that clients do not self-insure by accumulating a buffer stock, but that earnings are either immediately consumed or invested in illiquid assets, such as housing, business investments or children's education.

Third, paying the insurance premium does not create budget constraints with respect to group loan repayment:

$$(n-n^*)(e-ph) \ge n^*(h-e) \tag{2}$$

Despite the insurance premium payment *ph*, $n-n^*$ group members are able to cover the loan repayment for n^* delinquent peers. This assumption ensures that taking insurance does not increase the risk of group default.

Clients' preferences form the final building block of the model. Clients maximize expected utility over the present and all future loan cycles, taking into account beliefs about the current number of insured peers and insurance decisions in the past. Utility is strictly increasing, concave, time-separable and utility from zero earnings is normalized to zero.

There are two types of clients in the group: clients with high risk aversion (`high RA') versus clients with low risk aversion (`low RA'). High risk aversion is defined such that high RA clients prefer to enroll when facing an insurance decision without joint liability or dynamic incentives. In other words, they prefer to earn $e-ph$ with certainty over the gamble of earning *e* only when healthy:

$$U^h(e-ph) \ge (1-p)U^h(e) \tag{3}$$

3 The model focuses on the health risks that are typically covered by microinsurance, for instance hospitalization and acute illnesses. It does not allow for adverse selection (heterogeneity in p), epidemics (cross-sectional correlation) or chronic illness (serial correlation). The homogeneity in health risk can be interpreted as assortative matching on health status that drives group formation.

An individual has low risk aversion if and only if (3) is not satisfied:

$$U^l(e-ph) < (1-p)U^l(e) \tag{4}$$

Notice that not every strictly concave utility function satisfies (3) because health expenditures exceed earnings net of loan repayment: $h > e$. Uninsured ill clients do not fully repay their share of the loan. As a result, the one-time earnings with insurance, $e-ph$, are strictly below the expected one-time earnings without insurance, $e(1-p)$. Actuarially fair insurance (from the perspective of the insurer) is actuarially unfair for clients who do not fully repay in case of individual delinquency.

2.2 THE VALUE OF INSURANCE

The theoretical model focuses on symmetric equilibria with time-invariant strategies. We assume that full group enrollment in all periods (`Always Full Enrollment', AFE) is welfare-improving on zero enrollment in all periods (`Always Zero Enrollment', AZE) for both types. By definition, this is satisfied for clients with high risk aversion.

PROPOSITION II.1: *Always full enrollment (AFE) is welfare-improving over always zero enrollment (AZE) for clients with high risk aversion.*

See Appendix 1 for all proofs. For high RA individuals, insurance has three benefits. First, it increases the probability of continuation. Second, insurance decreases their risk of incurring health expenditures. Third, within a round, full enrollment creates higher utility than zero enrollment because no contributions are required for ill peers.

To determine whether full enrollment is welfare-enhancing for low RA clients, note that in a fully insured group every individual earns $e-ph$ forever. Therefore, the net present value for low RA types from AFE is:

$$V^l_{AFE} = \frac{U^l(e-ph)}{1-\beta} \tag{5}$$

A similar derivation yields the value of AZE, using p_f for the probability that *f* peers are ill and P'_{n^*} as the cumulative probability that at most n^* group members, including oneself, are ill:

$$V^l_{AZE} = \frac{(1-p)\sum_{f=0}^{n^*} p_f U^l(e-c(f))}{1-\beta P'_{n^*}} \tag{6}$$

Figure 2 indicates at what discount rates β and health shock probabilities p the net present value of AFE in (5) is higher than the net present value of AZE in (6), fixing other parameters[4]. In Regime 1, full enrollment is welfare-improving on zero enrollment only for members with high risk aversion. At such low β clients with low risk aversion do not suficiently value the increased probability of continuation to the next loan cycle. Also, as the probability of a health shock and hence the insurance premium increases, insurance becomes increasingly unattractive since the premium is not actuarially fair from the client's perspective.

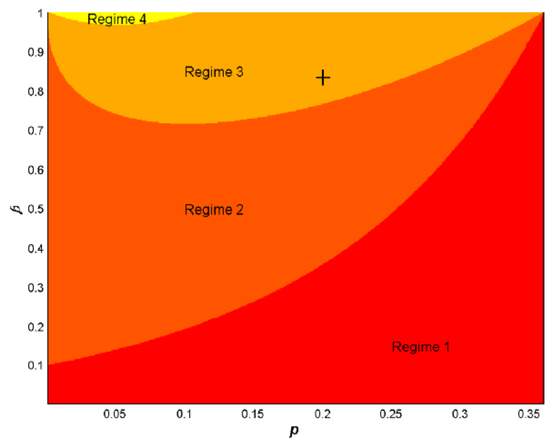

FIGURE 2. SOLUTION REGIMES IF $e = 9/16l$, $h = e + l$, $n = 5$ AND $n^* = 1$.
REGIME 1: INSURANCE IS WELFARE-IMPROVING FOR HIGH RA TYPES ONLY. REGIMES 2-4: INSURANCE IS WELFARE-IMPROVING FOR BOTH HIGH AND LOW RA TYPES. REGIME 2 (3 AND 4): DYNAMIC INCENTIVES ARE TOO WEAK (SUFFICIENTLY STRONG) FOR TRIGGER STRATEGY TO BE EFFECTIVE. REGIME 4: ZERO ENROLLMENT NOT AN EQUILIBRIUM IF A GROUP MEMBER'S RISK AVERSION IS GOING TO INFINITY. A GRIM TRIGGER STRATEGY IS THEREFORE NOT A CREDIBLE THREAT.

In the remaining regimes, full enrollment is welfare-improving on zero enrollment for clients with high as well as low risk aversion. Henceforth, we only consider parameter combinations outside Regime 1 where:

$$V^l_{AFE} > V^l_{AZE} \tag{7}$$

Furthermore, we focus on the parameter space where never enrolling (AZE) is an equilibrium. It is costly to enroll if nobody else does because an insured client in an otherwise uninsured group pays the insurance premium and is more likely to contribute for delinquent peers. If peers never enroll and P^*_n is the probability that at most n^* peers - excluding oneself - fail to repay, the value of taking insurance one time for type *i* is:

4 The figure focuses on the parameter values as adopted in the game. We experimented with other values for n, n^* and e with qualitatively similar predictions.

$$\sum_{f=0}^{n^*} p_f U^i(e - ph - c(f)) + \beta P_{n^*} V^i_{AZE} \quad (8)$$

We assume that this is strictly below the value of never enrolling, V^i_{AZE}, even for high RA clients who value insurance most:

$$\sum_{f=0}^{n^*} p_f U^h(e - ph - c(f)) < V^h_{AZE}(1 - \beta P_{n^*}) \quad (9)$$

This is a very weak assumption. In Figure 2, it holds for a wide range of parameters even for the most risk averse client, i.e. the limiting case with risk aversion going to infinity. Only in Regime 4, this most risk averse client would enroll if all peers remain uninsured.

2.3 FREE-RIDING AND COORDINATION PROBLEMS

This section investigates for Regimes 2 and 3 whether the insurance decision entails a free-riding or coordination problem. We define these concepts as follows. Free-riding occurs if an individual has a private incentive to defect on full enrollment. A coordination problem arises if it is optimal to take insurance if and only if a suficient number of peers enrolls.

Under group insurance, these social dilemmas are absent as is shown next. Group insurance requires a unanimous decision to enroll; without unanimity, nobody enrolls and nobody pays the insurance premium.

PROPOSITION II.2: *Under group insurance, individuals do not have an incentive to defect on enrollment, and willingness to enroll is independent of the number of peers believed to enroll.*

Given Proposition II.1 and Restriction (7), both types are best off if all group members enroll. No individual has an incentive to defect on full enrollment. Defection of a single individual bars all peers from insurance, increasing the risk of contributing for peers and group default. Also the coordination problem is absent because clients only pay for insurance if all peers choose to enroll. Taking insurance is therefore a weakly dominant strategy for both types[5].

In contrast, under individual insurance, free-riding and coordination problems do exist. For ease of exposition, only equilibria with full or zero enrollment are considered[6]. We distinguish between Regimes 2 and 3 in Figure 2, which mainly differ in the discount rate.

The next proposition is related to free-riding.

PROPOSITION II.3: *Under individual insurance, a client in Regime 2 has an incentive to defect on full enrollment if and only if she has low risk aversion. A client in Regime 3 has an incentive to defect on full enrollment if and only if i) she has low risk aversion and ii) group members do not condition current enrollment on peers' prior insurance decisions.*

If all peers enroll, they ensure continuation to the next loan cycle, irrespective of one's own insurance decision. An individual faces a trade-off between the risk-free insurance option or a gamble with higher but uncertain earnings. By (3), clients with high risk aversion prefer to enroll and do not have an incentive to defect. By (4), on the other hand, clients with low risk aversion are tempted to free-ride on contributions from their insured peers.

Path-dependent equilibrium strategies may solve this social dilemma. Clients are able to sanction free-riders by staying uninsured in the future themselves. Groups with free-riders will move to the AZE equilibrium. This is a credible threat given that never enrolling (AZE) is an equilibrium by Assumption (9). For this threat to be effective, dynamic incentives need to be suficiently strong. A client with low risk aversion will cooperate only if the current utility gain from defection is smaller than her future losses due to peers remaining uninsured:

$$(1 - p)U^l(e) - U^l(e - ph) \leq \beta \left(V^l_{AFE} - V^l_{AZE} \right) \quad (10)$$

In Regime 2 with relatively low discount rates, (10) is not satisfied so that the trigger strategy is not effective, and individuals with low risk aversion will defect on full enrollment. Regime 3 with higher discount rates satisfies (10) for any concave utility function.

PROPOSITION II.4: *Under individual insurance, a client faces a coordination problem if i) she has high risk aversion and ii) all peers have high risk aversion.*

By Proposition II.3, an individual with low risk aversion will defect unless her peers use a trigger strategy to commit her to the social optimum. Thus, groups with low RA members face no coordination but a free-riding problem.

5 Full enrollment is not a unique equilibrium solution but even if a group member believes that her peers are unwilling to take insurance, she will be indifferent with respect to enrollment.

6 We also calculated partial enrollment equilibria for the parameters in the game. Predictions are available upon request.

A high RA client who believes that all her peers will enroll coordinates on the full enrollment equilibrium. In a group with only high RA types, all group members have an incentive to enroll as long as they believe others will do so as well. However, a coordination failure may arise in these groups because individuals may fear that peers will not enroll. Since it is costly to enroll in otherwise uninsured groups by Assumption (9), high RA clients who do not trust their peers may forgo insurance themselves.

To summarize, the propositions describe conditions under which risk-pooling in microcredit groups may hinder the uptake of formal health insurance. Under individual insurance, we identify two social dilemmas. Groups with only high RA clients face a coordination problem. Groups with low RA clients face a free-riding problem, unless clients effectively condition own insurance decisions on peer's prior enrollment. Group insurance solves these social dilemmas and may thereby increase demand.

3. METHOD

3.1 DESIGN

To test the theoretical predictions, we played microinsurance games with 355 microcredit clients from a microfinance institution (MFI) in Dar es Salaam, Tanzania, during March and April 2011. The MFI at that time was contemplating whether to offer health insurance to its clients and if so, whether the scheme should be offered at the group or the individual level.

The experimental identification consists of two steps. First, participants played a basic microinsurance game with both credit and insurance offered at the individual level. Since participants are not jointly liable in this game, their decision yields an elementary measure of risk aversion. Subsequently, participants played a public good game that was framed as a health insurance decision in a jointly liable microcredit group, with insurance offered either at the individual or the group level. This microinsurance game closely resembles the theoretical framework described in Section 2, modeling the real-life context of the MFI.

MEASURE FOR RISK AVERSION: The left-hand side of Figure 1, earnings before contributing, represents the first introductory lottery *without* joint liability or dynamic incentives. A participant borrows l = 40; 000 Tanzanian Shillings (TZS) and falls ill with probability p = 1/5. Healthy participants, able to repay their loan, earn e = 22; 500 after loan repayment. Ill participants incur health expenditures that fully absorb their earnings before loan repayment; h = 62; 500. As a result, they earn nothing and cannot repay their loan.

Before the realization of the health shock, participants are offered insurance at a premium equal to ph = 12; 500. An insured player earns $e-ph$ = 10; 000 with certainty after loan repayment. The participant hence faces a trade-off between lower risk-free earnings versus higher but risky earnings[7].

By Definitions (3) and (4), a client will enroll in insurance if and only if she has high risk aversion[8]. Because there is no joint liability in this firrst introductory game, our measure for risk aversion reflects risk attitudes rather than social preferences or altruism.

FREE RIDING AND COOPERATION UNDER GROUP VERSUS INDIVIDUAL INSURANCE.: To identify free-riding and cooperation problems, participants played a microinsurance game with joint liability. The two main differences with the introductory game are that participants are now assigned to microcredit groups with n = 5 members who contribute for delinquent peers, and that defaulting groups do not continue to the next loan cycle. All other parameters are the same as in the introductory game.

If one group member cannot repay, her four peers (both insured and uninsured) each contribute 10; 000 for the delinquent. The group loan is entirely repaid and the group continues to the next loan cycle. If more than n^* = 1 group member cannot repay, the remaining group members have insuficient earnings to contribute and the group defaults. In that case, the group repays as much as it can afford. Profits are zero for all members and the game ends.

Participants were told that they would play the game for a large, unknown number of rounds. The game continued for at least four rounds as long as the group repaid. After the fourth round, the group appointed one of its group members to toss a die. If the die landed at 1, the game would end for the group[9]. Or, as stated by one of the participants:

"I congratulate our sister for throwing another number than one, which enables us to play this round. That

7 To increase clients' understanding of dynamic incentives in the game, this game was played for two rounds and the client moved to the second round only if she repaid the first loan. Dynamic incentives are absent in the second and last round. Decisions in this round are used for the risk aversion measure, assuming that uninsured individuals who defaulted in the first round would have forgone insurance in the second round as well. Results are robust to using first-round decisions as a proxy for risk aversion.

8 For the CRRA utility function $u(x) = x^{1-\gamma}/(1-\gamma)$ if $\gamma \neq 1$, and $u(x) = \ln(x)$ if $\gamma = 1$, a client has low risk aversion if and only if her CRRA parameter $\gamma < .725$.

9 Because of time constraints, at most 6 rounds were played in practice. Clients were not informed that the sixth round was the last round to avoid a last round effect.

means the game goes on and our earnings increase as well." (based on transcripts from participants' communication during the games).

As earnings were accumulated within a relatively short time span, we assume that there is no discounting in the game. Rather, the probability of continuation determines the value of future rounds. For rounds 4 and higher, we therefore substitute the discount rate in the theoretical framework, β, by the probability of continuation in the game:

$$\beta_t = 1 \text{ if } t < 4 \text{ and } \beta_t = \frac{5}{6} \text{ if } t \geq 4 \quad (11)$$

The experiment varied in two dimensions as summarized below: the type of insurance and the possibility to communicate. Under individual insurance (II), enrollment was an individual decision. Alternatively, in the treatments with group insurance (GI), group members would enroll if and only if all group members expressed their willingness to join. This was determined by casting anonymous votes. In treatments without communication (NC), group members could not talk to each other. In the communication treatments (C), group members had the option to discuss health insurance for two minutes preceding every round. Communication was recorded, transcribed and translated to English.

The communication treatments served to verify whether low demand can indeed be attributed to a coordination failure. When group members are able to talk to each other, it is easier for them to coordinate and jointly decide all to enroll even under individual insurance. Communication in the games does not necessarily reduce free-riding because it is cheap talk. Nevertheless, empirical evidence suggests that communication can reinforce social norms even in the absence of sanctioning mechanisms (Sally, 1995)[10].

	Individual Insurance		Group Insurance
No Communication	II-NC	⇔	GI-NC
	n=75 (3 sessions)		n=90 (4 sessions)
	↕		↕
Communication	II-C	⇔	GI-C
	n=75 (3 sessions)		n=115 (4 sessions)

Fourteen sessions were played. Treatments varied by session. Each session included 3 to 6 groups of five individuals. The individual insurance treatments with and without communication were both played in three sessions with on average 5 groups per session, resulting in a sample size of 75 participants each. Four sessions were organized for each of the group insurance treatments, resulting in a sample size of 90 and 115 participants for the group treatments without and with communication respectively. Every participant was assigned to only one treatment to limit a bias due to learning or order effects.

3.2. EMPIRICAL STRATEGY

This section describes the empirical strategy used to identify free-riding and coordination problems under individual versus group insurance. The main outcome variable in our analysis is the willingness to join insurance, henceforth referred to as demand. In treatments with individual insurance, demand is measured as individual enrollment in health insurance. In the treatments with group insurance, demand is based on the individual votes that are preference-revealing if participants play their weakly dominant strategy.

Because the outcome measure is a binary variable, a probit model is estimated for the following equation:

$$P(d_{igt} = 1) = \Phi\left(\alpha + \beta_{gi} GI_g + \beta_c C_g + \beta_{gic} GI_g C_g + \beta_{\mathbf{x}} \mathbf{x}_{igt}\right) \quad (12)$$

where $\Phi(\cdot)$ is the cumulative distribution for the standard normal, d_{igt} a dummy variable that indicates demand for participant *i* in group *g* and round *t* with d_{igt} = 1 if a participant is willing to join, GI_g is a dummy variable equal to 1 if group *g* is in a group insurance treatment, C_g is a dummy variable equal to 1 if communication is permitted, GIC_g is the interaction between these two variables, and x_{igt} is a vector of dummy variables for round and lagged illness.

Standard errors are clustered at the group level.

The cross in Regime 3 of Figure 2 indicates the theoretical regime associated with the parameters specific to the games. By Proposition II.2, there are no free-riding and coordination problems under group insurance. By Proposition II.3, low RA clients will free-ride under individual insurance unless their peers adopt a trigger strategy. Thus, a positive effect of group insurance in the main demand Equation (12) among the subset of low RA participants supports the

10 Communication also potentially enhances understanding, but this holds for both group and individual insurance. We hence focus on the extent to which communication overcomes the coordination failure.

free-riding hypothesis (Hypothesis 1) and indicates that the trigger strategy is not effectively adopted.

Given the parameters in the game, if one peer is believed to free-ride, the least risk-averse client of the high RA type prefers to go without insurance. If more peers are believed to free-ride, increasingly risk-averse clients will decide not to enroll either[11]. Thus, we predict that high RA clients with free-riding low RA peers will have lower demand for individual than for group insurance (Hypothesis 2).

By Proposition II.4, groups with only high RA clients face a coordination problem in the individual insurance treatment but not under group insurance, especially when communication is not permitted. To test for coordination failure, Equation (12) is estimated for the subset of participants that have high risk aversion and no low RA peers, and we will test for coordination failure comparing demand under group and individual insurance (Hypothesis 3).

Communication under individual insurance may help high RA groups coordinate on the social optimum. In that case, demand under individual insurance will be higher when communication is permitted (Hypothesis 4). This allows for a comparison of group insurance and communication as a coordination device.

We are mainly interested in the effect of group insurance. Because Equation (12) is nonlinear, the estimated coeficients β_{gi} and β_{gic} do not give the marginal effects. We calculate the average marginal effect of group insurance for the total sample as well as the marginal effect for participants unable to communicate (C_g = 0) and participants in the communication treatments (C_g = 1) separately.

Further, Equation (12) is also estimated by means of a Heckman selection model to control for selective attrition. The effect of group insurance on demand could be biased because clients unwilling to join have a higher group default risk. Formally, if y_{igt} indicates whether individual i in group g is still in the game in round t, we only observe demand d_{igt} if y_{igt} = 1. To identify the selection bias, we correct for the group default risk by adding the (random) lagged number of ill peers LN^{ill} to the selection equation:

$$P(y_{igt} = 1) = \Phi\left(\delta_{gi}GI_g + \delta_{gic}GIC_g + \delta_c C_g + \delta_{\mathbf{x}}\mathbf{x}_{igt} + \eta \mathrm{LN}^{ill}_{igt}\right)$$

The parameter ρ is the correlation of the standard errors in the main and selection equation. If clients unwilling to join are more likely to drop out, this correlation will be positive, $\rho > 0$[12].

Finally, we will estimate a dynamic model for renewal decisions with individual fixed effects to investigate whether demand for individual insurance reacts to decisions in previous rounds. We hypothesize that clients are more likely to forgo insurance if fewer peers enrolled.

3.3. PROCEDURES

The experimental sessions were organized near clients' houses or businesses in eight different areas of Dar es Salaam, in venues where credit groups typically meet with their loan oficers for the weekly loan repayment. Participants were recruited during the loan group meetings and invited to come to one of the 14 sessions. To enhance attendance, people were encouraged to bring along group members (snowball sampling). Treatments were assigned such that every treatment was played at most once in an area and they were not announced during mobilization.

Because clients were unfamiliar with the concept of experimental games, the study was introduced as an interactive seminar about health insurance. Clients were informed about the show-up fee of 7,000 TZS (US $ 4.67) and that they could earn in addition up to 27,500 TZS (US $ 18.35).

As clients arrived, assistants administered for each participant a short questionnaire on socio-demographics, health and credit group-related characteristics. Three games were played: the introductory microinsurance game with insurance and lending at the individual level to elicit a measure for risk aversion; the same game but with more expensive insurance (a premium of 17,500), which served as a robustness check; and the game with joint liability. An experimental session lasted approximately 3 hours.

Clients were randomly assigned to a group, unconditional on their degree of risk aversion. Although participants could observe who was in their group, all decisions were taken in private and remained anonymous. Every game started with Kiswahili instructions. Individual earnings throughout the game were stored in closed boxes (the piggybanks) and paid in cash at the end of the session. For every 10,000 earned, a participant received 1,000 TZS.

11 Calculations available upon request, also for rounds 1-3. Figure 2 applies to the fourth round and higher when the continuation probability is constant, β = 5/6. In earlier rounds, the game was not terminated by an exogenous end-of-the-game shock, yielding stronger dynamic incentives. Hypotheses for these rounds however remain the same as postulated in this section.

12 We also estimated a linear two-step and full maximum likelihood Heckman model, and a Heckman probit model with constant term in the selection equation. The estimates presented in this paper are smallest in size and significance, and therefore provide a conservative lower bound for the difference in demand for individual versus group insurance.

On average, participantsearned 18,000 TZS (US $12) including the 7,000 TZS show-up fee. This equals nearly 2.5 days of profit for the average participant.

4. DATA

4.1. STUDY POPULATION AND PARTICIPANT CHARACTERISTICS

The microfinance games were played by clients of Tujijenge Tanzania Ltd, an MFI that started its operations in 2006 in several areas in Dar es Salaam. Tujijenge currently has approximately 12,800 members engaged in group lending schemes. The average loan size is 450; 000 Tanzanian Shillings (US $ 300) and clients pay 12 percent interest per loan cycle of three months. Groups of five to seven members are jointly liable for loan repayment. They formulate by-laws such as fines for not repaying ("delinquency") in the weekly loan repayment meeting.

Columns 1- 3 in Table 1 describe the main characteristics of the 355 participants in the games. The other columns will be discussed in a later section. Panel A summarizes demographic and socio-economic characteristics. As is common in microfinance institutes, the majority of our participants is female. The average participant has completed around 7 years of education, corresponding to primary school. Monthly per capita income is on average 84,425 TZS (US $ 54).

Panel B describes the population in terms of health characteristics. Although 41.1 percent of the participants knows what health insurance is, only 7.3 percent is enrolled; mainly because health insurance is inaccessible for workers outside the formal sector. Just more than half of the participants (54.9 percent) consulted a health care provider in the past three months, and for 73.5 percent, at least one other household member did so. Average household-level health expenditures over that same period are 8,332 TZS (US $ 5) per capita, or 9.9 percent of monthly per capita income. Participants report on average 0.6 times that one of their household members needed care in the past 3 months but did not receive it due to a lack of money.

Panel C presents descriptive statistics for a number of credit group-related variables. The average length of membership is just over one year. Eleven percent of participants recently joined Tujijenge and are waiting to take out their first loan. The average monthly business profit is TZS 225,944 (US $ 145), representing a considerable proportion of total monthly household income. Approximately one third of the participants indicate that at least one of their credit group members defaulted on a (bi-)weekly loan repayment in the past three months. The respondents contributed for these persons in almost all cases. Another 13 percent of respondents were unable to repay in the past 3 months themselves. Half of them (6.8 percent of the total) report that group members contributed on their behalf.

Panel D shows game-related variables. The first two variables examine the social ties between group members in the games. Participants were randomly assigned to groups that included on average one other person they knew by sight, but only 0.5 of their game group members were also a member of their Tujijenge credit group.

Finally, one quarter (25.6 percent) of the participants have `low risk aversion' in the introductory game; 46.2 percent have high risk aversion and at least one low RA peer; and the remaining 28.1 percent are high RA participants with only high RA peers.

Table 1—Descriptives of participants and the target group

	Games			Tujijenge		Probit LRA	
	(1) N	(2) Mean	(3) (s.d.)	(4) Mean	(5) t-test	(6) Mean	(7) (s.d.)
A. Demographic and socio-economic characteristics							
Female	355	74.6	(44)	67.8	-2.08*	-0.337†	(0.182)
Age	355	36	(8.5)	36	0.117	-0.535	(0.365)
Household size	354	5.1	(2.1)	4.6	-4.14**	0.087†	(0.046)
Married	355	76.1	(43)	80.8	1.61	-0.029	(0.194)
Muslim	355	58.3	(49)				
Christian	355	41.7	(49)				
Years of education	354	7.7	(2.4)	8.2	2.39*	0.042	(0.036)
Per capita hh income	349	84,425	(60,378)	82,700	-0.337	0.112	(0.105)
B. Health characteristics							
Knows insurance	355	41.1	(49)				
Has health insurance	355	7.3	(26)	11.2	1.77†	0.612*	(0.308)
Visited provider	355	54.9	(50)	24.8	-8.93**	-0.050	(0.187)
Health expenses	348	13,382	(29,711)	5,569	-4.25**	-0.055†	(0.030)
Other visited provider	355	73.5	(44)	37.6	-10.6**	0.032	(0.264)
Health exp. others	350	29,113	(70,443)	26,954	-0.131		
# times foregone care	355	0.6	(1.4)				
C. Microcredit variables							
Membership years	355	1.1	(1.6)				
Profit business	323	225,944	(204,725)				
Has a loan	355	89	(31)	97.1	4.48**	-0.556*	(0.252)
Last loan	347	460,029	(369,377)	424,750	-1.33	-0.069	(0.129)
Default in group	355	32.4	(47)				
Contributed	355	27.3	(45)				
Client defaulted	355	13.0	(34)				
Group contributed	355	6.8	(25)				
D. Game-related variables							
Nr. known	355	1	(1.1)				
Nr. in credit group	355	0.5	(0.79)				
Low RA	355	25.6	(44)	30.7[1]			
High RA, LRA peer	355	46.2	(49.9)				
High RA only	355	28.1	(45.0)				

[1] Out-of-sample prediction. Confidence interval based on Delta standard errors: [23.3,38.2].
† $p < .1$ * $p < .05$ ** $p < .01$. Binary variables presented in %. All monetary variables in Tanzanian Shillings (TZS). US $ 1 was approximately 1,500 TZS at the time of the study. Column (4): survey among representative sample of 407 Tujijenge clients. All variables available in both datasets are presented here. Column (5): Unpaired and unequal t-test statistic. Column (6)-(7) LRA: low risk aversion. Probit regression uses log transformation for age, total hh health expenses, household income and loan size. Health expenses self and other household members are combined into total household health expenditures.

4.2. BALANCE OF CHARACTERISTICS OVER TREATMENTS

To examine the comparability of treatment groups, Table 2 compares the char-acteristics of the participants in each of the four treatments. The first two columns compare individual and group insurance without communication. The last two columns compare the two treatments with communication. The significance levels are calculated based on an unpaired t-test of a means comparison, with standard errors clustered at the group level.

Participants in each of the treatments are very similar on a large number of key characteristics. Only a few characteristics are not well balanced over the four treatments at the 10%-significance level, which may be due to chance alone. Thus, the assignment of treatments seems to have resulted in four comparable treatment groups. Results are robust to the in- or exclusion of the characteristics listed in Table 2 as control variables.

Health shocks were random in the games. As predicted by the law of large numbers, a health shock occurred for around 20 percent of the observations. The prevalence of illness is however lower under individual insurance without communication in round 4. We therefore include illness in the previous round as a control variable but results are robust to its in- or exclusion.

TABLE 2—BALANCE OF PARTICIPANTS' CHARACTERISTICS AND GAME-RELATED VARIABLES

	No communication		Communication	
	II mean	GI mean	II mean	GI mean
A. Demographic and socio-economic characteristics				
Female	74.7	70	77.3	76.5
Age	35.8	36	36.1	36
Household size	5.2	5.3	5.2	4.9
Married	81.3	75.6	78.7	71.3
Muslim	68.0	52.2†	54.7	59.1
Years of education	8	7.4	7.7	7.8
Per capita HH income	83,956	85,011	87,554	82,155
B. Health characteristics				
Knows health insurance	45.3	31.1†	49.3	40.9
Has health insurance	8.0	3.3	12.0	7
Visited provider	52.0	52.2	61.3	54.8
Health expenses	12,046	11,963	16,182	13,542
Other visited provider	73.3	73.3	72.0	74.8
Health expenses others	28,532	32,400	27,146	28,136
Nr. times foregone care	0.50	0.6	0.70	0.5
C. Microcredit variables				
Membership years	1.1	1	1.0	1
Profit business	274,541	227,415	240,507	193,906
Has an outstanding loan	85.3	93.3†	86.7	89.6
Last loan	552,329	450,000	455,946	410,797
Delinquent in group	25.3	28.9	37.3	36.5
Contributed for peer	28.0	24.4	32.0	26.1
Has been delinquent	9.3	12.2	10.7	17.4
Peers contributed	4.0	6.7	2.7	11.3*
D. Game-related variables				
Nr. known personally	0.80	0.9	1.1	1.2
Nr. in credit group	0.50	0.4	0.60	0.6
Low RA	26.7	31.1	22.7	22.6
High RA, LRA peer	53.3	41.1	57.3	38.3†
High RA only	20.0	27.8	20.0	39.1
Ill	17.3	23.1	17.0	21.5
- in round 1	12.0	21.1	14.7	14.8
- in round 2	21.3	21.2	16.0	20.9
- in round 3	24.0	18.7	18.6	22.9
- in round 4	9.3	20†	18.6	24
- in round 5	16.9	21.7	14.5	16.8
- in round 6	21.5	14.5	13.3	23.8
Number of observations	75	90	75	115

† $p < .1$ * $p < .05$ ** $p < .01$. p-values from t-test statistic for equal means with standard errors clustered at group level. Binary variables in percentages. All monetary variables are in Tanzanian Shillings (TZS). US $ 1 was approximately 1,500 TZS at the time of the study.

5. RESULTS

5.1. DESCRIPTIVE OUTCOMES

Table 3 shows descriptive statistics of demand by treatment. The first row includes the full sample. Demand for individual insurance is suboptimal at 79.6 percent. The percentage of players willing to join increases to 96.0 percent in the group insurance treatment. The second row gives demand for health insurance among individuals with low risk aversion. Willingness to join individual insurance is particularly low within this group of clients, with an average demand of only 45.3 percent. Their demand under group insurance is substantially higher at an average of 91.6 percent.

Table 3—Demand for insurance by risk type

	All		No Comm		Comm	
	Individual	Group	Individual	Group	Individual	Group
All	0.796	0.960	0.809	0.948	0.781	0.969
($n = 2010$)	(0.403)	(0.196)	(0.393)	(0.222)	(0.414)	(0.175)
Low RA	0.453	0.916	0.456	0.891	0.447	0.941
($n = 522$)	(0.499)	(0.278)	(0.500)	(0.312)	(0.501)	(0.237)
HRA, LRA peer	0.891	0.959	0.938	0.964	0.841	0.955
($n = 923$)	(0.312)	(0.199)	(0.242)	(0.187)	(0.366)	(0.209)
HRA, no LRA peer	0.931	0.992	0.933	0.986	0.929	0.996
($n = 565$)	(0.253)	(0.088)	(0.251)	(0.119)	(0.258)	(0.063)

The demand for insurance excludes defaulters. The descriptives may be biased if attrition in later rounds is selective. This table does not report whether differences are significant.

The third and fourth row give demand for participants with high risk aversion. Demand among those with at least one low RA peer is 89.1 percent under individual insurance. Under group insurance, their demand increases to 95.9 percent. Finally, the bottom row shows that high RA participants without low RA peers have very high demand throughout the game under both individual and group insurance, at 93.1 and 99.2

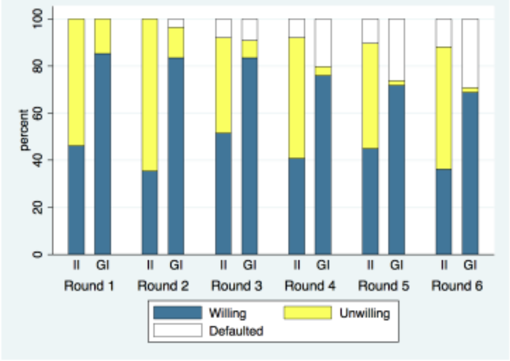

Figure 3. Demand under individual (II) versus group (GI) insurance among low RA participants

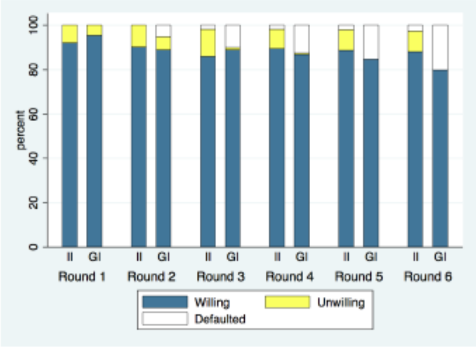

Figure 4. Demand under individual (II) versus group (GI) insurance among high RA participants

Also among high RA clients the percentage of participants unwilling to take insurance is consistently larger for the individual treatment compared to group insurance in every round. It ranges between 8.0 and percent respectively. Figures 3 and 4 disaggregate demand by round among the low versus high RA types. Both figures pool the treatments with and without communication. A persistent majority of participants with low risk aversion is unwilling to take insurance in the individual treatment. This stands in contrast to the proportion unwilling to join in the group treatment, which steadily decreases from 16.7 percent in the first round to a mere 2.0 percent in round 6. 12.4 percent under individual insurance. Under group insurance, the number of individuals unwilling to insure decreases from 5.3 percent in the first round to zero percent in rounds 5 and 6.

5.2. FREE-RIDING

The descriptive statistics do not control for selective attrition in the games. Table 4 presents the estimates for the main probit model in Equation (12) with demand for insurance as the dependent variable. Panel A gives the estimated coeficients. Panel B presents the average marginal effect of group insurance compared to individual insurance. Regression results are presented separately for the three subsets of participants - clients with low risk aversion, high risk aversion without low RA peers, and high risk aversion with at least one low RA peer.

According to the first hypothesis in Section III, low RA clients have an incentive to defect on full enrollment under individual insurance as long as group members do not adopt a trigger strategy. Column (1) in Table 4 estimates the probit model for participants with low risk aversion. Panel B shows that these participants are around 46 percentage points more likely to vote for insurance under group compared to individual insurance. These effects are significant at the 99% confidence level[13].

13 The results in Table 4 are robust to the in- or exclusion of control variables, to the use of alternative measures of risk attitudes based on the second introductory game, and to a linear specification.

Table 4—Private Demand

	(1)	(2)	(3)	(4)	(5)
	Low RA		High RA, LRA peer		HRA only
	Probit	Heckprob	Probit	Heckprob	Probit
Panel A. Coefficients					
Group	1.421**	1.512**	0.327	0.356	0.693*
	(0.397)	(0.395)	(0.403)	(0.400)	(0.327)
Comm	0.054	0.134	-0.540	-0.493	-0.029
	(0.391)	(0.387)	(0.381)	(0.381)	(0.361)
Group x Comm	0.294	0.163	0.404	0.345	0.499
	(0.544)	(0.565)	(0.583)	(0.573)	(0.490)
Lag ill	0.524*	0.309	0.598*	0.588*	0.349
	(0.231)	(0.228)	(0.276)	(0.274)	(0.409)
Round 2	-0.116	0.138	-0.103	-0.029	-0.292
	(0.222)	(0.213)	(0.190)	(0.200)	(0.354)
Round 3	0.315	0.510**	0.014	0.079	-0.196
	(0.194)	(0.189)	(0.203)	(0.215)	(0.471)
Round 4	0.233	0.404†	0.182	0.240	0.050
	(0.221)	(0.209)	(0.196)	(0.188)	(0.463)
Round 5	0.428†	0.614**	0.222	0.282	0.056
	(0.244)	(0.229)	(0.245)	(0.242)	(0.340)
Round 6	0.291	0.419†	0.234	0.280	-0.029
	(0.255)	(0.218)	(0.301)	(0.290)	(0.350)
Constant	-0.402	-0.706*	1.392**	1.282**	1.549**
	(0.333)	(0.325)	(0.288)	(0.313)	(0.325)
Panel B. Average marginal effect of group insurance					
All	0.460**	0.491**	0.076†	0.077†	0.060*
	(0.0808)	(0.0835)	(0.0400)	(0.0415)	(0.0247)
No Communication	0.446**	0.493**	0.032	0.036	0.051
	(0.119)	(0.117)	(0.0391)	(0.0412)	(0.0326)
Communication	0.476**	0.490**	0.117†	0.113	0.065†
	(0.107)	(0.115)	(0.0689)	(0.0699)	(0.0342)
ρ		0.624**		0.182	
		(0.213)		(0.204)	
χ^2	94.95**	92.00**	24.50**	22.86**	50.18**
Observations	463	522	827	923	565

† $p < .1$, * $p < .05$, ** $p < .01$ Standard errors in parentheses clustered by group. Demand is the willingness to join insurance. Column (5) is not matched with a Heckprob because groups with only HRA clients never defaulted. Lag ill uses practice round health outcomes for round 1.

To correct for a potential selection bias, column (2) shows the Heckman probit results for the same subsample of low RA participants. The estimate for lagged number of ill peers, used to identify the selection effect, has a large negative and statistically significant effect on continued participation in the games (see Appendix 2 for the estimation of the selection equation). The residuals of the selection and main equation are positively correlated as reected by the positive sign and significance of ρ. Selective attrition however does not strongly bias the findings; results are comparable to the estimates without Heckman correction. These findings yield evidence that low RA clients are free-riding under individual insurance and that the binding nature of group insurance commits them to enroll.

To test Hypothesis 2 - clients with high risk aversion respond to free-riding among their low RA peers by not enrolling themselves - Column (3) estimates the main equation for high RA clients with low RA peers. Without communication, there is no significant difference between individual and group insurance. When communication is permitted - and free-riding among low RA peers is more pronounced - demand of high RA clients is larger under group than under individual insurance. The increase of 7.6 percentage points is significant at the 10 percent error level. Column (4) estimates the effect of group insurance for this subset of participants, correcting for a potential selection bias by means of the Heckman probit model. Results are similar to the probit estimation.

These results are partly consistent with Hypothesis 2. When communication is permitted, demand is suboptimal under individual insurance and is raised by group insurance. The recorded transcripts under the communication treatment illustrate these findings. Although participants condemned their peers for not taking insurance, and these peers promised to take insurance as a result of social pressure, communication often remained cheap talk as acknowledged by a frustrated participant:

"Although we discuss and reach an agreement here, some of us are going to change their mind when they proceed to the assistant." (based on transcripts).

When communication is not permitted, group insurance however does not raise demand among high RA clients with low RA peers. This is mainly because their demand under individual insurance is already high at 93.8 percent (see Table 3). This poses the question why a high RA client would enroll even when her peers have low risk aversion. First, not all peers are of the low RA type and not all low RA peers are free-riding so that enrollment may still be optimal given the number of insured peers. Second, even high RA clients who believe some peers will not enroll may tolerate a limited number of free-riders if they are suficiently risk-averse.

5.3. COORDINATION

To test Hypotheses 3 and 4, Column (5) estimates the main equation for high RA clients that have no low RA peers. Throughout the game, this subset of participants had very high demand under both individual and group insurance. Only in 15 of the 565 cases, a participant decided not to enroll. As a result, none of these groups defaulted and there is no need to correct for selective attrition.

On average, group insurance increases demand by 6 percentage points. This is significant at the 10% error level. Thus, in line with Hypothesis 3, groups appear unable to fully coordinate on the social optimum. Given the low number of participants unwilling to join insurance in this subsample, we cannot draw conclusions on the effect of group insurance for treatments with and without communication separately.

However, we reject Hypothesis 4, which states that communication has a positive effect on demand for individual insurance. When the more risk-averse are able to talk to each other under individual insurance, this does not enhance their ability to coordinate on the optimal strategy. Instead, it leaves room for the group contract to increase demand.

Why does communication not facilitate coordination within groups with only members of the high RA type? One explanation lies in the contents of communication. Clients shared their negative experiences with existing health insurance schemes, for instance the problem that insured patients are given lower priority in facilities than non-insured patients who pay out-of-pocket. In principle, this should not affect decisions in the games, but it may have inuenced hesitant clients.

"A friend of mine has health insurance but complains that he is never given priority over non-insured people." (based on transcripts).

Moreover, under communication, group members discussed not only the benefits of insurance but also the benefits of risk-pooling within the group.

"Do you see also the advantage of being in a credit group? What if you were alone who could help you?" (based on transcripts).

Thus, our findings demonstrate that communication does not necessarily help a group to coordinate on the social optimum or improve decision-making. Whether communication effectively addresses a coordination failure also depends on the type of information that is shared.

To summarize, demand patterns among clients with low risk aversion are largely in line with the free-riding hypothesis. Low RA clients consistently decide not to enroll at the expense of the insured majority in their group. This also results in suboptimal demand among their peers with high risk aversion. These findings correspond to the interpretation of group insurance as a binding contract that enables participants to overcome the Prisoner's Dilemma inherent to the game.

We find weak support for a coordination failure among groups with only high RA members. Although demand for insurance is higher in the group treatments compared to treatments with individual insurance, demand under individual insurance is already very high. Although earlier literature shows that communication helps to coordinate on the social optimum, group insurance appears more effective than communication as a coordination device in our games.

5.4. DYNAMICS IN RENEWAL DECISIONS UNDER INDIVIDUAL INSURANCE

To further exploit time dynamics under individual insurance, Table 5 presents a linear probability model with individual fixed effects. This specification allows for an investigation of renewal decisions over time as a function of peers' prior enrollment decisions. All estimates control for lagged illness, lagged number of ill peers and the lag of one's own insurance decision.

The first three columns present estimates by type of participant with the lag number of insured peers as additional regressor. Clients with low risk aversion are less likely to enroll if a larger number of peers enrolled in the previous round but the coeficient is not significant. Their high RA peers on the other hand significantly increase demand as a larger number of peers enrolled in the previous round. Consistent with our predictions, high RA clients who believe that more peers enroll are also more likely to take insurance themselves. The coeficient is however small relative to the effect of other lagged variables. The third column shows that high RA clients without low RA peers do not significantly respond to insurance decisions of their peers. Notice however that only in 15 cases a player among this subset of participants chooses not to enroll, resulting in a limited sample size and low precision of the estimates.

Columns (4) to (6) present a similar model, now with the interaction between the lag of one's own demand and a defecting peer in the previous round as regressor. Again, this variable is statistically significant only for the subsample of high RA clients with low RA peers, while the effect size is relatively small.

Table 5—Dynamic renewal decisions

	(1) Low RA	(2) High RA LRA peer	(3) High RA HRA peers	(4) Low RA	(5) High RA LRA peer	(6) High RA HRA peers
Lag nr insured peers	-0.032	0.057*	0.019			
	(0.036)	(0.022)	(0.012)			
Lag demand x peer defects				0.069	-0.038†	-0.015
				(0.195)	(0.020)	(0.015)
Lag ill	0.023	0.098†	0.174	0.030	0.098†	0.174
	(0.097)	(0.055)	(0.124)	(0.102)	(0.056)	(0.125)
Lag nr ill peers	0.081†	-0.007	-0.040	0.079†	-0.011	-0.040
	(0.040)	(0.010)	(0.042)	(0.043)	(0.010)	(0.042)
Lag insured	0.038	-0.132	0.062	-0.004	-0.081	0.066
	(0.104)	(0.139)	(0.262)	(0.164)	(0.160)	(0.262)
Round 3	0.167*	-0.054	0.043	0.173*	-0.061	0.043
	(0.072)	(0.039)	(0.052)	(0.071)	(0.039)	(0.049)
Round 4	0.044	-0.019	0.041	0.052	-0.023	0.037
	(0.111)	(0.034)	(0.041)	(0.111)	(0.036)	(0.041)
Round 5	0.112	-0.040	0.037	0.126	-0.056	0.037
	(0.129)	(0.033)	(0.065)	(0.127)	(0.040)	(0.065)
Round 6	0.052	-0.045	0.022	0.073	-0.058	0.022
	(0.115)	(0.035)	(0.058)	(0.114)	(0.040)	(0.060)
Constant	0.389*	0.853**	0.770*	0.291**	1.006**	0.841*
	(0.168)	(0.132)	(0.206)	(0.103)	(0.130)	(0.236)
Observations	153	357	145	153	357	145

† $p < .1$, * $p < .05$, ** $p < .01$. Fixed effects estimated at the individual level. Standard errors in parentheses are clustered by group. Only treatments with individual insurance and Rounds 2-6 are included in the sample to estimate these dynamic models.

Thus, insured clients with at least one defecting peer in the previous round did not retaliate on a large scale by staying uninsured in the next round. The repeated nature of the game apparently did not induce participants to adopt a trigger strategy and fully reach the Pareto-eficient outcome. This might well be due to social norms among microfinance clients. The transcribed communication demonstrates that participants are very much aware that their peers are free-riding on their contributions:

"We all agreed from the start that we take health insurance but one person betrayed us. It is nothing but greed. He fell sick and now we have to contribute for him." (based on transcripts).

They are however unwilling to sanction their defecting peers by defecting themselves in the next round. This stands in contrast to findings from public good games played in conventional laboratory experiments.

6. POLICY IMPLICATIONS AND EXTERNAL VALIDITY

The previous section has shown that a group contract increases demand for insurance in a game with jointly liable credit groups. Does this also lead to higher enrollment rates in insurance and to improvements in other financial performance indicators? To answer these questions, this section analyzes the implications of the various demand patterns from three different perspectives: the insurer, the MFI and its clients.

6.1. THE INSURER: ENROLLMENT RATES

Low enrollment rates reduce the size of the risk pool with potentially severe consequences for the financial sustainability of insurance schemes. When insurance is offered at the group level, one member can bar the entire group from enrolling. This disadvantage is an important consideration for insurers that are often hesitant to offer group insurance.

To quantify this effect in the microinsurance games, Columns (1)-(2) in Table 6 estimate demand and actual enrollment for the full sample (controlling for selective attrition and the type of participant). Note that demand and enrollment are the same under individual insurance, but that these variables may differ under group insurance, given that enrollment also depends on peers' decisions.

Group insurance significantly raises demand in treatments both with and without communication. However, only when communication is allowed, we find a weakly significant positive effect of 13.5 percentage points on enrollment. Communication gives clients the opportunity to convince their peers to demand group insurance. Without communication, a few individuals continue to vote against group insurance every round, reducing overall enrollment rates. Their absolute number is small, but a mere two percent of negative voters in the sample can decrease group enrollment by up to ten percent. Thus, it seems worthwhile from an insurer's perspective to offer group insurance and simultaneously stimulate credit group members to discuss its advantages.

6.2. THE MFI: DEFAULT RATES

MFIs will also be interested in the impact of insurance on default rates. A reduced group default risk can be interpreted as a rent for the MFI when interest rates are not adjusted accordingly. The question is whether group insurance increases or decreases the default risk. Under individual insurance, unprotected risk is scattered over the population. As group insurance leads to a concentration of uninsured participants within a few credit groups, it increases groups' vulnerability to collective default.

Column (3) in Table 6 estimates a model for the probability that a group defaults, given the number of insured members. Observations are at the group level and estimates control for selective attrition as well as the total number of clients with low risk aversion (`Total LRA'). The group default probability does not significantly differ between individual and group insurance. Apparently, the higher probability of being insured in the group treatment is offset by a greater vulnerability to shocks for the uninsured.

Whereas in practice individual delinquency is common, group default rates in most MFIs are low. For instance, 98% of Tujijenge groups repay their loan. Higher default rates in the games can be partly attributed to a relatively higher probability of catastrophic expenditures than in real life. In the game, uninsured participants faced a one-fifth probability of incurring catastrophic health expenditures. In contrast, only 10.2 percent of participants reported health expenditures equal to or above per capita income in the past 3 months. But also given a one-tenth health shock probability, the game would have been a social dilemma. In fact, given the value of the discount rate β, Figure 2 shows that the game represents a social dilemma for all $\rho < .33$ in Regimes 2 and 3.

Further, even though in reality group default rates are low, health shocks are an important constraint on borrowers' capacity to repay. Our participants reported that 28 percent of individual delinquencies in the last 3 months were caused by an illness or injury in the household. This vulnerability to health shocks is common across MFIs in different parts of the world. Failure to repay can cause extreme psychological pressure and distress. Individuals go to large lengths to avoid default and the social shame and sanctions associated with it, underscoring the non-monetary benefits of insurance offered by MFIs.

6.3. THE CLIENT: PROFITS

Clients are concerned with earnings levels and income uctuations. As expected, free-riding under individual insurance is profitable at the expense of high RA peers. Participants with low risk aversion earned substantially more through-out the individual insurance games than their risk-averse group members with averages of 65,081 versus 50,877.

To estimate the effect of group insurance, Column (4) in Table 6 regresses total expected log profits on the experimental treatments. Profits are calculated at the individual level, not by round. Hence, a correction for selection bias is not necessary. We use the expected profits conditional on group members' enrollment decisions as a dependent variable, not actual profits that are affected by the random draw of a health card. Overall, expected profits do not significantly differ across treatments.

Especially clients with high risk aversion will seek a stable level of profits, shielded from excessive variance due to health expenses and contributions for peers. Column (5) estimates a model for the log variance of profits within a round, using a Heckman model to correct for selective attrition. Group insurance substantially reduces the variance of profits, both in the communication and no communication treatments, due to both higher enrollment and a lower incidence of delinquency among peers.

TABLE 6—OTHER OUTCOMES

	(1) Heckprob Demand	(2) Heckprob Enrolled	(3) Heckman E Default	(4) OLS E Profit	(5) Heckman V Profit
Panel A. Coefficients					
Group	0.993**	0.160	0.023	-0.084	-5.736**
	(0.303)	(0.343)	(0.020)	(0.062)	(2.172)
Comm	-0.098	-0.007	0.003	-0.093	0.459
	(0.269)	(0.261)	(0.014)	(0.063)	(2.447)
Group x Comm	0.192	0.463	-0.026	0.142	-1.913
	(0.471)	(0.472)	(0.024)	(0.086)	(2.856)
Low RA	-1.363**	-1.087**		0.020	3.569**
	(0.205)	(0.219)		(0.043)	(1.091)
High RA x Low RA peer	-0.329	-0.419†		-0.141**	2.633*
	(0.216)	(0.231)		(0.044)	(1.137)
Lag ill	0.439**	0.167†			-0.303
	(0.126)	(0.092)			(0.292)
Total nr. Low RA members			0.013**		
			(0.005)		
Constant	1.095**	0.839**	0.0445**	10.96**	8.514**
	(0.242)	(0.263)	(0.011)	(0.046)	(1.879)
Panel B. Average marginal effect of group insurance					
All	0.179**	0.090	0.009	-0.008	-6.745**
	(0.040)	(0.056)	(0.013)	(0.044)	(1.419)
No communication	0.162**	0.042	0.023	-0.084	-5.736**
	(0.048)	(0.087)	(0.020)	(0.062)	(2.172)
Communication	0.195**	0.135†	-0.003	0.058	-7.649**
	(0.062)	(0.070)	(0.014)	(0.060)	(1.846)
ρ	0.509**	0.732**	-0.295**		-0.308*
	(0.176)	(0.202)	(0.104)		(0.124)
Round dummies	Yes	Yes	Yes	No	Yes
Model fit	108.3**	73.95**	26.82**	0.111**	75.96**
Observations	2010	2010	402	355	2010

† $p < .1$, * $p < .05$, ** $p < .01$ Standard errors in parentheses clustered by group. Model fit: χ^2 in (1)-(4) and (6), R^2 in (5). Column (3) is at the group level. Column (4): Expected profits in the game in total, not by round. Column (5): Variance of profits within a round. Lag ill uses practice round health outcomes for round 1.

To summarize, the higher demand under group insurance translates into higher enrollment rates only when communication is allowed. It does not produce higher expected profits for the average participant nor does it reduce the group default risk. Its main merit from the client perspective is a decrease in the variance of profits, which will be valued especially by more risk averse individuals.

6.4. RISK ATTITUDES IN THE POPULATION

Free-riding affects demand in the games more than coordination problems. The extent of free-riding, and hence the benefits of group insurance, depends on the target group's risk attitudes. In target groups with a large proportion of low RA individuals, the free-riding problem will be more pronounced and the potential of group insurance to enhance enrollment is larger. This section extrapolates our findings to the average Tujijenge client.

The participants in the games do not perfectly represent the target group. Table 1 compares our sample to a representative survey among 407 Tujijenge clients conducted three months before the microfinance games. Column (4) gives the population averages based on this survey and Column (5) the *t*-statistic from testing for equal means in the two samples.

Game participants are more likely to be female, have larger households, less education and are less likely to be insured. They are also twice as likely to have visited a health provider in the past three months and they spent substantially more on health care. This could be due to seasonal differences in the prevalence of diseases, since the games and the Tujijenge survey were not conducted in the same period. Another explanation for higher health care utilization is an explosion in a munition depot near one of the study areas just prior to the games. This accident caused injuries for a substantial proportion of households in the surrounding neighborhoods.

To extrapolate results to the target group, it is necessary to know which variables correlate with risk aversion. The last column in Table 1 estimates a probit

model for low risk aversion. Women as well as participants with higher household health expenditures both overrepresented in the games - are more risk averse. Participants with health insurance,- underrepresented in the games,- are less risk averse.

These estimates are used to predict that 30.7% of clients in the target group have low risk aversion. This is slightly higher than the 25.6% in the participant sample, which suggests that our results represent a lower bound for the effectiveness of group insurance in the games. The difference in the proportion of clients with low risk aversion is however not significant. Standard errors calculated by means of the Delta method yield a 95% confidence interval equal to [23.3, 38.2].

On a final note, the findings show that risk aversion and behavior in the games are correlated with individual characteristics. Our participants might behave very differently from how university students would act. This highlights once more the value of a framed field experiment to study strategic decisions in microcredit groups outside the lab.

7. CONCLUSIONS

In the absence of formal insurance, households rely on informal risk management strategies such as mutual insurance arrangements. Although informal support networks provide only partial protection, demand for affordable microinsurance typically remains at low levels. This paper provided and tested a mechanism to explain such low enrollment rates.

We theoretically showed that the introduction of individual insurance in jointly liable credit groups creates a social dilemma. First, individuals with low risk aversion are tempted to forgo individual insurance and free-ride on contributions from peers when they fall ill, although all had been better off if the entire group would have been insured. Second, even credit groups with only high risk averse members may fail to coordinate on the social optimum because it is costly to enroll if peers remain uninsured. The binding nature of group insurance offers a solution to these social dilemmas and may increase the demand for health insurance to optimal levels.

Microinsurance games played by 355 microcredit clients in Tanzania varied whether participants were offered individual or group insurance. This framed field experiment yielded substantial support for the free-riding hypothesis and weak support for the existence of a coordination problem. A majority of participants with low risk aversion did not take individual insurance, while group insurance significantly increased their demand from 45.3 to 91.6 percent. Their inclination to free-ride under individual insurance also had a downward effect on the demand of peers with high risk aversion. In groups with only high risk averse clients, group insurance appeared more effective than communication as a coordination device.

Overall enrollment rates were higher under group insurance but only in the communication treatments. Without communication, a small minority of individuals consistently voted against group insurance. As a result, enrollment rates were equally high under both group and individual insurance. In addition, group insurance did not affect the probability of group default or expected earnings, but profits were more stable under group insurance, smoothening earnings over time.

These results suggests that the standard choice faced by MFIs to offer insurance either at the individual or at the group level should reach beyond a concern for adverse selection, improved understanding or administrative considerations. Because members of jointly liable credit groups informally share risk, strategic decisions in such groups can be an important determinant of the demand for microinsurance.

This study extends findings from public good games played in laboratory experiments to the field. Participants were not recruited from a standard student population but were potential beneficiaries of a newly developed micro health insurance scheme, and the microinsurance games resembled the real world of the Tujijenge microcredit groups as close as possible. External validity nevertheless remains a caveat. The success of group versus individual insurance will depend on many more factors than can possibly be modeled in a game. We therefore recommend piloting both an individual and a group scheme, preferably by means of a well-designed randomized controlled trial (RCT) that limits bias due to confounding factors.

Further, group insurance is not the only way to solve the social dilemmas inherent to individual insurance decisions. Alternatives are for example stronger social sanctions, individual liability for loan repayment, or an individual insurance product with a deductible that would only step in if too many group members simultaneously incur a health shock. Another option is to make enrollment mandatory, and this naturally leads to the question why MFIs have been reluctant to do so. Low enrollment rates will not only be driven by strategic decisions, but also by explanations such as a poor quality of provided health care[14]. As a result, MFIs may fear that mandatory enrollment will chase away clients to competitors[15].

To conclude, group insurance can solve commitment and coordination problems that hamper the uptake of individual health insurance. This is not only relevant for the design of ongoing pilots of health insurance schemes, but also for other types of microinsurance. Moreover, since informal risk-sharing arrangements exist beyond the credit group, the findings may generalize to other pre-existing risk pools such as communities, extended families or cooperatives. As such, they are relevant to the design and implementation of microinsurance schemes in a wide variety of contexts.

14 The communication transcripts from our games actually support the notion that clients have a negative perception of the quality of health care that insurance provides.

15 For a case of client resistance to mandatory enrollment, see for instance Banerjee and Duo's discussion on the introduction of health insurance in the Indian MFI SKS Microfinance, in: `Poor economics: a radical rethinking of the way to fight global poverty', pages 149 - 151.

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ANNEX 1

Proposition II.1 *Always full enrollment (AFE) is welfare-improving over always zero enrollment (AZE) for clients with high risk aversion.*

PROOF:
To see this, note that full enrollment in insurance ensures continuation to the next round, while group default remains a risk under zero enrollment. Moreover, full enrollment creates higher utility within a round than zero enrollment for high RA types:

$$U^h(e-ph) > (1-p)U^h(e) > (1-p)\sum_{f=0}^{n^*} p_f U^h(e-c(f)) \quad (13)$$

The first inequality follows from Definition (3) and the second inequality from the fact that *c(f)* > 0 for any *f* > 0, while $\sum_{f=0}^{n^*} p_f < 1$ because $n^* < n$. This can be extrapolated to an infinite number of periods in which group members attain either always full enrollment or always zero enrollment.

Proposition II.2 *Under group insurance, individuals do not have an incentive to defect on full enrollment, and willingness to enroll is independent of the number of peers believed to enroll.*

PROOF:
From Section 2B, the net present value from always full enrollment is:

$$V^i_{AFE} = \frac{U^i(e-ph)}{1-\beta} \quad (14)$$

If an individual defects on full enrollment, the entire group remains uninsured. If this defection is worthwhile in one period, there will be an incentive to also defect in all future loan cycles. Hence, the net present value from full enrollment needs to be compared with the net present value of never enrolling:

$$V^i_{AZE} = \frac{(1-p)\sum_{f=0}^{n^*} p_f U^i(e-c(f))}{1-\beta P'_{n^*}} \quad (15)$$

By Proposition II.1, $V^h_{AFE} > V^h_{AZE}$. Moreover, outside Regime 1 where Restriction (7) holds, full enrollment is also welfare-improving for clients with low risk aversion: $V^l_{AFE} > V^l_{AZE}$. Both types hence have no incentive to defect on full enrollment.

To see that the willingness to enroll is independent of the number of peers believed to enroll, note that voting for insurance is a weakly dominant strategy. An individual who is willing to but cannot take insurance (because peers vote against it) does not pay the insurance premium. There is hence no coordination problem in which it is costly to choose insurance when peers choose not to join.

Proposition II.3 Under individual insurance, a client in Regime 2 has an incentive to defect on full enrollment if and only if she has low risk aversion. A client in Regime 3 has an incentive to defect on full enrollment if and only if i) she has low risk aversion and ii) group members do not condition current enrollment on peers' prior insurance decisions.

PROOF:
First, we prove that in Regime 2, a client has an incentive to defect on full enrollment if and only if she has low risk aversion. The expected utility for type i under full enrollment is:

$$U^i(e-ph) + \beta V^i_{AFE} \quad (16)$$

An insured individual earns *e* with certainty, pays the insurance premium *ph* in the present loan cycle and continues to the next loan cycle.

To derive a suficient condition for defection to be profitable, the proof focuses first on path-dependent strategies. This is because a client is less likely to defect when group members condition enrollment on peers' prior insurance decisions than under path-independence. In the former case, expected utility from defection is:

$$(1-p)U^i(e) + \beta V^i_{AZE} \quad (17)$$

Defecting individuals who do not take insurance expect to earn e with probability $1-p$, risk earning 0 with probability p and continue to the next loan cycle with certainty. If peers punish free-riders by not enrolling themselves in future rounds, the value of continuation is V^i_{AZE}.

The utility difference between enrolling and defection is:

$$U^i(e-ph) - (1-p)U^i(e) + \beta\left(V^i_{AFE} - V^i_{AZE}\right) \quad (18)$$

In Regime 2, where (10) is not satisfied, (18) is strictly negative for a client with low risk aversion. This type therefore has an incentive to defect on full enrollment. For a client with high risk aversion, this difference is strictly positive by Definition (3) and Proposition II.1. The high RA type will therefore not defect. Thus, in Regime 2, a client defects on full enrollment if and only if she has low risk aversion.

Next, we show that a client in Regime 3 has an incentive to defect on full enrollment if and only if she has low risk aversion and group members do not condition present insurance decisions on past enrollment.

If group members enroll conditionally on peers' prior cooperation, the utility of conforming to full enrollment is strictly higher than the utility of defection because (10) is satisfied in Regime 3. By Definition (3), (18) is also strictly positive for high risk averse types. Therefore, both types with high and low risk aversion will not defect on full enrollment.

If there is no such path-dependence in strategies, clients with low risk aversion cannot be committed to the social optimum and are tempted to free-ride. In the absence of a trigger strategy, the net present value of defection on full enrollment is $(1-p)U^l(e)+\beta V^l_{AFE}$. The difference with the value of conforming to full enrollment (16) is:

$$U^i(e-ph)-(1-p)U^i(e) \qquad (19)$$

This is strictly positive if and only if a client has high risk aversion by Definitions (3) and (4). In Regime 3, clients thus have an incentive to defect on full enrollment if and only if they have low risk aversion and their peers do not condition present insurance decisions on past behavior.

Proposition II.4 *Under individual insurance, a client faces a coordination problem if i) she has high risk aversion and ii) all peers have high risk aversion.*

PROOF:
If all group members have high risk aversion, no individual has an incentive to defect on full enrollment by Proposition II.3. Always enrolling therefore is an equilibrium strategy. Never enrolling is an equilibrium strategy if and only if:

$$V^h_{AZE} \geq \sum_{f=0}^{n^*} p_f U^h(e-ph-c(f)) + \beta P_{n^*} V^h_{AZE}$$
$$V^h_{AZE}(1-\beta P_{n^*}) \geq \sum_{f=0}^{n^*} p_f U^h(e-ph-c(f)) \qquad (20)$$

where P_{n^*} the probability that at most n^* peers - excluding oneself - fail to repay. This inequality is satisfied by Assumption (9). Thus, if a client and all her peers have high risk aversion, both full enrollment and zero enrollment are equilibria and clients face a coordination problem.

ANNEX 2

Table: Maximum likelihood estimation Heckman probit models

	(1) Low RA		(2) HRA, LRA peer	
	Demands HI	Select	Demands HI	Select
Group	1.512**	0.926**	0.356	0.594*
	(0.395)	(0.273)	(0.400)	(0.299)
Comm	0.134	0.778	-0.493	1.377*
	(0.387)	(0.521)	(0.381)	(0.541)
Group x Comm	0.163	-0.681	0.345	-1.455†
	(0.565)	(0.735)	(0.573)	(0.786)
Lag ill	0.309	-0.186	0.588*	0.583**
	(0.228)	(0.302)	(0.274)	(0.215)
Round 2	0.138	4.011**	-0.0288	3.614**
	(0.213)	(0.781)	(0.200)	(0.816)
Round 3	0.510**	3.335**	0.0792	3.331**
	(0.189)	(0.562)	(0.215)	(0.533)
Round 4	0.404†	3.236**	0.240	3.440**
	(0.209)	(0.526)	(0.188)	(0.570)
Round 5	0.614**	2.243**	0.282	2.541**
	(0.229)	(0.378)	(0.242)	(0.418)
Round 6	0.419†	2.420**	0.280	2.811**
	(0.218)	(0.482)	(0.290)	(0.588)
Lag nr. ill peers		-1.462**		-1.544**
		(0.262)		(0.269)
Constant	-0.706*		1.282**	
	(0.325)		(0.313)	
Rho		0.624**		0.182
		(0.213)		(0.204)
Observations	522		923	

† $p < .1$, * $p < .05$, ** $p < .01$. Standard errors in parentheses clustered by group. Lag ill uses health outcome in practice round for round 1.