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The Social Dilemma of Microinsurance: Free-riding in a Framed Field Experiment

Wendy Janssens* and Berber Kramer†

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Abstract

Health shocks are among the most important unprotected risks for microfinance clients, but the take-up of micro health insurance typically remains limited. This paper attributes low enrollment rates to a social dilemma. Our theory is that in jointly liable groups, insurance is a public good. Clients can rely on contributions from group members to cope with shocks. Less risk averse clients have a private incentive to free-ride and forgo individual insurance even when insurance optimizes group welfare. The binding nature of insurance offered at the group level eliminates such free-riding. A framed public good experiment in Tanzania, eliciting demand for group versus individual microinsurance, yields substantial support for this hypothesis. This provides a potential explanation for low take-up rates.

JEL Codes: D71, I13, G21

Keywords: Health insurance, microfinance, risk-sharing, public goods experiment

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1 Introduction

Limited access to formal insurance induces the poor to share risk with other households (Townsend, 1994). Because these risk-pooling arrangements provide only partial protection from shocks (Udry, 1994; De Weerdt and Dercon, 2006), microinsurance schemes have the potential to enhance welfare. Enrollment nevertheless typically remains at low levels (see the programs described in for instance De Allegri et al., 2009; Cole et al., 2013). We argue that this is precisely because insurance is offered to individual members of existing risk-sharing groups, resulting in free-riding problems.

This study uses a framed laboratory experiment in Tanzania to analyze whether the health insurance decision in microcredit groups entails a social dilemma. Illnesses and injuries are among the most important unprotected risks in developing countries (Gertler and Gruber, 2002) and health shocks are a major reason for individual default in microfinance. To reduce default rates, microcredit is typically offered through group-based lending.[1] Jointly liable clients can continue borrowing only if the group loan is fully repaid. Thus, clients have dynamic incentives to share risk and contribute for peers who cannot repay (Besley and Coate, 1995). These contributions provide mutual insurance, but the insurance is incomplete since the group will still default if too many members cannot repay.

Although incomplete, such existing risk-sharing arrangements can crowd out formal insurance (Arnott and Stiglitz, 1991). Using non-cooperative game theory, we show that the decision to take individual health insurance in jointly liable credit groups is subject to free-riding. Even when group welfare is highest if all members enroll, less risk averse clients are tempted to forgo insurance, since fellow group members contribute to their loan repayment in case they cannot repay themselves. More risk averse clients are not tempted to free-ride.

It is not clear a priori whether our free-riding theorem holds empirically in microcredit groups for at least four reasons. First, microfinance groups are long-term

[1] Although several microfinance institutes including the Grameen Bank have moved to individual liability, group-based lending is still the predominant way to bank the poor.

relationships with repeated insurance decisions. The threat of future retaliation may well induce cooperative behavior (Bó, 2005). Second, microfinance institutions teach their clients to be 'good borrowers' (Armendariz and Morduch, 2010), which may shape social norms to enroll in insurance. Third, microfinance clients meet regularly to repay their loans. Communication during these meetings may help reinforce social norms and reduce free-riding (Sally, 1995). Fourth, existing social ties may facilitate cooperation (Cassar, Crowley and Wydick, 2007).

We therefore test our free-riding hypothesis by means of a framed field experiment (Harrison and List, 2004). In this experiment, 355 clients from a microfinance institution in Dar es Salaam, Tanzania, played a public good game resembling their decision-making context with joint liability. Depending on the treatment, participants were offered insurance either at the individual level or at the group level. Group insurance requires a unanimous decision to enroll. Because a vote against insurance bars all peers from insurance as well, this treatment eliminates free-riding. If clients are willing to join group insurance, they perceive full enrollment to be welfare-enhancing. Lower demand in the individual treatment only among less risk averse clients, but not among more risk averse clients, can be interpreted as free-riding.

The experimental findings provide substantial evidence of this theory. In the group insurance treatment, nearly all participants opt for insurance, including groups with less risk averse members. Under individual insurance, most clients with high degrees of risk aversion enroll while a large number of less risk averse clients forgo insurance. A significant share free-rides on contributions from their more risk averse peers, and is even less likely to enroll in insurance when paired with other less risk averse clients. This social dilemma provides an explanation for low take-up of micro health insurance.

This study contributes to the existing literature in three distinctive ways. First, the theoretical framework models limited commitment to explain why members of social risk-sharing networks 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), and on limited commitment to share risk in informal networks (Kocherlakota, 1996; Ligon, Thomas and Worrall, 2002). We show that risk-sharing can distort private incentives to enroll in microinsurance.

Second, the experiment sheds light on the replicability of findings from conventional public good games to the field. A large body of literature analyzes social dilemmas in abstract laboratory experiments with university students. Our microinsurance games mimic real-life decisions for a population that differs from this usual participant in many respects (Cardenas and Carpenter, 2008), in a context where free-riding is not a trivial outcome. As such, the games extend the experimental literature on strategic behavior in microcredit groups (e.g. Cassar, Crowley and Wydick, 2007; Giné et al., 2010).

Third, the study offers a policy analysis of group insurance, highlighting a crucial difference between individual and group insurance schemes that is currently ignored in the literature. Group insurance does not only limit adverse selection, but also eliminates free-riding and potentially enhances demand. This is relevant for numerous microinsurance programs struggling to increase enrollment. Further, group insurance enhances group welfare by reducing inequality between less and more risk averse clients.

This study analyzes demand for insurance in a microfinance setting but the findings generalize to alternative risk-sharing networks such as cooperatives or informal saving groups. Independently, De Janvry, Dequiedt and Sadoulet (2012) refer to free-riding problems to explain low take-up of rainfall insurance in cooperatives but they do not empirically test their hypotheses. Their proposition is that free-riding occurs in the case of covariate shocks. Our theory may hence generalize to other commonly occurring shocks such as demand or weather shocks.

The remainder of this chapter is structured as follows. The next section models the insurance decision in a jointly liable microcredit group and derives the free-riding hypothesis. Section 3 introduces the framed field experiment designed to test this theoretical prediction. Section 4 describes the study population, discusses the risk aversion measure, and tests whether participants' characteristics are well balanced across treatments. Section 5 analyzes whether the decision to take insurance is subject to free-riding. Section 6 addresses policy implications. The final section concludes.

2 Theory

2.1 The model

This section develops a model for the health insurance decision in jointly liable microcredit groups. A group of n microcredit clients jointly borrows nl in every loan cycle $t \in \{1, ..., \infty\}$. Clients face idiosyncratic health risk. An ill client incurs health expenditures and cannot repay her share of the group loan. Her fellow group members (henceforth peers) contribute to loan repayment but the group defaults if too many members fall ill. In that case, the group will not continue to the next loan cycle. Clients can take insurance as a protection against health expenditures, reducing the group default risk. Their insurance decisions resemble a public goods game.

Figure 1 presents this game graphically. The left-hand block in the figure indicates disposable income before contributing for ill peers, π_{it}. A client invests her loan l and earns $\pi_{it} = e$ net of loan repayment. Prior to repayment, she risks an IID health shock that occurs every period with probability p and affects income in the present loan cycle.[2] Ill clients incur catastrophic health expenditures $h \in (e, e + l]$ and repay $l - (h - e)$. For these so-called delinquents, disposable income is zero, $\pi_{it} = 0$.

Before the realization of the health shock, clients have the option to enroll in insurance, which fully covers health expenditures at an actuarially fair insurance premium ph. Disposable income for an insured client is $\pi_{it} = e - ph$ irrespective

[2] The model focuses on health risks that are typically covered by microinsurance, i.e. major injuries and acute illness. It does not focus on adverse selection (heterogeneity in p), epidemics (cross-sectional correlation) or chronic illness (serial correlation). Our theoretical results are robust to heterogeneous health risks for a wide range of parameters. The homogeneity in health risk can also be interpreted as assortative matching on health status.

of the health outcome, and earnings are sufficiently large to pay the premium, $e > ph$. Indicating client i's insurance status with d_{it}, equal to one if she enrolls in loan cycle t and zero otherwise, the number of insured group members is:

$$n_t^I \equiv \sum_i^n d_{it}$$

The right-hand block of Figure 1 indicates a client's value after contributing for delinquent peers. We define the random number of uninsured ill group members, i.e. delinquents, as F_t. This variable follows a binomial distribution,

$$F_t \sim B(p, n - n_t^I),$$

where $n - n_t^I$ is the number of uninsured group members.

In order to repay the full group loan and continue borrowing, the group needs to jointly contribute $h - e$ for each delinquent, so the total contribution in loan cycle t is $F_t(h - e)$. Define $c(F_t, \pi_{it})$ as an individual's contribution, depending on the number of delinquents F_t and her disposable income π_{it}. A client never contributes more than her own income:

$$c(F_t, \pi_{it}) \leq \pi_{it}$$

with $\pi_{it} = e - ph$, $\pi_{it} = e$ and $\pi_{it} = 0$ for insured, healthy uninsured and ill uninsured clients, respectively. If $\Pi_t \equiv \sum_i^n \pi_{it}$ indicates total income within the group, a group can hence jointly contribute at most:

$$\sum_i^n c(F_t, \pi_{it}) \leq \Pi_t,$$

Clients however do not fully share the risk. If too many clients cannot repay their share, the group is unable to repay the full loan, $F_t(h - e) > \Pi_t$. The bank stops lending from period $t + 1$ onwards, and clients derive zero value from future loan cycles. If the group is able to repay the loan, $\Pi_t \geq F_t(h - e)$, repaying clients jointly contribute $F_t(h - e)$ and lending continues. Because earnings within a round cannot be negative and have a positive expected value, continuation has a strictly positive value for all clients.

Under such joint liability, the group repays the full loan and continues with probability $P_{n_t^I}$, defined as:

$$P_{n_t^I} \equiv P\left(F_t(h - e) \leq \Pi_t | n_t^I\right) \tag{1}$$

Insured clients can always repay their share of the loan, so if all n group members take insurance, the group continues with certainty, $P_n = 1$.

The model presented above makes four key assumptions. The first assumption reflects the stylized fact that total default on group loans is very uncommon in microfinance.[3] We therefore assume that in case of group default, clients repay as much as they can, namely total disposable income from the present loan cycle,

$$F_t(h - e) > \Pi_t \Rightarrow c(F_t, \pi_{it}) = \pi_{it}. \tag{2}$$

A second assumption follows from the finding that clients generally contribute for their delinquent peers, which is often attributed to the practice of conditioning future access to microfinance on full group loan repayment. This creates dynamic incentives to contribute in a cooperative Nash equilibrium (Besley and Coate, 1995). We therefore do not model a discretionary contribution decision but assume that when able to repay jointly, the group will cooperate and fully repay the group loan:

$$F_t(h - e) \leq \Pi_t \Leftrightarrow \sum_i^n c(F_t, \pi_{it}) = F_t(h - e) \tag{3}$$

To see that this is a Nash equilibrium, consider a group able to repay, $F_t(h - e) \leq \Pi_t$. If a client's peers jointly contribute $F_t(h - e) - c(F_t, \pi_{it})$, her dominant strategy

[3] Several factors could explain why clients rarely default strategically (Armendariz and Morduch, 2010). Clients may for instance have compulsory savings that the bank can use to enforce partial loan repayment or fear pressure and harassment from loan officers.

is to contribute $c(F_t, \pi_{it})$ because the value of continuation is strictly positive. A lower contribution would result in group default and prevent continuation to the next loan cycle. The strategy to contribute $c(F_t, \pi_{it})$ given that peers contribute $F_t(h - e) - c(F_t, \pi_{it})$ is hence incentive-compatible. By symmetry, this holds for every client i.

Third, the analysis focuses on the interplay between formal insurance and social risk-sharing. The model abstracts from other coping mechanisms, apart from current income. Survey data suggest that 27.8 percent of our study population uses mutual insurance as their main strategy to cope with illnesses and injuries. Another 22.6 percent relies on their business income as the most important source to finance acute health expenditures. Substantially fewer respondents report other insurance strategies like selling assets or depleting their savings.

Clients' risk preferences form the fourth building block of the model. Client $i \in \{1, ..., n\}$ with a degree of risk aversion $\theta_i \in \Theta$ maximizes expected utility over the present and all future loan cycles. Utility is time-separable, and utility from earning X within a round is $U(X; \theta_i)$, with $U'(X; \theta_i) > 0$, $U''(X; \theta_i) < 0$ and $U(0; \theta_i) = 0$. Clients are risk averse because $U''(X; \theta_i) < 0$. These are the only restrictions on the parameter set Θ.

We define a threshold level of risk aversion $\theta^* \in \Theta$ such that a client with $\theta_i = \theta^*$ is indifferent between enrolling and not enrolling in a context without joint liability or dynamic incentives; in other words, is indifferent between risk-free earnings $e - ph$ and a gamble of earning e only when healthy:

$$U(e - ph; \theta^*) = (1 - p)U(e; \theta^*) \tag{4}$$

Recall that health expenditures exceed earnings net of loan repayment, $h > e$. Uninsured ill clients therefore 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, $e(1 - p)$, and risk averse clients may forgo actuarially fair insurance.[4]

[4]Insurance is actuarially fair from the perspective of the insurer, but not from the perspective of clients. They have

Equation (4) defines two types of clients: clients with high risk aversion (the 'high RA' type), with a risk aversion parameter $\theta_i \geq \theta^*$, and clients with low risk aversion (the 'low RA' type), with $\theta_i < \theta^*$. High RA clients weakly prefer to enroll when facing an insurance decision without joint liability or dynamic incentives. Conversely, low RA clients will not enroll.

When optimizing expected utility, clients take into account beliefs about the current and future number of insured peers and information on insurance decisions in the past. They have complete information on pay-offs and types, as well as perfect recall of peers' past health shocks and insurance decisions.

2.2 The value of insurance

The insurance decision entails a social dilemma when clients strategically forgo insurance even though insurance optimizes group welfare. We consider parameter ranges in which group welfare is highest if all clients enroll in every loan cycle t ('Full Enrollment', *FE*). This section first defines total expected utility under *FE*, where $d_{it} = 1$ for all i, t, and compares it to total expected utility when no client ever enrolls, i.e. $d_{it} = 0$ for all i, t ('Zero Enrollment', *ZE*). Next, we state a number of key conditions regarding these two values.

The value of *FE* in loan cycle t is defined as client i's total discounted expected utility if the entire group has insurance in the current and all future loan cycles. In this case, client i's disposable income is $e - ph$ forever,

$$V_t(FE; \theta_i) \equiv \sum_{s=t}^{\infty} \beta_{t,s} U(e - ph; \theta_i), \tag{5}$$

where $\beta_{t,s} \equiv 1/(1 - \delta_{t,s}) < 1$ is the period-t discount factor and $\delta_{t,s}$ the period-t discount rate for loan cycle s. The present loan cycle is not discounted, so $\beta_{t,t} = 1$.

limited liability, because delinquents do not fully repay their loan. Delinquency is an externality either for the jointly liable group or the microfinance institution.

Client i's value with no group member ever having insurance, *ZE*, is:

$$V_t(ZE;\theta_i) \equiv \sum_{s=t}^{\infty} P_0^{s-t}\beta_{t,s}(1-p)\,\mathrm{E}\,U(e - c(F_s, e);\theta_i) \tag{6}$$

Under *ZE*, an uninsured individual is healthy with probability $1-p$, earns $\pi_{it} = e$, and contributes $c(F_t, \pi_{it})$. With probability p, a client is ill and has zero income, $\pi_{it} = 0$, yielding zero utility. The group continues borrowing with probability P_0, the probability that a fully uninsured group can repay the loan.

To restrict the analyses to parameters at which a social dilemma exists, we specify three conditions. The first condition rules out the existence of 'always-takers' who prefer to have insurance even if no other group member is ever insured. Formally, the value of taking insurance once in an otherwise uninsured group is strictly below the value of never enrolling, $V_t(ZE;\theta_i)$, even for the most risk averse client:

$$\sup_{\theta}\left[\mathrm{E}\,U(e - ph - c(F_t, e-ph);\theta_i) + P_1\beta_{t,t+1}V_{t+1}(ZE;\theta_i) - V_t(ZE;\theta_i)\right] < 0 \tag{7}$$

A client who is the only one in her group to have insurance earns e, pays the insurance premium ph, and contributes $c(F_t, e - ph)$. With probability P_1, her group (with one insured client) repays and continues to the next loan cycle.[5]

Condition (7) is very weak. Although insured clients are less likely to incur own health expenses, they are more likely to contribute for ill peers. This reduces the benefits of insurance in otherwise uninsured groups substantially.

A second condition is that full group enrollment in all periods, *FE*, is welfare-improving on zero enrollment, *ZE*, for all $\theta_i \in \Theta$:

$$V_t(FE;\theta_i) > V_t(ZE;\theta_i)\ \theta_i \in \Theta \tag{8}$$

This condition holds for every $\theta_i \in \Theta$ if it also holds for the lowest degree of risk

[5] Note that if a client prefers not to have insurance once in an otherwise uninsured group, this will generalize to any number of loan cycles under the assumption that the discount rate, $\delta_{t,s}$, is constant or increasing in t.

aversion, i.e. the limiting case of risk-neutrality. This is true for a wide range of parameters. Condition (8) is always satisfied for the high RA type:

LEMMA 1 *If* $\theta_i \geq \theta^*$, *then* $V_t(FE; \theta_i) > V_t(ZE; \theta_i)$.

See Appendix A for all proofs. For high RA clients, *FE* has three benefits compared to *ZE*. Within a round, it mitigates their own risk of incurring health expenditures. It also reduces the risk of contributing for ill peers. Further, by eliminating the group default risk, it increases future expected utility. This also explains why the second inequality in Lemma 1 is strict.

Figure 2 shows the combinations of health shock probabilities p (horizontal axis) and a constant discount factor β (vertical axis) that satisfy Condition (7) and Condition (8).[6] Regime 1 violates Condition (8) in the limiting case of risk-neutrality. At high discount rates, or low β, clients with linear utility do not sufficiently value the increased probability of continued access to loans, so that *FE* does not improve welfare over *ZE*. The same *might* hold for the low RA type with $\theta_i \in \Theta$, $\theta_i < \theta^*$. Also, as the health shock probability and hence the insurance premium increases, *FE* becomes increasingly unattractive since the premium is not actuarially fair from a client's perspective.

In Regime 4, Condition (7) does not hold, meaning that we cannot rule out the existence of 'always-takers'. At very low discount rates, or high β, infinitely risk averse clients always prefer to have insurance, even in otherwise uninsured groups. Insurance increases the continuation probability from P_0 to P_1, which they value more than the cost of paying the premium and having to contribute for delinquent peers at the same time. We therefore restrict the analyses to Regimes 2 and 3, where every client prefers *FE* over *ZE*, regardless of her level of risk aversion $\theta_i \in \Theta$, and where taking insurance in an otherwise uninsured group reduces welfare for even the most risk averse client.

[6]The figure fixes other parameters to the values as adopted in the game, with $n = 5$, $h = e + l$, and $c(F_t, \pi_{it}) = \min(\pi_{it}, F_t(h - e)/(n - F_t))$. We also analyzed whether Conditions (7) and (8) hold for other values of n, h and e, and assuming a changing discount factor (most notably the discount factor used to analyze optimal behavior in the experiment: $\beta_{t,s} = 1$ for all $s \leq 4$ and $\beta_{t,s} = (5/6)^{s-\max\{t,4\}}$ for all $s > 4$). These analyses yielded qualitatively similar predictions (calculations available upon request).

A third condition is that the probability of continuation satisfies $P_{n-1} = 1$, meaning that $n-1$ insured clients earn enough to contribute for the one uninsured group member, $(n-1)(e-ph) \geq h-e$. This constrains the ratio of net earnings after loan repayment and health expenditures:

$$\frac{e}{h} > \frac{1+(n-1)p}{n} \tag{9}$$

Without loss of generality, this condition makes the free-riding problem more salient. If all peers enroll, a client can decide to forgo insurance without reducing the probability that she continues to the next loan cycle.

These conditions ensure that *FE* optimizes total welfare in the group, not only compared to *ZE*, but compared to any insurance allocation within the group. The following lemma states that if all group members prefer *FE* over *ZE*, group welfare under *FE* is at least as large as under partial enrollment:

LEMMA 2 *If (8) and (9) hold, then* $\sum_i V(FE;\theta_i) \geq \sum_i V(\boldsymbol{d};\theta_i)\ \forall\ \boldsymbol{d} \in D^C$,

where $\boldsymbol{d}$ is an n-vector with the ith element indicating that individual i has insurance and D^C is the set of insurance allocations satisfying $n_t^I(e-ph) \geq (n-n_t^I)(h-e)$ - i.e. insured clients' joint earnings are sufficient to contribute for the $n-n_t^I$ uninsured peers. The insured clients will hence ensure continuation.

The intuition for this lemma is as follows. Because insurance is actuarially fair, total group earnings under partial enrollment are a mean-preserving spread of risk-free earnings under full enrollment (as long as a sufficient number of members enroll to avoid group default). Partial enrollment raises expected earnings for uninsured clients, but insured clients' earnings are reduced by an equal amount due to contributions for ill peers. Since utility is concave, full group enrollment optimizes group welfare in Regimes 2 and 3.

2.3 The demand for group insurance

We consider two types of insurance: group insurance (GI) and individual insurance (II). The former requires a unanimous decision to enroll. Every round, clients vote either for or against insurance. Voting occurs simultaneously and in private. If and only if all group members vote for insurance, the group will have insurance. Every client then pays the insurance premium. Without such unanimity, nobody enrolls nor pays for insurance.

Let b_{it} indicate the number of peers that client i believes will vote for insurance in loan cycle t and $d^*_{GI}(b_{it};\theta_i)$ her best response to this belief under group insurance. By the following proposition, there is no free-riding under group insurance.

PROPOSITION 1 $d^*_{GI}(n-1;\theta_i) = 1$ *if and only if Condition* (8) *holds for* θ_i. *In addition,* $d^*_{GI}(b_{it};\theta_i) = \{0,1\}$ *for all* $b_{it} < n-1$.

Proof Assume that Condition (8) holds. *FE* improves individual welfare on *ZE*. If client i believes that all peers will vote for insurance, $b_{it} = n-1$, her best response is to vote for insurance, $d^*_{GI}(n-1;\theta_i) = 1$, and attain *FE*. If she believes that some of her peers will not vote for insurance, $b_{it} < n-1$, her vote will not affect the outcome or earnings, and the client is indifferent between voting for and against insurance, $d^*_{GI}(b_{it};\theta_i) = \{0,1\}$. Voting for insurance is a weakly dominant strategy.

Assume that Condition (8) does not hold. *ZE* improves individual welfare on *FE*, or keeps welfare equal. Thus, if $b_{it} = n-1$, her best response is not to vote for insurance and attain *ZE*. If $b_{it} < n-1$, she will again be indifferent between voting for and against insurance. Voting for insurance is hence a weakly dominated strategy. ■

Group insurance eliminates free-riding since a vote against insurance also bars all peers from insurance. This increases the risk of contributing for peers and of group default. Further, if Condition (8) holds, it is also relatively easy to coordinate on *FE* because voting for insurance is a weakly dominant strategy for all clients. By Lemma 2, taking insurance then maximizes group welfare.

2.4 Individual insurance: A prisoner's dilemma

In the individual insurance game, group members decide simultaneously and in private whether to enroll in insurance. Unlike group insurance, a client can take individual insurance independent of her peers' decisions. Every client willing to join pays the insurance premium and receives insurance coverage.

This section will derive whether *FE* is a pure strategy Nash equilibrium for different types of players. We are interested in whether free-riding occurs among individuals who believe that all peers will enroll. Our purpose is to analyze whether in theory the group can commit to *FE* when this outcome optimizes group welfare. Many mixed strategies and other possible equilibria exist, but our aim is not to provide a full listing of all equilibria.

Denote $d^*_{II}(b_{it}, \theta_i)$ as client i's best response if she believes that b_{it} peers will enroll under individual insurance (II). We define free-riding as follows:

$$d^*_{II}(n-1, \theta_i) = 0$$

In words, for a client who believes that all $n-1$ peers will enroll, the best response is to forgo insurance. *FE* is then not an equilibrium. The next theorem states when free-riding occurs. Appendix A provides a proof.

THEOREM 1 *Given Condition* (9) *and Definition* (4)*,*

$$d^*_{II}(n-1, \theta_i) = \begin{cases} 1 \ \forall \ \theta_i \geq \theta^* \\ 0 \ \forall \ \theta_i < \theta^* \end{cases}$$

and FE is not a Nash Equilibrium if at least one group member has $\theta_i < \theta^*$*. If in addition Condition* (7) *is satisfied for a contribution* $c(F_{it}, \pi_{it})$ *as defined in Equations* (2) *and* (3)*, then there is at least one other Nash equilibrium, ZE:*

$$d^*_{II}(0, \theta_i) = 0 \ \forall \ \theta_i \in \Theta$$

Intuitively, by Condition (9), a client who believes that all peers will enroll believes that her peers will ensure continuation to the next loan cycle, irrespective of her own insurance decision. She hence faces a trade-off between the one-time risk-free insurance option and a gamble with higher but uncertain earnings, as in a context without joint liability and dynamic incentives.

By Definition (4), the best response is to enroll if and only if $\theta_i \geq \theta^*$. Low RA clients with $\theta_i < \theta^*$ will free-ride on contributions from insured peers, so *FE* is not an equilibrium if at least one group member has low risk aversion. Conditions (7) and (8) are not necessary for this first result.

Although FE is not always an equilibrium, *ZE* is. This holds independent of clients' level of risk aversion by Condition (7). Taking insurance in an otherwise uninsured group is costly, even for high RA clients.

This results in equilibrium predictions for three types of groups. First, groups with only low RA group members face a Prisoner's Dilemma. While *FE* optimizes group welfare, every individual has a private incentive to free-ride and forgo insurance, leading them to the *ZE* equilibrium. Every client will have lower expected earnings, and face more risk than under *FE*.

Second, in mixed groups with a limited number of low RA clients, the less risk averse will free-ride. More risk averse clients may in turn decide to forgo insurance as well. Even if part of the group enrolls, total group welfare is suboptimal by Lemma 2. Such free-riding does not only imply a transfer of expected earnings from high RA to low RA clients, but also increases the variance of earnings over time, harming high RA clients' welfare.

Third, groups with only high RA members do not face a free-riding problem. The best response of a high RA client who believes that all peers will enroll is to enroll as well. Because *ZE* is an equilibrium, groups with only high RA clients might however fail to coordinate on the welfare-improving *FE* equilibrium if clients believe some of their peers will not enroll.[7]

Finally, note that the model ignores losses due to lower productivity or sick-

[7]This coordination problem can also be interpreted as a case of background risk. Purchasing insurance increases the probability of having to contribute for uninsured ill peers. So far, the literature has attributed low demand to other types of background risk, for instance limited credibility of the insurance provider (Dercon, Gunning and Zeitlin, 2011).

ness absenteeism. Our focus on expenditures does not qualitatively affect the free-riding theorem. Even when insurance does not cover all losses associated with health shocks, a level of risk aversion θ' exists such that clients with $\theta_i < \theta'$ have an incentive to free-ride if *FE* optimizes group welfare. Income losses however may reduce the size of the area in which *FE* optimizes welfare by decreasing future income. Thus, Regime 1 would encompass a larger range of parameter values, while Regimes 2 and 3 diminish in size.

2.5 Solutions to free-riding

Although our theory predicts free-riding for a wide range of parameter combinations, it is not trivial that our theorem holds empirically, especially in a microfinance setting where group membership is a long-term commitment. Groups borrow often increasing amounts conditional on prior loan repayments, and switching groups is costly. Clients will hence face repeated insurance decisions within the same group, and they might sanction free-riders by staying uninsured.[8] Conventional laboratory experiments indeed find that dynamic interactions enhance cooperation (Bó, 2005).

To analyze when dynamic interactions can induce cooperation in microinsurance decisions, assume that the best response d^*_{II} depends on past insurance decisions. If $d_{i\tau}$ indicates the insurance decision of group member $i \in \{1, ..., n\}$ in loan cycle τ, with $d_{i\tau} = 1$ if client i took insurance in cycle τ and $d_{i\tau} = 0$ otherwise, clients can for example play the following grim trigger strategy:

$$d^*_{II} = \min d_{j\tau} \ \forall \ j \neq i, \tau \in \{1, ..., t-1\}$$

Assuming that all group members adopt this strategy, the strategy is credible since *ZE* is an equilibrium by Condition (7). A client who believes that none of her peers will enroll has no incentive to enroll herself.

[8] Alternatively, clients could exert direct social pressure. Fehr and Gächter (2000) show that individuals are willing to punish their peers even if this is costly. We allow for retaliation through future decisions. Immediate sanctions are left for future research.

Dynamic incentives need to be sufficiently strong for this threat to be effective. A client tempted to free-ride will enroll only if her current utility gain from free-riding is smaller than future losses due to peers staying uninsured in the future:

$$(1-p)U(e;\theta_i) - U(e-ph;\theta_i) \leq \beta_{t,t+1}\left(V_{t+1}(FE;\theta_i) - V_{t+1}(ZE;\theta_i)\right) \tag{10}$$

In Figure 2, Inequality (10) is not satisfied in Regime 2 with relatively low discount factors, even in the limiting case of risk-neutrality. Regime 3 with a higher discount factor, on the other hand, satisfies (10) for any $\theta_i \in \Theta$. Here, the threat of future retaliation is sufficiently strong to commit free-riders to the social optimum.

Further, social ties, norms and communication in a group may reduce free-riding (Sally, 1995). Even when oral agreements are not enforceable, empirical evidence suggests that communication creates social capital, can reinforce social norms and limit free-riding, for instance since individuals perceive a cost of lying or feel guilt from blame (Battigalli and Dufwenberg, 2007; Vanberg, 2008; Charness and Dufwenberg, 2011). This result will be strongest in groups with close social ties (Cassar, Crowley and Wydick, 2007). Further, communication shapes focal points and beliefs, helping the group coordinate on full group enrollment.

To summarize, we hypothesize that microcredit groups with at least one low RA client will have suboptimal demand for individual insurance due to a social dilemma. If full group enrollment optimizes social welfare, even low RA clients will be willing to join group insurance. They are however tempted to free-ride under individual insurance, unless social ties, norms, communication or the threat of retaliation in repeated insurance decisions induce cooperation. Otherwise, only groups with high RA clients are able to coordinate on the social optimum.

3 Method

3.1 Design

To test the free-riding mechanism, we conducted a framed field experiment with 355 clients from a microfinance institution (MFI) in Dar es Salaam, Tanzania.

Participants first played a basic microinsurance game to measure their risk aversion type. A second game elicited their demand for either group or individual insurance. This public goods game framed the insurance decision in a jointly liable microcredit group and closely resembled the theoretical framework described in Section 2. For participants used to group lending, the microcredit frame may trigger different norms and behavior compared to an abstract public goods game.

Framed field experiments offer several advantages over empirical methods outside the laboratory. First, the laboratory provides a controlled setting where distortions of e.g. initial beliefs, health and social capital do not bias the results. 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. 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).

At the same time, the high degree of control in the laboratory goes hand-in-hand with an abstraction from other mechanisms that drive insurance decisions. Although the main game resembles group-based lending as closely as possible, the demand for microinsurance in jointly liable credit groups depends on more factors than can be studied simultaneously in a game. The concluding section discusses a number of mechanisms to consider when interpreting our theoretical predictions outside the laboratory.

3.1.1 Game 1: Measure for risk aversion

Participants first played an individual insurance game *without* joint liability or dynamic incentives. The left-hand side of Figure 1, earnings before contributing, represents this introductory lottery. A participant borrows $l = 40,000$ Tanzanian Shillings (TZS; 26.67 USD) and falls ill with probability $p = 1/5$.[9] Healthy participants, able to repay their loan, earn $\pi_{it} = e = 22,500$ after loan repayment.

[9] This is higher than the 10.2 percent of participants who report health expenditures equal to or above monthly per capita income. Nonetheless, given the value of the discount rate β in the games, free-riding may occur in theory for all $p < 0.33$ as we will show later using Figure 2.

Ill participants incur health expenditures that fully absorb their earnings before loan repayment; $h = 62,500$. As a result, they cannot repay their loan and receive nothing, $\pi_{it} = e + l - h = 0$.

Before the realization of the health shock, participants can take insurance at a premium equal to $ph = 12,500$. An insured player receives $\pi_{it} = e - ph = 10,000$ with certainty after loan repayment. The participant hence faces a trade-off between lower risk-free earnings versus higher but risky earnings.[10] By Definition (4), a client has high risk aversion, $\theta_i \geq \theta^*$, if and only if she enrolls. In that case, her CRRA parameter is calculated to be $\theta_i \geq 0.725$, which Holt and Laury (2002) classify as very risk averse. Because there is no joint liability, our measure reflects risk attitudes rather than social preferences or beliefs about peers' decisions. We do not separate risk aversion from a certainty or framing effect, but the decision in the first game is sufficient to separate the two theoretical participant types.

3.1.2 Game 2: Group versus individual insurance

Next, in groups of $n = 5$ clients, participants played a microinsurance game *with* joint liability and dynamic incentives. Group members contribute for delinquent peers who cannot repay their share of the loan, and defaulting groups do not continue to the next loan cycle. All other parameters are the same as in the first game.

Note that the group can contribute for at most one delinquent. If one group member cannot repay, her four repaying peers (both insured and uninsured) each contribute $10,000$. The group loan is fully repaid and the group continues to the next loan cycle. If more than one group member cannot repay, the remaining group members' disposable income is at most three times 22,500, which is insufficient to contribute the 80,000 required for two delinquents. In that case, the group defaults and repays as much as it can afford. After contributing, profits are zero for all members and the game ends.

[10] To enhance understanding of the dynamic incentives, a participant played two rounds of this game and moved to the second round only if she repaid the first loan. Dynamic incentives are absent in the second and last round. The risk aversion measure uses decisions in this round, assuming that uninsured individuals who defaulted in the first round would have forgone insurance in the second round as well. Using first- instead of second-round decisions yields similar results.

Similar to Cassar, Crowley and Wydick (2007), participants are told that they will play the game for a large, unknown number of rounds to avoid a last round effect. The game continues for at least four rounds as long as the group repays. After the fourth round, one group member tosses a die. If the die lands at 1, the game ends for the group.[11] Or, as stated by one of the participants (based on transcripts from participants' communication during the games):

> *"I congratulate our sister for throwing another number than one, which enables us to play this round. That means the game goes on and our earnings increase as well."*

As earnings are accumulated within a relatively short time span, we assume that there is no time discounting during a session.[12] Rather, the value of future rounds is determined by the probability of continuation in the game. We therefore substitute $\beta_{t,s}$, the period-t discount rate for loan cycle s, by the conditional probability of reaching round s:

$$\beta_{t,s} = 1 \ \forall\ s \leq 4 \text{ and } \beta_{t,s} = \frac{5}{6}^{s-\max\{t,4\}} \ \forall\ s > 4 \tag{11}$$

The cross in Regime 3 of Figure 2 indicates the game-specific parameter values. At the cross, free-riding problems exist but a coordinated grim trigger strategy is credible and effective.[13] Because participants will anticipate that the game cannot continue forever, $\beta = 5/6$ is an upper bound for rounds 4 and higher. Nonetheless, a free-riding problem also exists at lower values of β in Regime 2 and 3.

At the start of the experiment, every participant received a symbol that she was asked not to reveal to others. Participants learned about the insurance decision and health status of the other symbols in their group, i.e. their peers. This information was revealed after every round, also after the first game used to elicit risk aversion. Hence, participants know the types of their peers and can update their beliefs about

[11] Because of time constraints, clients played at most six rounds in practice, but were not informed of this.

[12] The time-separable utility function however does assume narrow bracketing of earnings into different loan cycles.

[13] The figure applies to rounds 4 and higher, in which β remains constant. However, calculations generalize to all rounds with β as in (11). Calculations are available upon request.

peers' actions. The identification through anonymous symbols limits the effects of future outside interactions on behavior in the game.

In this second game with joint liability, treatments vary in two dimensions. First, under individual insurance (II), enrollment is an individual decision. Under group insurance (GI), clients enroll if and only if all group members express their willingness to join in an anonymous vote. This treatment reveals whether individuals prefer full over zero enrollment in a context with joint liability and therefore tests Condition (8). Alternative treatments such as mandatory insurance and individual liability are unable to verify this key assumption. In the former alternative, clients cannot reveal their preference, and in the the latter, insurance is valued differently as there is no risk-sharing within the group. Group insurance provides a benchmark for optimal demand and lower demand under individual insurance indicates the social dilemma.

The experiment also varies the possibility to communicate. In treatments without communication (II-NC and GI-NC), clients cannot talk to other participants. In the communication treatments (II-C and GI-C), group members can talk for two minutes preceding every round. This helps identifying whether verbal interactions, inevitably occurring in real life, can solve the social dilemma. Assistants tape-recorded, transcribed and translated communication to English.

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

Treatments varied by session. We organized fourteen sessions with on average five groups of five clients each. The experiment included six sessions with individual insurance, three with and three without communication, and 75 participants in both treatments. Eight sessions were organized for the group insurance treatments, four with and four without communication, with 115 and 90 participants, respectively. Every participant was assigned to only one treatment to avoid order effects.

3.2 Hypotheses

The main outcome of interest is the proportion of rounds that a participant is willing to join insurance, henceforth called demand. Under group insurance, demand is derived from the individual votes by round. These reveal whether participants have a preference to enroll when there are no opportunities to free-ride.[14] The experiment tests for lower demand in individual compared to group insurance sessions, distinguishing between three types of participants: (i) low RA clients, (ii) high RA client in groups with at least one low RA member, and (iii) high RA client in groups with only high RA members.

We test Theorem 1, which predicts suboptimal demand for groups with low RA participants but not for groups with only high RA participants. When a low RA participant believes that all her peers will enroll, her best response is to take group but not individual insurance. Such free-riding may also affect demand among high RA peers. The least risk-averse client of the high RA type will not enroll as soon as she believes that at least one peer will free-ride. If a client believes that more peers will free-ride, increasingly risk-averse participants will decide not to enroll either. When all peers remain uninsured, even clients with risk aversion going to infinity will forgo insurance.[15]

In contrast, in groups with only high RA clients, a client's best response is to enroll in individual insurance only if she believes that her high RA peers will enroll as well. Uncertainty about peers' actions may cause a coordination failure, but the communication treatment will minimize the uncertainty about the behavior of group members.

[14] We assume that participants play their weakly dominant strategy.

[15] Calculations are available upon request. Predictions also apply to a wider range of discount factors $\beta_{t,s}$, and to the specification for $\beta_{t,s}$ in (11).

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 officers for weekly repayment. During these meetings, clients were invited to come to one of the sessions, introduced as interactive seminars for a research project on health insurance. They could bring along credit group members. 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). Every treatment was played at most once in an area and treatments were not announced during mobilization. Clients knew that only members of their MFI would participate, that the research was independent of the MFI, and were assured confidentiality.

A session lasted approximately 3 hours. First, assistants administered a short questionnaire on participants' socio-demographics, health and credit group-related characteristics. Three games were then played: (1) the first game with both insurance and lending at the individual level to elicit a measure for risk aversion - including a practice round; (2) the same game but with a higher insurance premium of 17,500 TSH, compared to the standard premium of 12,500 TSH, which served as a robustness check; and (3) the main game with joint liability and dynamic incentives eliciting demand for either group or individual insurance - also preceded by a practice round.

Participants received their earnings after every round. This helped understand the financial implications of their decisions and will have induced them to bracket, or evaluate, earnings by round rather than in terms of cumulative outcomes. At the same time, it may have created wealth effects. This experiment could not randomly select one of the rounds for payment, since dynamic incentives are a core feature of the game. Individual earnings were therefore stored in closed boxes (piggybanks), so that participants would not keep accumulated earnings on hand. Total earnings from the piggybank were paid in cash at the end of the session. For every 10,000 earned, a participant received 1,000 TZS. The average participant earned 18,000 TZS (US $ 12), approximately 2.5 days of business profit.

4 Data

4.1 Study population and participant characteristics

The microfinance games were played by clients of Tujijenge Tanzania Ltd, an MFI providing microcredit in several areas of Dar es Salaam since 2006. 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 repayment. They formulate by-laws such as fines for not repaying ("delinquency") in their weekly meetings.

Columns (1) and (2) in Table 1 describe the main characteristics of the 355 participants in the games. Panel A summarizes demographic and socio-economic characteristics. As is common in MFIs, the majority of our participants is female. Participants are on average 36 years old and 76.1 percent is married. The average participant has 5.1 household members and has completed around 7 years of education, corresponding to primary school. Monthly per capita income is on average 84,400 TZS (US $ 54).

Panel B describes the population in terms of health characteristics. Just more than half (54.9 percent) of the participants consulted a health care provider in the past three months, and for 73.5 percent, at least one other household member did so. Health expenditures, averaged over all household members over that same period, were 43,000 TZS, or 8,300 TZS (US $ 5) per capita. This is 9.9 percent of monthly per capita income. In the past three months, the event that a household member needed health care but did not receive it due to a lack of money occurred on average 0.6 times. Finally, although 41.1 percent of the participants know what health insurance is, only 7.3 percent are enrolled; mainly because insurance is virtually inaccessible for workers outside the formal sector.

Panel C presents credit-related variables. The average monthly business profit is TZS 226,000 (US $ 145) and represents a considerable proportion of total household income. The average participant has been a member of Tujijenge for a little more than one year, and eleven percent of participants are waiting to take out their next loan. Approximately one third indicates that at least one member of their credit group defaulted during a meeting in the past three months. Respondents contributed for almost all delinquents. Among respondents who failed to repay themselves, a much lower percentage reports that group members contributed. Participants are either more supportive to their group members than non-participants, or give socially desirable answers to these sensitive questions.

The last variable examines the social ties between group members in the games. Within sessions, participants were randomly assigned to groups. On average 0.5 of their game group members were also a member of their real credit group. Pre-existing social ties could potentially affect enrollment decisions through trust, co-operation and beliefs. We will exploit random variation in the number of real group members to check whether social ties offer a solution to the social dilemma.

The next section discusses Panel D. Columns (3) and (4) compare our sample to a representative survey among 407 Tujijenge clients conducted three months before the microfinance games. Column (3) gives the population averages based on this survey and the significance of the *t*-statistic from testing for equal means in the two samples. Column (4) shows the standard deviation of relevant variables.

Game participants are more likely to be female, have larger households, less education and are less likely to be insured than the average Tujijenge member. Participants are also twice as likely to have visited a health provider in the past three months. This could be due to 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 surrounding areas.

The sample of participants does not perfectly resemble the respondents in the representative survey. As is common in framed field experiments, microfinance clients would only attend a session when interested. Further, since the survey was conducted three months earlier, it will have included clients who already dropped out of the group by the time of the experiment, as well as inactive clients from the MFI's register who were not borrowing at the time of the experiment. This should be kept in mind when interpreting the results.

4.2 Risk aversion

Panel D summarizes the measure of risk aversion. Using the first game without joint liability and dynamic incentives, we classify 25.6 percent of the participants as 'low risk averse'; 46.2 percent are of the 'high risk aversion' type with at least one low RA peer; and the remaining 28.1 percent are 'high risk averse' participants with only high RA peers.

This large share of high RA participants implies a relatively risk averse sample compared to participants in conventional risk lotteries as discussed in Section 3.1.1. Framing the lottery as an insurance decision may have induced loss-averse behavior or a preference for certainty. This does not confound our identification strategy, which only requires that first-game decisions predict second-game equilibrium strategies.

Due to time constraints within sessions, we did not play standard risk lotteries such as Binswanger or Holt and Laury. To validate our measure, Columns (5) to (8) present a Probit model for low risk aversion as a function of participants' characteristics. Columns (7) and (8) only include the variables common to both the representative survey and the questionnaire administered with participants in the experiment.

Consistent with our expectations, women as well as participants with higher household health expenditures are more risk averse, although the coefficient for the first variable is not statistically significant in the full model. Participants from larger households, who have more opportunities for intra-household risk-sharing, and those with health insurance are less risk averse. The latter finding is most likely due to a wealth effect. In the absence of microinsurance only formally employed households have access to insurance.

Risk aversion increases with the number of membership years and with having an outstanding loan. People in debt might be more risk averse. None of the delinquency and contribution variables in Panel C is significant. This increases confidence that the risk aversion measure is not correlated to social preferences or 'good borrower behavior', but rather measures preferences towards the riskiness of private earnings.

The extent of free-riding depends on the target group's risk profile. Our theory predicts that the social dilemma will be more pronounced in target groups with a large proportion of low RA individuals. We use the model in Columns (7) and (8) to predict out-of-sample that 30.7 percent of clients in the target group have low risk aversion (see Column (3) in Panel D). This is slightly higher than the 25.6 percent in the participant sample. Our results will therefore represent a lower bound for the level of free-riding in the population. 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 percent confidence interval equal to [23.3, 38.2].

4.3 Balance of characteristics over treatments

To examine the comparability of treatment groups, Table 2 compares the characteristics of participants in group insurance versus individual insurance sessions. The first two columns compare low RA participants under individual and group insurance. The next two columns restrict the sample to high RA participants with low RA peers. The last two columns present the same comparison for high RA participants with only high RA peers.

The assignment to treatments seems to have resulted in relatively comparable treatment groups. Participants in group insurance and individual insurance sessions are very similar in terms of most key characteristics. Only a few characteristics are not well balanced over the two treatments. Under individual insurance, low RA participants are younger and less likely to have defaulted in the past 3 months; high RA participants with low RA peers come from larger households with higher business profits and fewer outstanding loans; high RA participants with only high RA peers are more likely to have insurance and outstanding loans. We will show that the regression results are robust to including these characteristics as control variables.

Some of the game-related variables in Panel D vary in absolute terms across treatments. The risk types themselves are well-balanced across treatments. In the group insurance treatment, 26.3 percent of participants are of the low RA type, versus 24.7 percent in the individual insurance treatment ($p = 0.722$). However, participants offered individual insurance are less often grouped with peers of the same type. As a result, the number of low RA peers is lower under individual insurance. The regressions will control for this variable and analyze interaction effects with the individual insurance treatment.

Further, health shocks are random in the games and occur for around 20 percent of the observations as predicted by the law of large numbers. Nonetheless, their incidence is not perfectly balanced, especially in the first game and for low RA participants. Results are robust to including the proportion of ill rounds in the first game as well as the public goods game as control variables.

5 Results

This section tests Theorem 1, focusing on 'demand' as the main outcome variable, i.e. the proportion of rounds that a participant is willing to join while still in the game. We first treat every session as one observation and use a one-sided Mann-Whitney test to examine whether individual insurance sessions rank lower in terms of average demand compared to group insurance. Second, a regression model for individual demand tests whether the non-parametric findings are robust to the inclusion of control variables. Third, we analyze to what extent communication and social ties affect the main results. The final part analyzes whether results are sensitive to the number of low RA peers.

We use the proportion of rounds that a participant is willing to join instead of the willingness to join per round to avoid an attrition bias due to selective group default. Figure 3 plots the cumulative percentage of participants that are out of the game in a given round by risk aversion type. High RA types with only high

RA peers are excluded from the figure because these groups never defaulted. The figure shows substantial default rates, especially in the group insurance treatment. Treating every participant instead of every decision as one observation reduces the bias due to selective group default.[16]

5.1 Non-parametric findings

Figure 4 presents the demand for health insurance among low RA participants. Panel (a) shows the average percentage of rounds that low RA participants are willing to join in group insurance (GI) and in individual insurance (II) sessions, without communication (NC) and with communication (C), respectively. Demand is high under group insurance. The average low RA participant votes for insurance in 84 percent of all rounds. Under individual insurance, the low RA type is significantly less willing to join, and takes insurance only in 42 percent of all rounds ($p < 0.01$). Panel (b) disaggregates demand by round. In line with Theorem 1, demand for individual insurance is suboptimal in every round.

Figure 5 shows demand for group versus individual insurance among high RA participants with at least one low RA peer. Panel (a) again gives average demand by session. Demand is high throughout the game for both group and individual insurance. Participants are willing to join in 93 and 89 percent of all rounds, respectively. Individual insurance sessions do not rank significantly lower than group insurance sessions. Panel (b) disaggregates demand by round and shows that there is a difference only from round 3 onwards. This difference is not statistically significant.

Figure 6 finally compares the willingness to join group insurance versus individual insurance among high RA participants with only high RA peers. Consistent with Theorem 1, demand for insurance is high among this subset of participants in both treatments. On average, participants vote for insurance in 99 percent of

[16] Section 6 returns to the policy implications of these differential default rates. We have also performed all analyses using the decision per round as unit of observation. To control for selective attrition in these analyses, we have a) estimated a Heckman selection model, and b) imputed missing observations with either the last-round decision or a predicted insurance decision. The key results are very similar to the results presented here and are available upon request.

the rounds in the group insurance treatment. Individual insurance sessions do not rank significantly lower, with participants joining insurance in 94 percent of the rounds. Panel (b) presents the willingness to join insurance by round. Demand for individual insurance is slightly lower in later rounds but again this is not statistically significant.

In sum, the non-parametric analysis demonstrates that average demand among low RA participants is significantly lower in individual insurance sessions. While the vast majority of this type is willing to join group insurance, a substantial share of low RA participants forgoes insurance when offered at the individual level. High RA participants on the other hand have high demand for insurance in both treatments, regardless of their peers' types.

5.2 Regression analyses

To test whether these findings are robust to the inclusion of control variables, we estimate a linear model for demand d_{igs}. This variable indicates the proportion of rounds that member i of group g in session s is willing to join. The estimating equation is:

$$d_{igs} = \alpha + \beta_{II} II_s + \beta_{lra} n^{lra}_{igs} + \beta_x x_{igs} + \varepsilon_{igs} \tag{12}$$

where II_s equals 1 under individual insurance and 0 under group insurance, n^{lra}_{igs} is the number of low RA peers, x_{igs} is a control variable, and ε_{igs} an individual-specific residual, assumed to be uncorrelated with the regressors.

Table 3 presents the results for the three subsamples of participants. Column (a) indicates the number of observations for each subsample and (b) their average demand under group insurance. Column (1) controls only for the number of low RA peers. The next columns also control for the variables that significantly differ between group and individual insurance for the low RA subsample (see Table 2). These are, consecutively, the proportion of rounds that a participant was ill in the first game in Column (2); her age in Column (3); a binary variable that indicates whether peers contributed for her in Column (4); and the proportion of rounds that she was ill in the main public good game in Column (5).[17]

We test whether the difference in demand between group and individual insurance, β_{II} in Equation (12), is negative. Every panel in Table 3 presents this estimated coefficient, $\hat{\beta}_{II}$, followed by its standard error in parentheses, clustered at the session level. The next row shows the probability that demand for individual insurance is suboptimal, $\beta_{II} < 0$. Due to a relatively small number of 14 sessions, the table presents the one-sided *t*-percentile in a clustered wild bootstrap. Cameron, Gelbach and Miller (2008) show that this procedure improves inference even when there are as few as five clusters and that this generalizes to cases where the dependent variable is binary instead of continuous.[18] The final row shows the R-squared.

Panel A restricts the sample to low RA participants. The estimated difference is similar in size and significance to the non-parametric estimate. A large share is willing to join group but not individual insurance. In Column (1), individual insurance reduces demand significantly by 43.3 percentage points. This estimate is robust to the inclusion of different controls in Columns (2) to (5). Thus, the slight imbalance in observed characteristics between the treatments cannot account for the large difference in demand for group insurance versus individual insurance.

Panel B estimates the main equation for high RA clients with low RA peers. These results are similar to the non-parametric estimates as well. In the regression framework, demand is on average 3.4 percentage points lower for individual insurance than for group insurance in Column (1). This is a small and statistically insignificant difference. The estimates in Columns (2) to (5) are very similar.

Panel C tests for suboptimal demand among high RA clients with only high RA peers. Individual insurance reduces demand by 6.2 percentage points in Column (1). This difference is relatively small but statistically significant, also when adding controls in Columns (2) to (5). A potential explanation is that the high

[17] We restrict the control set to enable inference in the presence of a limited number of sessions. Results do not change qualitatively when a larger set of control variables is simultaneously included or when we include additional variables that are significant in the comparison for high RA types. Having defaulted is collinear with peers having contributed, and therefore not presented as a separate control variable.

[18] The bootstrap procedure imposes $\beta_{II} = 0$ and uses Rademacher weights for the residuals.

RA participants face a coordination failure. In this case, the problem will be most pronounced in the first round, when participants have not observed their peers' decisions yet and uncertainty is highest. An alternative hypothesis is that some participants have a degree of risk aversion just above the threshold θ^*, as measured at the start of the session. When they accumulate earnings throughout the game, they might become less risk averse and act as the low RA type in later rounds.

Panel A in Table 4 estimates Equation (12) for the first round only. Differences in wealth effects and peers' enrollment decisions between group and individual insurance do not yet influence demand in this round. The first row restricts the sample to low RA clients. Each specification shows a significantly negative coefficient for the individual insurance variable, consistent with Theorem 1.

The second row estimates demand among high RA clients with low RA peers. Their demand in the first round is not significantly lower under individual insurance. Also the third row, focusing on groups with high RA members only, finds no significant effect of individual insurance. This result is difficult to reconcile with a coordination failure, and seems more consistent with the hypothesis that some high RA participants become less risk averse as they are accumulating wealth.

Panel B shows estimates of β_{II} for rounds 2 and higher where participants have updated their beliefs and behavior is influenced by prior decisions. The results become somewhat more pronounced, but the size and significance of the estimates remain broadly similar to that of the estimates in Table 3.

Thus, the regression analyses show a pattern close to the non-parametric results. None of the unbalanced characteristics and game-related variables distort our main findings. Low RA participants have significantly lower demand under individual compared to group insurance throughout the game. For high RA participants both with and without low RA peers, the differences between group and individual insurance are limited and do not appear until later rounds, if at all. The high RA types might become less risk averse as they accumulate wealth, inducing some to start free-riding in later rounds.

This indicates that a substantial proportion of low RA clients are free-riding on their high RA peers. Repeated interactions, communication, social ties and social norms, the solutions to the free-riding problem as discussed in Section 2.5, do not enforce cooperation in all groups.

5.3 Communication and social ties

As discussed in Section 2.5, communication and social ties in microcredit groups may offer a solution to free-riding. To test whether social interactions influence behavior in our experiment, Table 5 presents findings by communication treatment in Columns (2) and (3), and for groups without and with prior social ties in Columns (4) and (5), respectively. In groups with prior social ties, at least two participants know each other from their real microcredit group. The table presents estimates separately for the three types of participants. All estimates of β_{II} control for the number of low RA peers.

The first column repeats the estimates from Column (1) in Table 3. In Columns (2) and (3), the sample is disaggregated by communication treatment. To shed light on the robustness of free-riding to the option to communicate, we test whether demand in the communication treatment is lower under individual insurance compared to group insurance, $\beta_{II} < 0$.[19]

Panel A estimates demand for low RA participants. Inference is weak for the subsamples with and without communication due to a smaller number of sessions. However, the estimated difference between group and individual insurance is large even when communication is permitted in Column (3). Panel B estimates the same model for high RA participants with at least one low RA peer. Their demand under individual insurance is significantly lower than under group insurance only if communication is permitted ($p < 0.10$).

Finally, Panel C restricts the analyses to high RA participants with only high RA peers. In Column (3), the difference is significantly negative, which implies

[19] Since our aim is not to compare the two communication treatments, the table does not test for equal coefficients in Columns (2) and (3). Test statistics are available upon request.

that demand can be suboptimal even when group members have the opportunity to communicate. Recall from the discussion of Table 4 that some high RA participants, potentially driven by wealth effects, may have decided to free-ride in later rounds.

Why does communication not solve the social dilemma under individual insurance? The transcripts of the recorded communication demonstrate that participants are very much aware of free-riding:

> *"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."*

Nonetheless, communication is not sufficient to enforce the social optimum. Although participants condemn their peers for not taking insurance, and these peers promise to take insurance, communication sometimes remains 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."* [from whom the participant can purchase insurance]

Further, whereas the group discussions mostly create focal points to take insurance, the discussions move a few groups away from full enrollment:[20]

> Person 1: *"It is better not to take it and find your own way to get money when you are sick. And if you are not sick the money is gone."* [...]
> Person 4: *"Let us not take health insurance."*

As a second measure of social interactions, Columns (4) and (5) test whether the results are robust to the presence of pre-existing social ties within groups. Pre-existing ties may enhance commitment and coordination in microcredit groups

[20] Only after the game ended due to default two rounds later, the group realized that it would have been better to enroll:

Person 1: *"We are out. Only if we would have taken health insurance the game could not end for us."*
Person 2: *"I told you that health insurance is very important but you did not want to listen to me."*

(Cassar, Crowley and Wydick, 2007). Because participants were randomly assigned to groups, the number of peers from their real credit group is exogenous within sessions. We can hence test whether demand is suboptimal also in groups whose members have close social ties.

Column (4) restricts the sample to participants assigned to a group without any of their real microcredit group members. Column (5) focuses on participants that have close social ties with at least one of their group members in the games. Demand for individual insurance is suboptimal in both cases among low RA participants. This suggests that our experimental evidence of free-riding is not an artifact of anonymous groups, and that they may generalize to real microcredit groups with frequent social interactions.

For high RA participants with low RA peers, individual insurance does not affect demand both in groups with and without social ties. Finally, for groups with only high RA participants, demand under individual insurance is lower only in groups without prior social ties. This provides some suggestive evidence for social ties solving the social dilemma among this subsample.

5.4 The number of low RA peers

This section investigates to what extent our results are sensitive to differences in the number of low RA peers within a group. Theorem 1 predicts that when all peers are of the high RA type - which we use as a proxy for the belief that all peers will enroll - a client's best response is not to enroll *if and only if* she is of the low RA type herself. To test this empirically, we investigate whether the difference in demand for individual versus group insurance is heterogeneous depending on the number of low RA peers, n^{lra}_{igs}. Due to the random assignment to groups within a session, this variable is exogenous.

Adding the interaction between the number of low RA peers and the individual insurance variable to Equation (12), we obtain the following linear model for demand:[21]

$$d_{igs} = \gamma + \delta_{II} II_s + \delta_{lra} n_{igs}^{lra} + \eta(II_s \times n_{igs}^{lra}) + \omega_{igs} \tag{13}$$

A free-riding participant will always opt out of individual insurance, even when she believes that all her peers will enroll, $b_{igs} = n - 1$. Because mainly low RA but not high RA types forgo individual insurance, the interaction between individual insurance II_s and the number of high RA peers, $n - 1 - n_{igs}^{lra}$, proxies beliefs under the assumption that participants use peers' prior decisions to update their beliefs. We reject the free-riding hypothesis if $\delta_{II} = 0$, that is, if participants enroll when all peers are of the high RA type, $n_{igs}^{lra} = 0$, and the participant hence believes that they will all enroll, i.e. $b_{igs} = n - 1$.

Table 6 estimates Equation (13). Results are presented for low RA and high RA participants separately. Columns (1) and (3) look at demand in the second round only. These columns represent the initial response to having a low RA peer in the individual insurance treatment. The dependent variable in Columns (2) and (4) is the proportion of rounds that a participant is willing to join using Rounds 2 to 6. The coefficients in these columns reflect group dynamics over the entire game, including peers' responses to ones own past behavior.

The first row presents the coefficient for individual insurance, δ_{II}, i.e. the difference in demand for participants who do not have any low RA peers. Consistent with the free-riding hypothesis, this coefficient is negative and significant for low RA participants in Column (1) and Column (2). A large number of low RA participants opt out even if they believe that all peers will enroll. For high RA participants with only high RA peers, we do not find a significant difference in Columns (3) and (4) - consistent with previous estimates. They are not tempted to free-ride.

Members of social risk-sharing networks may sort on risk attitudes (Genicot and Ray, 2003; Attanasio et al., 2012). This could result in homogeneous groups with either only high RA clients, or only low RA clients. An empirical question

[21] We do not include control variables here, but the estimates are robust to the inclusion of the control variables listed in Table 2.

is hence whether the social dilemma becomes more pronounced if a group has a larger fraction of low RA members.

The second row indicates by how much every additional low RA peer reduces demand for individual insurance. Among low RA participants, we find a robust and significant negative effect of having an additional low RA peer under individual insurance in Columns (1) and (2). This suggests that assortative matching would magnify the social dilemma among the low RA. There is no significant effect of additional low RA peers in Columns (3) and (4). High RA participants apparently do not sanction their free-riding peers by forgoing insurance themselves.

Given the observed level of tolerance towards free-riding peers, it is rather puzzling that not all low RA participants defect on full group enrollment. Despite their unwillingness to join insurance in the first game without joint liability, some choose to join when grouped with other clients. Communication, social ties and trigger strategies - as discussed in Section 2.5 - do not appear to explain this finding. We cannot rule out the hypothesis that pre-existing social norms have induced cooperation among some low RA participants.

To conclude, we find substantial evidence of the free-riding hypothesis among low RA types. Although insurance is welfare-enhancing even for low RA participants as revealed in the group insurance treatment, a large share forgoes individual insurance at the expense of their insured peers. Despite the repeated nature of the game, the threat of retaliation was not sufficiently strong to prevent all low RA participants from free-riding. Throughout the game, relatively few high RA participants conditioned their enrollment decision on the behavior of peers.

These patterns stand in contrast to findings from conventional laboratory experiments in at least two respects. First, the tolerance for free-riders in this framed field experiment is difficult to reconcile with high punishments observed even in the last round of conventional public good games. Second, despite this tolerance for free-riders in some groups, a number of low RA clients in other groups decide to cooperate. A question for future research is whether this is due to social norms of solidarity among microfinance clients.

6 Policy implications and external validity

The previous section discussed demand, i.e. the willingness to join insurance. Whereas demand and enrollment are the same variable under individual insurance, they differ under group insurance because actual enrollment also depends on peers' decisions. Does free-riding reduce enrollment rates under individual insurance and worsen other financial performance indicators as well? To answer these questions, this section analyzes the implications of the various demand patterns from three different perspectives: The insurance provider, the MFI and its clients.

6.1 Insurance providers: 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 consideration makes insurance providers often hesitant to offer group insurance. To quantify this effect in the microinsurance games, Panels A and B in Table 7 estimate Equation (12) for demand and actual enrollment, respectively. The analyses control for the number of low RA peers. Results are robust to the inclusion of the other control variables presented in Table 1.

Column (1) includes the full sample. In line with the previous section, participants in the group insurance treatment vote for insurance in the vast majority of rounds, 92.7 percent. Individual insurance reduces demand by 15.2 percentage points ($p < 0.05$, see Panel A). Actual enrollment rates in Panel B are however not significantly lower under individual insurance.

Columns (2) to (4) disaggregate the estimates by participant type. Panel A repeats the difference in demand by type as estimated in Column (1) of Table 3. Individual insurance substantially reduces demand as well as enrollment rates among low RA clients. A few low RA individuals consistently vote against group insurance, reducing overall enrollment rates in this treatment, especially among their high RA peers. Although the absolute number of rounds in which participants vote against group insurance is small, a mere 7.3 percent of negative votes in Column (1) reduces total enrollment under group insurance to 80.4 percent.[22]

6.2 Microfinance institutions: Default rates

An important question for MFIs is which type of insurance minimizes default rates. A reduced group default risk can be interpreted as a rent for the MFI when interest rates are not adjusted down accordingly. Under individual insurance, unprotected risk is scattered over groups, since clients can decide to enroll individually. Group insurance leads to a concentration of uninsured participants within a few microcredit groups, which might increase groups' vulnerability to collective default. Conditional on the number of insured group members, predicted default rates are therefore higher under group insurance.

Panel C in Table 7 estimates Equation (12) using expected group defaults, i.e. the probability that a participant's group defaults given the number of insured members, as dependent variable. This probability is averaged over all rounds that a group is still in the game. We use this calculated probability instead of actual group defaults to control for differences in the incidence of health shocks under group versus individual insurance.

For the total sample in Column (1), individual insurance decreases expected group defaults compared to group insurance. This difference is however statistically not significant. Also in Columns (2) and (4), for low RA clients and high RA clients with only high RA peers, the differences in default rates are insignificant. Only high RA clients with low RA peers are 4.5 percentage points less likely to default in the individual insurance treatment.

In practice, group default rates in most MFIs are low. For instance, 98 percent

[22] In both treatments, enrollment rates in the experiment are relatively high compared to take-up rates outside the laboratory. The framed field experiment abstracts from a number of other mechanisms that contribute to low enrollment rates, for instance liquidity constraints and transaction costs.

of Tujijenge groups repay their loan. Health shocks are nevertheless an important constraint on borrowers' individual capacity to repay. 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 great lengths to avoid default and the social shame and sanctions associated with it, underscoring the non-monetary benefits of insurance offered by MFIs (Armendariz and Morduch, 2010).

6.3 Clients: Profits

Clients are concerned with earnings levels and income fluctuations. Panel D in Table 7 estimates the difference in expected profits, averaged over the different rounds, between individual insurance and group insurance. Panel E repeats this analysis for the variance of profits (in 10,000 TZS). Expected profits and the variance of profits are calculated based on a client's own insurance status and the number of insured peers. We use the average within-round expectation and variance, and do not take into consideration the risk of group default for ease of calculation.

Individual insurance does not significantly affect expected profits and its variance for the aggregate sample in Column (1). It should however not come as a surprise that low RA clients in Column (2) earn significantly more under individual insurance ($p < 0.01$). Free-riding increases their profits by on average 23,400 TZS at the expense of their high RA peers in Column (3). Their profits also have significantly higher variance under individual insurance.

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. In Column (4), restricting the sample to groups with high RA clients only, we find no significant differences in expected profits between the two treatments, nor in the variance. Note that pure high RA groups face very low variance in either case due to the high levels of insurance take-up.

To summarize, lower demand of the low RA under individual insurance does not translate into significantly lower enrollment rates or higher group default risk. Individual insurance induces a redistribution of profits from high to low RA clients and potentially increases the variance of profits.

These findings highlight a second dilemma of microinsurance. On the one hand, MFIs and insurance providers may prefer individual insurance schemes because they lead to similar enrollment rates and reduced default risk. On the other hand, group welfare - and in particular welfare of more risk averse clients - will be optimal under group insurance. To increase the number of groups enrolling in group insurance (which reduces the aggregate default risk, benefiting the MFI), insurance providers could experiment with more flexible group insurance products. These can for instance use majority voting rules that do not give veto power to uninterested clients, or exempt individuals who are covered by other schemes.

7 Conclusion

In the absence of formal insurance, households rely on alternative risk management strategies such as social risk-sharing arrangements. Although social networks provide only partial protection, demand for affordable microinsurance typically remains limited. This study provided and tested a mechanism to explain these low enrollment rates.

We showed that the introduction of individual insurance in jointly liable credit groups creates a social dilemma. Clients with low risk aversion are tempted to forgo individual insurance even though the group would have been better off if all group members had enrolled. For groups with only low RA clients, the insurance decision hence entails a Prisoner's Dilemma. But also in heterogeneous groups with both low RA and high RA types, the high RA clients may forgo insurance if they believe that their peers will remain uninsured. The binding nature of group insurance offers a solution to this social dilemma and increases the demand for health insurance to optimal levels.

To empirically test our theoretical framework, microinsurance games played with 355 microcredit clients in Tanzania elicited demand for individual versus group insurance. This experiment yielded substantial support for the existence of a social dilemma. While nearly all participants, 92.7 percent, were willing to join group insurance, a large share of low RA participants - 58 percent - consistently decided not to enroll in individual insurance, even when all peers enrolled. This provides evidence of the free-riding hypothesis. In contrast, few groups with only high RA clients failed to coordinate on the social optimum.

This study sheds light on the replicability of findings from conventional public good games played in the laboratory. Consistent with such games, the social dilemma in our framed field experiment resulted in suboptimal outcomes. An open question is why the high RA participants did not sanction their free-riding low RA peers through a trigger strategy, as is more common in the lab, and why a number of low RA members cooperated without free-riders being sanctioned. The microcredit frame combined with the non-standard type of participant may have evoked a different set of norms and behaviors than is commonly observed among student populations. This illustrates how external validity remains a caveat of conventional laboratory experiments.

The results suggest that the choice to offer insurance either at the individual or at the group level should reach beyond the standard concern for adverse selection or administrative considerations. Because members of jointly liable credit groups share risk, strategic decisions in such groups can be an important determinant of the demand for microinsurance. In addition, group insurance eliminates the opportunity to free-ride on peers, and hence reduces inequality within groups. Indeed, in the experiment, group insurance significantly increased expected earnings of high RA clients because they no longer had to contribute for their free-riding peers.

However, enrollment rates were not significantly higher under group insurance because a small minority of individuals consistently voted against it, barring their peers from enrolling as well. Moreover, group insurance increased the probability of group default due to a higher concentration of uninsured risk in a few groups.

Adopting a less strict voting rule than unanimity and exemptions for some clients may attenuate these unintended consequences. Further, group insurance is not the only way to solve the social dilemma. Alternatives are for instance mandatory enrollment, stronger social sanctions, individual liability for loan repayment, or an individual insurance product that would only step in if too many group members simultaneously incur a health shock.

The microinsurance games resembled the real world of the Tujijenge microcredit groups as closely as possible. However, the demand for microinsurance in jointly liable credit groups depends on more factors than can be studied simultaneously in a game. A promising area for further research is to analyze the dynamics between insurance and endogenous group formation. The introduction of insurance may affect the optimal group composition. Insurance may for instance induce sorting on preferences for formal insurance versus social risk-sharing. While microinsurance schemes are currently rolled out to existing microcredit group members who face high switching costs, insurance may well affect group formation of new microfinance clients, which in turn influences their demand for formal insurance.

To conclude, we find suboptimal demand for individual insurance because jointly liable microcredit group members free-ride on contributions from their peers. This is not only relevant for the design of ongoing pilots of health insurance schemes, but also for other types of microinsurance. Moreover, since social risk-sharing arrangements exist beyond the credit group, the findings may generalize to other pre-existing risk pools such as neighbors, migrant networks, informal savings groups or cooperatives. As such, our findings may help explain low take-up in a wide range of microinsurance schemes.

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Figures and Tables

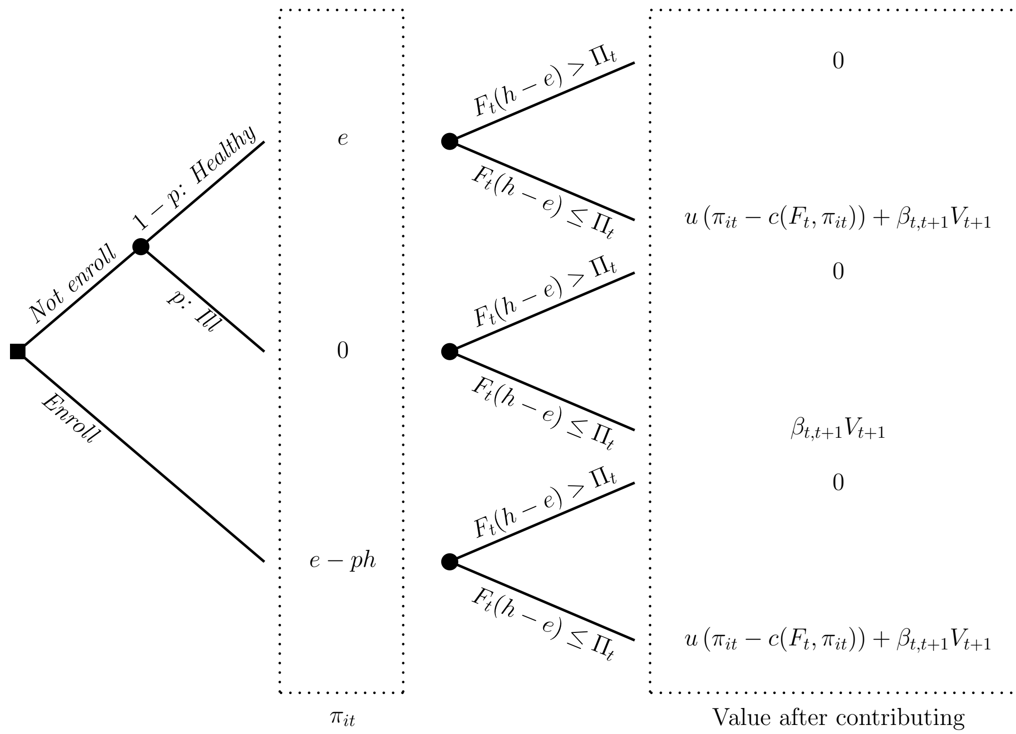


Figure 1: Game tree.
Clients receive a loan l and earn $e + l$ before loan repayment. The symbol p represents the health shock probability, e private earnings net of loan repayment, $h \in (e, e + l]$ health expenditures, F_t the number of delinquent peers, Π_t total income in the group, and $c(F_t, \pi_{it})$ the contribution for F_t delinquent peers, given an individual's disposable income π_{it}. Finally, $\beta_{t,t+1} < 1$ is the period-t discount factor for period $t + 1$ and V_{t+1} the value of continuing to the next loan cycle.

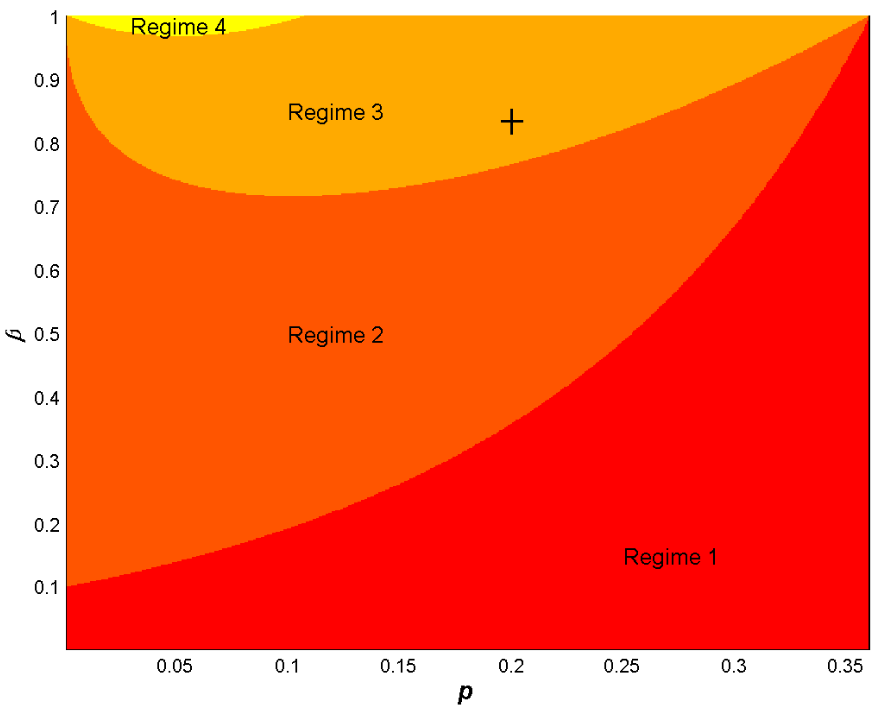
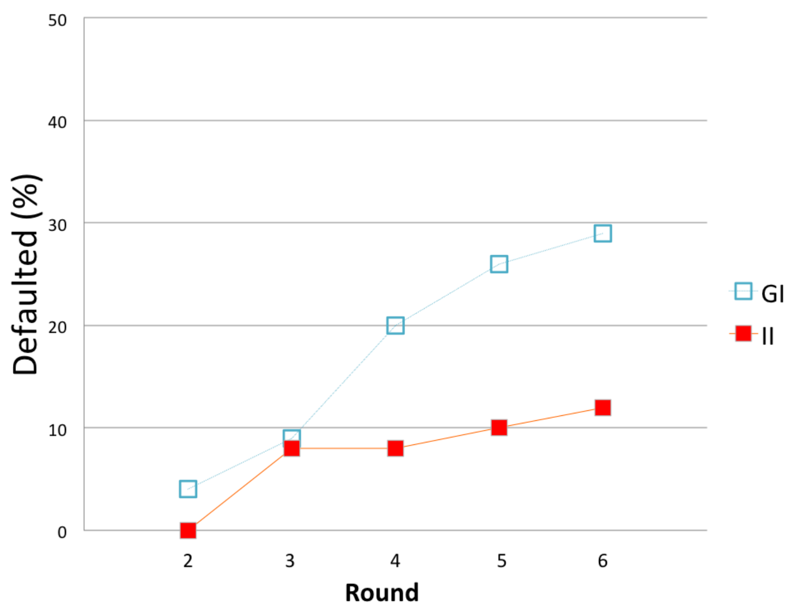


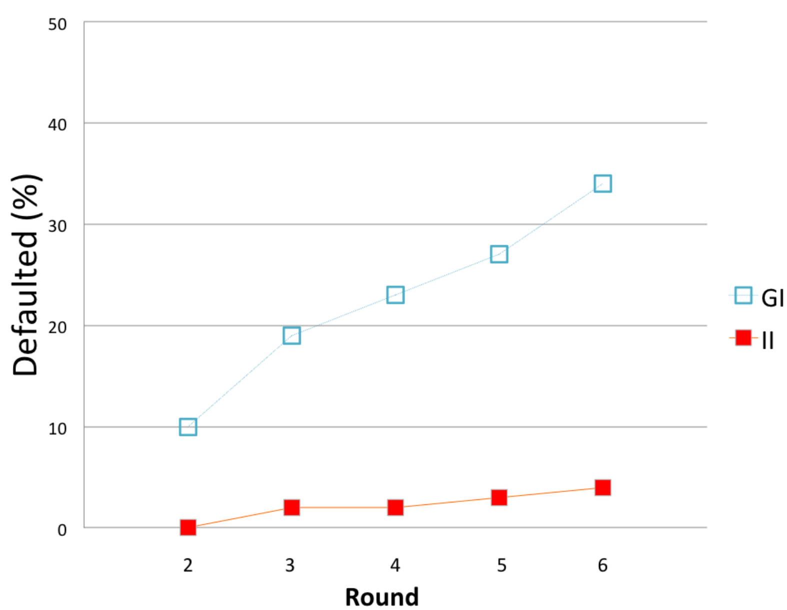
Figure 2: Solution regimes.

Earnings net of loan repayment l are $e = 9/16l$, health expenditures $h = e + l$, the number of group members $n = 5$ and the group can contribute for at most one delinquent peer. Regime 1: $V(FE;\theta_i) > V(ZE;\theta_i)$ if $\theta_i \geq \theta^*$ (by Lemma 1) and $V(FE;\theta_i) < V(ZE;\theta_i)$ in the limiting case of risk-neutrality. Regimes 2-4: $V(FE;\theta_i) > V(ZE;\theta_i)$ for all $\theta_i \in \Theta$. Regime 2 (3 and 4): Condition (10) is violated (satisfied), so that dynamic incentives are too weak (sufficiently strong) for trigger strategy to be effective. Regime 4: Condition (7) is violated, so ZE is not an equilibrium. A grim trigger strategy is therefore not a credible threat.

Figure 3: Individual (II) versus group (GI) insurance - Default rates

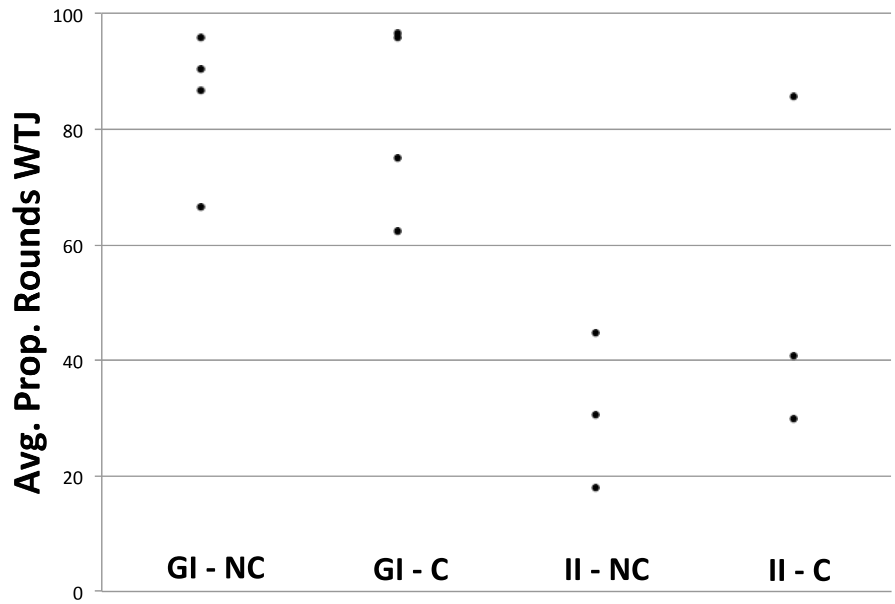


(a) Low RA participants

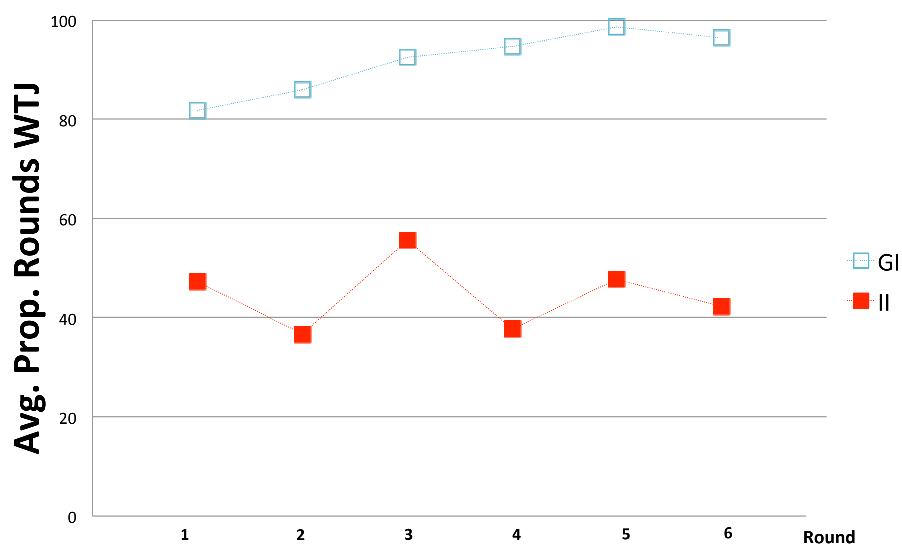


(b) High RA participants with at least one low RA peer

Figure 4: Group (GI) versus Individual (II) Insurance - Low RA participants



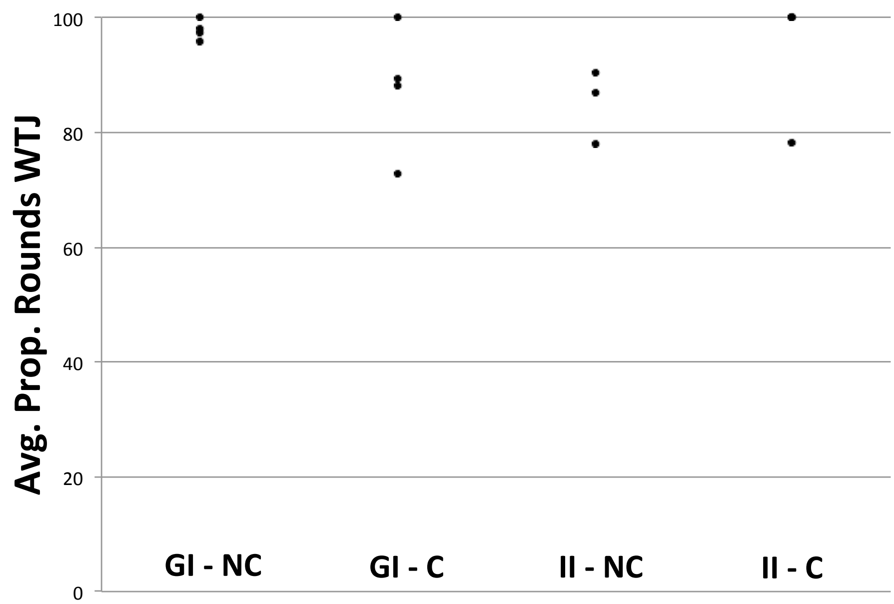
(a) Average demand by session.



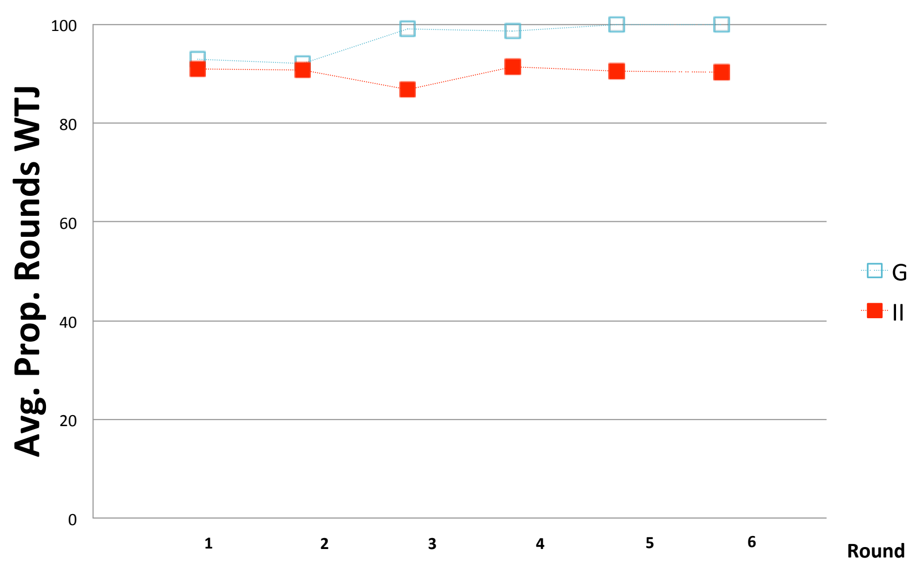
(b) Average demand by round.

Notes: GI-NC: Group Insurance, No Communication. GI-C: Group Insurance, Communication. II-NC: Individual Insurance, No Communication. II-C: Individual Insurance, Communication. Avg. Prop. WTJ: Proportion of rounds that a participant is still in the game and willing to join (session average).

Figure 5: Group (GI) versus Individual (II) Insurance - High RA, Low RA peer



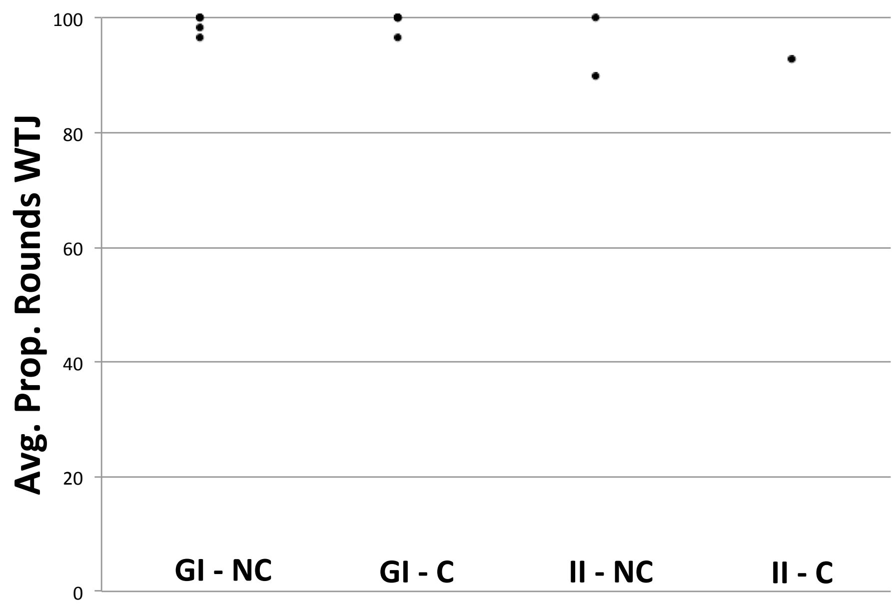
(a) Average demand by session



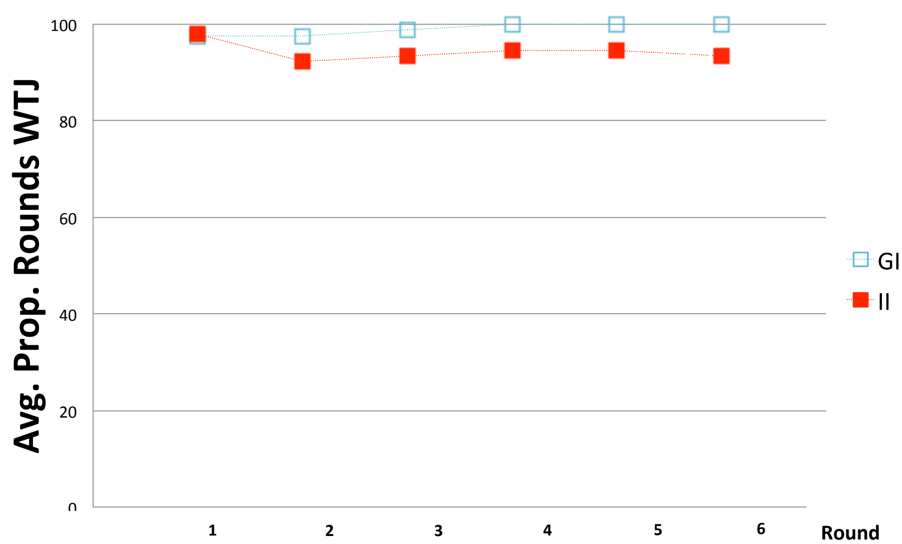
(b) Average demand by round

Notes: GI-NC: Group Insurance, No Communication. GI-C: Group Insurance, Communication. II-NC: Individual Insurance, No Communication. II-C: Individual Insurance, Communication. Avg. Prop. WTJ: Proportion of rounds that a participant is still in the game and willing to join (session average).

Figure 6: Group (GI) versus Individual (II) Insurance - High RA only



(a) Average demand by session



(b) Average demand by round

Notes: GI-NC: Group Insurance, No Communication. GI-C: Group Insurance, Communication. II-NC: Individual Insurance, No Communication. II-C: Individual Insurance, Communication. Avg. Prop. WTJ: Proportion of rounds that a participant is still in the game and willing to join (session average).

Table 1: Description of the study population

	Games		Tujijenge		Probit Low Risk Aversion			
	(1) Mean	(2) (s.d.)	(3) Mean	(4) (s.d.)	(5) Low RA	(6) (s.e.)	(7) Low RA	(8) (s.e.)
A. Demographic and socio-economic characteristics								
Female	74.6		67.8^{*}		-0.078	(0.067)	-0.109^{+}	(0.062)
Married	76.1		80.8		0.004	(0.064)	-0.009	(0.060)
Age	36.0	(8.5)	36.0	(9.2)	-0.176	(0.119)	-0.165	(0.113)
Household size	5.1	(2.1)	4.6^{**}	(1.8)	0.029^{*}	(0.016)	0.027^{+}	(0.014)
Years of education	7.7	(2.4)	8.2^{*}	(2.7)	0.014	(0.012)	0.013	(0.011)
Per cap. HH income	84.4	(60.4)	82.7	(76.9)	0.033	(0.050)	0.035	(0.032)
B. Health characteristics								
Visited provider								
- Self	54.9		24.8^{**}		-0.025	(0.061)	-0.015	(0.058)
- HH member	73.5		37.6^{**}		0.008	(0.086)	0.010	(0.080)
HH health expenses	43.0	(80.9)	32.5	(30.2)	-0.015	(0.010)	-0.017^{+}	(0.009)
Nr. foregone care	0.6	(1.4)			0.015	(0.019)		
Knows insurance	41.1				0.013	(0.057)		
Has insurance	7.3		11.2^{+}		0.238^{*}	(0.131)	0.217^{*}	(0.119)
C. Microcredit variables								
Profit business	226	(205)			-0.005	(0.041)		
Membership years	1.1	(1.6)			-0.045^{*}	(0.021)		
Has outstanding loan	89.0		97.1^{**}		-0.150	(0.105)	-0.195^{*}	(0.096)
Last loan value	460	(369)	425	(353)	-0.007	(0.045)	-0.021	(0.040)
Delinquent in group	32.4				0.065	(0.084)		
Contributed for peer	27.3				-0.051	(0.081)		
Has been delinquent	13.0				-0.049	(0.105)		
Peers contributed	6.8				0.224	(0.185)		
Nr. real credit group	0.5	(0.8)						
D. Risk aversion								
Low Risk Aversion	25.6		30.7[1]					
High RA x LRA peer	46.2							
High RA only	28.2							

$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$. [1]Out-of-sample prediction using (8)-(9). Delta Confidence Interval: [23.3,38.2] Binary variables presented in %. Monetary variables are in 1,000 Tanzanian Shillings (TZS), or approx. 0.67 USD at exchange rates during the study. Column (4)-(5): survey among representative sample of 407 Tujijenge clients. The table presents all variables available in both datasets and the stars in Column (4) indicate whether means in the two datasets are significantly different. The Probit regressions in Columns (6)-(9) use a log transformation for age, HH health expenses, household income, business profits and loan size.

Table 2: Participants' characteristics by treatment

	Low RA		HRA, LRA peer		High RA only	
	(1) GI	(2) II	(3) GI	(4) II	(5) GI	(6) II
A. Demographic and socio-economic characteristics						
Female	68.5	70.3	74.1	79.5	77.1	73.3
Married	70.4	78.4	72.8	80.7	75.7	80.0
Age	36.4	33.2^{+}	35.4	36.4	36.3	38.0
Household size	5.5	4.8	4.7	5.5*	5.2	5.0
Years of education	8.0	8.6	7.7	7.7	7.3	7.4
Per capita HH income	82.3	91.5	86.8	88.3	80.3	71.6
B. Health characteristics						
Visited provider	50.0	45.9	53.1	60.2	57.1	60.0
Other visited provider	64.8	64.9	74.1	77.1	81.4	70.0
HH health expenses	31.3	25.8	38.5	51.9	58.3	37.2
Nr. times foregone care	0.6	0.4	0.4	0.7	0.7	0.5
Knows insurance	42.6	51.4	34.6	45.8	34.3	46.7
Has insurance	13.0	16.2	3.7	6.0	1.4	13.3^{+}
C. Microcredit variables						
Profit business	213.8	229.1	208.7	275.3^{+}	204.4	213.0
Membership years	0.7	0.8	1.1	1.2	1.2	1.0
Has outstanding loan	88.9	75.7	93.8	85.5^{+}	90.0	100.0**
Last loan value	452.7	448.6	417.6	518.8	420.9	529.7
Delinquent in group	37.0	32.4	28.4	33.7	35.7	23.3
Contributed for peer	29.6	27.0	21.0	31.3	27.1	30.0
Has been delinquent	20.4	5.4*	12.3	12.0	14.3	10.0
Peers contributed	14.8	0.0**	8.6	3.6	5.7	6.7
Nr. real credit group	0.4	0.6	0.5	0.5	0.5	0.6
D. Risk aversion and incidence of health shocks						
Nr. low RA peers	1.5	0.9**	1.7	1.4*	0.0	0.0
Prop. ill rounds in first game	0.3	0.2*	0.2	0.1	0.2	0.2
Prop. ill rounds main game	0.3	0.2	0.2	0.2	0.2	0.1*
Observations	54	37	81	83	70	30

$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$ Binary variables presented in percentages. Monetary variables are in 1,000 Tanzanian Shillings (TZS), or approx. 0.67 USD at exchange rates during the study. Low RA: Clients with low risk aversion. HRA, LRA peer: Clients with high risk aversion and at least one low RA peer. High RA only: Clients with high risk aversion and only high RA peers. GI (II): Variable's average value in the Group (Individual) Insurance treatment.

Table 3: Demand for insurance by participant type

	N	Mean GI	Difference II (β_{II})				
A. Low RA	(a)	(b)	(1)	(2)	(3)	(4)	(5)
β_{II}	91	0.863	-0.433	-0.414	-0.465	-0.428	-0.449
			(0.112)	(0.118)	(0.094)	(0.112)	(0.112)
$P(\beta_{II} < 0)$			0.011^{*}	0.014^{*}	0.001^{**}	0.016^{*}	0.010^{*}
R-squared			0.299	0.305	0.367	0.300	0.317
B. High RA with LRA peer							
β_{II}	164	0.912	-0.034	-0.028	-0.036	-0.033	-0.027
			(0.052)	(0.05)	(0.056)	(0.054)	(0.056)
$P(\beta_{II} < 0)$			0.286	0.304	0.269	0.276	0.341
R-squared			0.004	0.018	0.006	0.004	0.014
C. High RA only							
β_{II}	100	0.993	-0.062	-0.062	-0.063	-0.062	-0.060
			(0.017)	(0.017)	(0.016)	(0.018)	(0.019)
$P(\beta_{II} < 0)$			0.076^{+}	0.088^{+}	0.067^{+}	0.079^{+}	0.046^{*}
R-squared			0.084	0.084	0.087	0.089	0.085
Controls				Ill fg	Age	Peers	Ill mg

$^{+}$ $p < .1$, * $p < .05$, ** $p < .01$. First line: OLS estimate. Second line: std. err. clustered by session. Third line: one-sided t-percentile in wild cluster-bootstrap (999 replications). All equations control for a participant's number of low RA peers. Other controls: 'Ill fg' ('mg') - proportion of ill rounds in first game (main game); 'Age' - of participant. 'Peers' - Peers in real microcredit group contributed for participant. N: No. of observations. Mean GI: Mean demand in the Group Insurance treatment. Difference II: Estimate of β_{II} in Equation (12).

Table 4: Demand for insurance by round

	N	Mean GI	Difference II (β_{II})				
A. Round 1	(a)	(b)	(1)	(2)	(3)	(4)	(5)
Low RA	91	0.852	-0.377	-0.326	-0.402	-0.374	-0.390
			(0.125)	(0.126)	(0.113)	(0.127)	(0.125)
P(β_{II} < 0)			0.029^{*}	0.039^{*}	0.007^{**}	0.017^{*}	0.018^{*}
R-squared			0.178	0.209	0.204	0.178	0.187
High RA with LRA peer	164	0.926	-0.030	-0.029	-0.027	-0.030	-0.029
			(0.053)	(0.053)	(0.053)	(0.054)	(0.056)
P(β_{II} < 0)			0.291	0.336	0.335	0.320	0.334
R-squared			0.006	0.006	0.008	0.006	0.006
High RA only	100	0.986	-0.019	-0.017	-0.022	-0.019	-0.028
			(0.027)	(0.029)	(0.027)	(0.027)	(0.022)
P(β_{II} < 0)			0.315	0.327	0.337	0.328	0.275
R-squared			0.004	0.007	0.015	0.005	0.028
B. Proportion of rounds willing to enroll in Rounds 2 - 6							
Low RA	91	0.871	-0.444	-0.429	-0.480	-0.443	-0.449
			(0.114)	(0.119)	(0.096)	(0.111)	(0.115)
P(β_{II} < 0)			0.009^{**}	0.004^{**}	0.004^{**}	0.010^{*}	0.004^{**}
R-squared			0.271	0.275	0.338	0.271	0.279
High RA with LRA peer	164	0.890	-0.011	-0.000	-0.014	-0.009	-0.006
			(0.069)	(0.069)	(0.075)	(0.071)	(0.072)
P(β_{II} < 0)			0.438	0.482	0.450	0.441	0.487
R-squared			0.003	0.033	0.007	0.003	0.009
High RA only	100	0.994	-0.071	-0.072	-0.072	-0.071	-0.068
			(0.021)	(0.021)	(0.021)	(0.022)	(0.024)
P(β_{II} < 0)			0.073^{+}	0.070^{+}	0.032^{*}	0.063^{+}	0.030^{*}
R-squared			0.096	0.097	0.097	0.101	0.102
Controls				Ill fg	Age	Peers	Ill mg

$^{+}$ $p < .1$, * $p < .05$, ** $p < .01$. First line: OLS estimate. Second line: std. err. clustered by session. Third line: one-sided t-percentile in wild cluster-bootstrap (999 replications). All equations control for a participant's number of low RA peers. Other controls: 'Ill fg' ('mg') - proportion of ill rounds in first game (main game); 'Age' - of participant. 'Peers' - Peers in real microcredit group contributed for participant. N: No. of observations. Mean GI: Mean demand in the Group Insurance treatment. Difference II: Estimate of β_{II} in Equation (12).

Table 5: Demand without and with communication and social ties

	Difference II (β_{II})				
	(1)	(2)	(3)	(4)	(5)
A. Low RA participants	All	No Comm	Comm	No ties	Ties
$\hat{\beta}_{II}$	-0.433	-0.364	-0.509	-0.377	-0.516
	(0.112)	(0.200)	(0.059)	(0.121)	(0.141)
P(β_{II} < 0)	0.011^{*}	0.082^{+}	0.001^{**}	0.043^{*}	0.005^{**}
Mean GI	0.863	0.833	0.895	0.889	0.807
R-squared	0.299	0.250	0.370	0.296	0.309
Observations	91	48	43	58	33
B. High RA participants with low RA peer					
$\hat{\beta}_{II}$	-0.034	0.009	-0.103	-0.016	-0.069
	(0.052)	(0.045)	(0.065)	(0.066)	(0.049)
P(β_{II} < 0)	0.260	0.416	0.076^{+}	0.403	0.138
Mean GI	0.912	0.935	0.893	0.890	0.953
R-squared	0.004	0.029	0.034	0.001	0.019
Observations	164	77	87	105	59
C. High RA participants with only high RA peers					
$\hat{\beta}_{II}$	-0.062	-0.053	-0.067	-0.086	-0.028
	(0.017)	(0.036)	(0.004)	(0.01)	(0.027)
P(β_{II} < 0)	0.086^{+}	0.206	0.001^{**}	0.001^{**}	0.266
Mean GI	0.993	0.987	0.996	0.989	1.000
R-squared	0.084	0.077	0.084	0.115	0.056
Observations	100	40	60	65	35

$^{+}$ $p < .1$, * $p < .05$, ** $p < .01$. First line: OLS estimates. Second line: standard errors are clustered by session. Third line: one-sided t-percentile, based on wild cluster-bootstrap with 999 replications. All equations control for a participant's number of low RA peers. Difference II: Estimate of β_{II} in Equation (12).

Table 6: Demand for insurance by number of low RA peers

	Low RA		**High RA**	
	(1) Round 2	(2) Rounds 2-6	(3) Round 2	(4) Rounds 2-6
Individual Insurance ($\hat{\delta}_{II}$)	-0.320	-0.282	-0.028	-0.047
	(0.164)	(0.121)	(0.046)	(0.046)
P(δ_{II} < 0)	0.073^{+}	0.038*	0.259	0.197
II x Nr. low RA peers ($\hat{\eta}$)	-0.200	-0.146	-0.004	-0.004
	(0.104)	(0.046)	(0.059)	(0.047)
P(η < 0)	0.027*	0.014*	0.484	0.469
Mean GI	0.865	0.871	0.937	0.941
N	89	89	256	256
R-squared	0.329	0.299	0.010	0.025

$^{+}$ $p < .1$, * $p < .05$, ** $p < .01$. First line: OLS estimates. Second line: standard errors clustered by session. Third line: one-sided t-percentile, based on a wild cluster-bootstrap with 999 replications. All estimates control for the number of low RA peers.

Table 7: Other outcomes: Enrollment, default and profits

	(1)	(2)	(3)	(4)
A. Proportion of rounds willing to join	All	Low RA	High RA, LRA peer	High RA only
$\hat{\beta}_{II}$	-0.152	-0.433	-0.034	-0.062
	(0.050)	(0.112)	(0.052)	(0.017)
P(β_{II} < 0)	0.010*	0.020*	0.580	0.172
Mean GI	0.927	0.863	0.912	0.993
R-squared	0.194	0.299	0.004	0.084
B. The insurer: Proportion of rounds enrolled				
$\hat{\beta}_{II}$	0.032	-0.317	0.174	-0.033
	(0.056)	(0.121)	(0.078)	(0.026)
P(β_{II} < 0)	0.460	0.056^{+}	0.054^{+}	0.311
Mean GI	0.804	0.740	0.709	0.964
R-squared	0.106	0.139	0.058	0.020
C. The MFI: Default probability averaged over rounds				
$\hat{\beta}_{II}$	-0.022	-0.020	-0.045	-0.008
	(0.012)	(0.021)	(0.019)	(0.005)
P(β_{II} < 0)	0.116	0.450	0.058^{+}	0.154
Mean GI	0.051	0.068	0.077	0.009
R-squared	0.095	0.019	0.080	0.059
D. The client: Expected profits averaged over rounds				
$\hat{\beta}_{II}$	-0.004	0.245	-0.141	-0.004
	(0.008)	(0.060)	(0.031)	(0.003)
P(β_{II} < 0)	0.716	0.002**	0.002**	0.292
Mean GI	1.029	1.038	1.043	1.005
R-squared	0.149	0.353	0.154	0.001
E. The client: Variance of profits averaged over rounds				
$\hat{\beta}_{II}$	0.084	0.275	-0.055	0.066
	(0.054)	(0.102)	(0.072)	(0.028)
P(β_{II} < 0)	0.104	0.048*	0.514	0.222
Mean GI	0.168	0.223	0.249	0.031
R-squared	0.117	0.149	0.010	0.115
Observations	355	91	164	100

$^{+}$ $p < .1$, * $p < .05$, ** $p < .01$. $\hat{\beta}_{II}$: OLS estimates. Second line: std. errors in parentheses clustered by session. Third line: one-sided t-percentile, based on a wild cluster-bootstrap with 999 replications. All estimates control for the number of low RA peers. Columns (2)-(4) in Panel A come from Table 3.

A Proofs

PROOF LEMMA 1

Proof By Definition (4), utility under full enrollment within a round satisfies:

$$U(e - ph; \theta_i) \geq (1 - p)U(e; \theta_i) \; \forall \; \theta_i \geq \theta^* \tag{14}$$

Utility under zero enrollment within a round satisfies:

$$(1 - p) \, \mathrm{E} \, U(e - c(F_t, e); \theta_i) < (1 - p)U(e; \theta_i) \tag{15}$$

since $c(F_t, e) > 0$ for any $F_t > 0$.

By (14) and (15), full enrollment creates higher utility than zero enrollment within a round for high RA clients with $\theta_i \geq \theta^*$. Full enrollment in insurance also ensures that the group can repay and is hence associated with a higher probability of continuation (with certainty) to the next round, $P_n = 1 > P_0$. Full enrollment hence creates higher discounted future expected utility compared to zero enrollment, also if generalized to an infinite number of periods in which group members coordinate on either always full enrollment or always zero enrollment. Thus, if $\theta_i \geq \theta^*$,

$$V(FE; \theta_i) > V(ZE; \theta_i) \qquad \blacksquare$$

PROOF LEMMA 2

Proof Assume that one group member remains uninsured. Since the group can repay for at least one group member by Condition (9), the $n - 1$ insured group members secure continuation to the next round. Total expected group payoff within a round is:

$$(n - 1)(e - ph) + (1 - p)e - p(h - e) = n(e - ph) \tag{16}$$

The $n - 1$ insured group members earn $e - ph$ each. The uninsured client earns e with probability $1 - p$ and loses $h - e$ with probability p.[23]

In general, whenever $\boldsymbol{d} \in D^C$ such that n_t^I insured group members are able to repay the full group loan, $n_t^I(e - ph) \geq (n - n_t^I)(h - e)$, expected payoff in the group is $n(e - ph)$. Total payoff in this case is a mean-preserving spread of the joint payoff in the full enrollment case, which is $n(e - ph)$ with certainty. Given the assumption of concave utility, Jensen's inequality implies:

$$\sum_i V_t(FE; \theta_i) > \sum_i V_t(\boldsymbol{d}; \theta_i) \; \forall \; \boldsymbol{d} \in D^C \qquad \blacksquare$$

[23] If l represents the size of the loan, the ill client earns $e + l$, pays health expenditures h, repays any remaining earnings, $e + l - h$, and the group contributes the remainder. As a result, the net payment by other group members is $h - e$.

PROOF THEOREM 1

Proof First, we prove the first part of the theorem,

$$d^*_{II}(n-1,\theta_i) = \begin{cases} 1 \ \forall \ \theta_i \geq \theta^* \\ 0 \ \forall \ \theta_i < \theta^* \end{cases}$$

By Condition (9), if client i believes that all her group members will enroll, her value if she enrolls is equal to:

$$U(e-ph;\theta_i) + \beta V(FE;\theta_i) \tag{17}$$

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

If she does not enroll, her value is equal to:

$$(1-p)U(e;\theta_i) + \beta V(FE;\theta_i) \tag{18}$$

She earns e with probability $1-p$, risks earning 0 with probability p and continues to the next loan cycle with certainty.

The utility difference between $d_i = 1$ and $d_i = 0$ is:

$$U(e-ph;\theta_i) - (1-p)U(e;\theta_i) \geq 0 \Leftrightarrow \theta_i \geq \theta^* \tag{19}$$

by Definition (4). An individual will take insurance if and only if $\theta_i \geq \theta^*$. This shows the first part of the theorem.

Under Condition (7), the best response to nobody enrolling is $d^*_{II}(0,\theta_i) = 0 \ \forall \ \theta_i \in \Theta$ as discussed in the text. Always Zero Enrollment, *ZE*, is therefore a Nash equilibrium. ■

B Experimental script

This appendix provides the most important elements of the instructions back-translated from Kiswahili.

Game 1: Individual liability and individual insurance

Introduction The game starts as follows: You are one of five members of a microcredit group. Assume that you are borrowing 40,000 Shillings from a bank every month for your business to make a profit. Your profit is 22,500 Shillings. If you are able to repay the loan, you will repay it. In that case you can borrow a second time so then you will play this game twice. If you do not repay the loan you will, you will not be able to play again.

Health problems Before you repay your loan, two things may happen: you may get sick or you may not. If you are healthy, you will be able to repay the 40,000 shilling debt to the bank. A research assistant will put a profit of 22,500 shillings in your piggybank. Since you repay your loan, the bank is allowing you to borrow again.

But if you are sick, you will need to use your full income on treatment. Therefore, you pay a research assistant your 62,500 shillings and your profit will be 0. It means that you will not be able to repay the loan. The bank will not lend you money again and hence you will not be able to play this game again. You will be able to borrow again from the bank and get money again only when a new game starts. It is important that you know you will not be able to open the piggybank when the game is in play. Therefore, you cannot use the money from the piggybank to repay your debt.

To know if you are sick or not, the research assistant will tell you to take a card from an envelope. There are 5 cards in the envelope. Four (4) of the cards have no writings on them and one card has a picture of a doctor. If you get the card with a picture, you are sick. You are supposed to take a card while you are not looking at it. After you get the card, look at it and then put it back into the envelope. Another person should do the same so that every person has the same chance to be sick.

Health insurance You can get a health insurance policy every time you play this game. It costs 12,500 shillings. With health insurance you will not be required to pay for medical expenses if you get sick. Therefore you will be able to repay the bank loan of 40,000 shillings. Your profit is always 10,000 shillings. The research assistant will put this profit in the piggybank. The bank will allow you to borrow again.

If you do not have health insurance, you will not pay 12,500 shillings for the insurance policy. If you are not sick, you will pay the loan and your profit will be 22,500 shillings. If you are sick, you will loose all your income and you will not be able to repay the loan, your profit will be 0 and you will not play in this round again. You will only be able to borrow from the bank again and get money in a new game.

The insurance will be used only for one round. You can decide if you want to pay for the health insurance policy or not in every round of the game.

A test game was played in public.

The group score board The research assistant will show you whether your group members managed to pay or not. The research assistant will do this after every round. Every member in your group is represented by a symbol: square, moon, circle, triangle and a star. The research assistant will put the symbol on the board.

A group member's profit is 22,500 shillings if the member did not pay for health insurance and is not sick in this round. A group member's profit is 0 shillings and he or she will not continue to play the game in future rounds if the member did not pay for health insurance and is sick. A group member's profit is 10,000 shillings if the member paid for health insurance and either got sick or not. All members who are on the green line can pay and hence can continue to play the game in future rounds. All group members who are on the red line cannot repay and will not continue to play the game.

Please remember that you can not talk to anybody when the game is in play. Your group members do not know your symbol and hence are unaware of your decisions.

From this point onward, the plastic money you will win will be converted to real money. You will get paid in cash the money in the piggybank at the end of this game. You will get paid 1,000 shillings in real money for every 10,000 shillings in plastic money in the bank.

Game 2: Joint liability and group insurance[24]

The second game looks like the first one. The cost of health insurance is 12,500 shillings. The difference with the first game is that the decision on enrolling in health insurance must be made by the whole group, not individually. The other difference is that now the loan from the bank is taken as a group and the loan is to be paid by the whole group in full. The bank will only allow the group to borrow again if the group will repay the entire loan. The game will be over for the whole group if the group fails to repay the full loan.

So first, in this game, you vote to decide if you want the group to have a health insurance policy or not. The policy will be paid if the whole group votes in favor of health insurance. If at least one member of the group votes not to get insurance, the whole group will go without

[24] Instructions for individual insurance treatments are similar to the instructions for group insurance but exclude the information on unanimity voting. Available upon request.

insurance and you will not pay the premium. You will vote on this card saying whether you want to get the policy or not. Circle the symbol on the left marked with a cross if you want to buy the policy. Circle the symbol on the right marked with a cross with a line passing through it if you do not want to pay for the insurance policy.

The other difference with the previous game is that now the whole group is required to pay the loan in full and together. Therefore, those who cannot cover their share of the loan should get assistance from their fellow group members. How much assistance will be required depends on how many group members fail to repay their share of the loan.

If all five members of the group can repay their loan, each member will pay 40,000 shillings. All five members of the group will advance to the next round. If four group members can repay their loan and one fails, each of those four will repay their loan of 40,000 shillings and will assist the one who failed with 10,000 shillings each. All group members will advance to the next round including the one who failed to meet his or her responsibility. If less than four people can repay their share, meaning that two or more group members fail to repay, then the group will not be able to repay in full. The game will end for all group members. Those who are able to repay their 40,000 shilling loan do so and spend the rest of their profits to help defaulting group members. Their final profit in this round is 0. Thus, each group is required to have four or more members who can repay to advance to the next round of the game.

Treatments without communication Please remember that you can not talk to anybody when the game is in play. Your group members do not know your symbol and hence are unaware of your decisions.

Treatments with communication Please remember that it is not allowed to communicate with anyone while the game is in play. But before each round begins, you are allowed to communicate with your fellow credit group members about the insurance policy. You may communicate with them for two minutes. Communication will not be allowed after these two minutes. Your group members do not know your symbol and hence are unaware of your decisions.

Number of rounds in the game We will play this game for several rounds. We are not certain how many rounds. If you do not drop out of the game, you will be able to play at least four times. From the fourth round onwards, we will toss a die after every round. The game will continue if the die lands at number 2, 3, 4, 5 or 6. The game will stop for everybody in the group if the die settles on number 1.