The social dilemma of microinsurance

A framed field experiment on free-riding and coordination in microcredit groups

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This paper analyzes whether individuals who share risk have suboptimal demand for microinsurance due to a social dilemma. Even when individuals prefer to enroll as a group, they are tempted to free-ride on contributions from their peers and may fail to coordinate on their social optimum when insurance is offered at the individual level. A framed laboratory experiment in Tanzania, eliciting demand for group versus individual insurance among microcredit clients, demonstrates substantial free-riding but only limited coordination failures. These findings extend the literature on strategic decisions in the presence of a public good and provide a potential explanation for the low take-up of microinsurance.

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I. Introduction

Limited access to formal insurance induces the poor to share risk with other households (Townsend, 1994). As 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 (De Allegri et al., 2009; Cole et al., 2010). We argue that demand for microinsurance may be suboptimal precisely because it is offered to individual members of risk-sharing networks, resulting in free-riding and coordination problems.

This paper uses a framed laboratory experiment in Tanzania to study 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 default in microcredit groups. Such groups pool risk of individual members since microcredit is typically offered through group-based lending. Jointly liable clients can continue borrowing only if the full group loan is repaid.[1] Thus, group members have dynamic incentives to contribute for peers who cannot repay (Besley and Coate, 1995). These contributions provide mutual insurance.

Although incomplete, such existing risk-sharing arrangements can crowd out formal insurance (Arnott and Stiglitz, 1991). We show that in theory, the decision to take individual health insurance in jointly liable credit groups is subject to a social dilemma. Even when group welfare is highest if all members enroll, less risk averse individuals may be tempted to forgo individual insurance because their fellow group members will contribute to loan repayment. High risk averse types, although not free-riding, may fail to coordinate on the social optimum to avoid paying the premium as well as contributing for uninsured ill peers.

To identify the existence of a social dilemma, we exploit the binding nature of

[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.

group insurance. Health insurance offered at the group level requires a unanimous decision to enroll and either none or all group members enroll. This implies that clients cannot free-ride and are more likely to coordinate on a Pareto-efficient outcome. Demand for group insurance hence reveals whether full group enrollment is Pareto-efficient and provides a benchmark for individual insurance.

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

Experiments offer several advantages over alternative empirical approaches. First, the laboratory provides a controlled setting where distortions of e.g. initial beliefs, health and social networks 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 will elicit behavior that differs from hypothetical survey questions (Holt and Laury, 2002).

The experimental findings provide evidence of substantial free-riding but only limited coordination failure. In the group insurance treatment, nearly all participants opt for insurance. Under individual insurance, most high risk averse clients enroll while a large number of low risk averse clients forgo insurance. They free-ride on their fellow group members' contributions even when all enroll.

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

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

Third, we extend the literature on behavior in public good games. We study strategic decisions in jointly liable microcredit groups (e.g. Cassar, Crowley and Wydick, 2007; Giné et al., 2010), and whether there is limited commitment to efficient risk-sharing (Kocherlakota, 1996; Ligon, Thomas and Worrall, 2002). The microinsurance games mimic real-life decisions for a population that differs from the usual participant, a university student, in many respects (Cardenas and Carpenter, 2008). As such, this study sheds light on the replicability of findings from public good games in conventional lab experiments to the field.

This paper frames the public good as insurance for health expenditures but may also apply to other commonly occurring idiosyncratic shocks such as business failure or livestock disease. Moreover, our findings are relevant not only for the provision of insurance in a microfinance setting. The potential of group insurance to solve free-riding and coordination failure may generalize to alternative social risk-sharing networks such as villages, cooperatives or informal saving groups (de Janvry, Dequiedt and Sadoulet, 2012).

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

II. Theory

A. The model

We model insurance as a public good for jointly liable microcredit groups. A group of n clients jointly borrows nl in every loan cycle $t \in \{1, ..., \infty\}$. Ill group members incur health expenditures and cannot repay their share. Other group members (henceforth peers) contribute to loan repayment but if too many fall ill, the group defaults and lending is terminated. Only if the full group loan is repaid, the group continues to the next loan cycle. Clients can take insurance as a protection against health expenditures, reducing the group default risk.

Figure 1 presents the game graphically. The left-hand block in the figure indicates profits before contributing for ill peers. Clients invest their loan l and earn e net of loan repayment. Prior to repayment, each group member risks an IID health shock that occurs with probability p for every group member.[2] Ill group members incur catastrophic health expenditures $h \in (e, e + l]$ and repay $e + l - h < l$. These delinquents earn 0 in the present loan cycle.

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. Thus, insured clients earn $e-ph$ irrespective of their health outcome. The model ignores losses due to lower productivity but the focus on expenditures does not qualitatively affect the results.

The right-hand block of Figure 1 indicates a client's value after contributing for delinquent peers. We define $n^* \in \{1, ..., n - 1\}$ as the maximum number of members for which a group can contribute without default and f as the number of delinquent peers. If more than n^* peers cannot repay their share, $f > n^*$, the group is unable to repay the full loan. Group members contribute as much

[2]The model focuses on health risks that are typically covered by microinsurance, mostly inpatient care due to hospitalization and acute illnesses. 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.

as possible to loan repayment but this is insufficient to avoid a group default. Lending is terminated and nothing is earned from present or future loan cycles.

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

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

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

Three key assumptions are made. First, individuals always repay and contribute for others when possible. This assumption reflects the common practice to condition access to microfinance on prior group loan repayment, creating dynamic incentives to contribute (Armendariz and Morduch, 2010). Although we do not model a discretionary contribution decision here, contributions to loan repayment would be incentive-compatible because these ensure continuation to the next loan cycle. There are however no dynamic incentives to fully cover ill peers' health expenditures beyond loan repayment, resulting in incomplete insurance.

Second, the analysis focuses on the interplay between formal insurance and informal risk-sharing. Earnings from previous loan cycles cannot be used to repay. Thus, clients do not self-insure by accumulating a buffer stock, and earnings are either immediately consumed or invested in illiquid assets.

Third, paying the insurance premium does not increase the risk of group default:

$$(n - n^*)(e - ph) \geq n^*(h - e) \Leftrightarrow \frac{n - n^*}{n^*} \geq \frac{h - e}{e - ph} \tag{2}$$

Despite the insurance premium payment ph, $n - n^*$ group members are able to cover the loan repayment for n^* delinquent peers. This also implies that there are no liquidity constraints to premium payment, which is a plausible assumption for clients with access to credit.

Clients' preferences form the final building block of the model. Client $i \in \{1, ..., n\}$ maximizes expected utility over the present and all future loan cycles, taking into account beliefs about the current and future number of insured peers and insurance decisions in the past. Utility is strictly increasing, concave, time-separable and utility from zero earnings is normalized to zero.[3] Clients have complete information on pay-offs, strategies and types, as well as perfect recall of all group members' past health shocks and insurance decisions.

We define two types of clients: clients with high risk aversion ('high RA') and clients with low risk aversion ('low RA'). High RA clients prefer to enroll when there is no joint liability or dynamic incentive. In other words, they prefer to earn $e - ph$ with certainty over the gamble of earning e only when healthy:

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

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

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

Risk aversion is hence defined relative to earnings e, the health shock probability p and health expenditures h. Given this definition, not every strictly concave utility function satisfies (3) because health expenditures exceed earnings net of loan repayment: $h > e$. This is due to limited liability; uninsured ill clients do not fully repay their share of the loan. As a result, the one-time earnings with insurance, $e - ph$, are strictly below the expected one-time earnings without insurance, $e(1 - p)$. Insurance is actuarially fair only from the insurer's perspective.

[3] The free-riding hypothesis however generalizes to the case where this utility equals negative infinity for some but not all group members.

B. The value of insurance

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

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

See Appendix 1 for all proofs. For high RA individuals, AFE has three benefits. Within a round, it mitigates their own health risk and reduces the risk of contributing for ill peers. It also increases the probability of continuation.

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

$$V^l_{AFE} = \sum_{t=0}^{\infty} \beta^t U^l(e-ph) = \frac{U^l(e-ph)}{1-\beta} \tag{5}$$

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

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

With probability $1-p$, an uninsured individual is healthy and earns $e-c(f)$. With probability p, this person is ill and earns nothing, yielding zero utility.

Figure 2 shows the combinations of health shock probabilities p (horizontal axis) and discount factors β (vertical axis) for which the net present value of AFE in

(5) is higher than the net present value of AZE in (6):[4]

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

The figure distinguishes between four regimes associated with different equilibrium predictions. In Regime 1, AFE is welfare-improving on AZE only for high RA clients. At such low β, low RA clients do not sufficiently value the increased probability of continuation to the next loan cycle. Also, as the health shock probability and hence the insurance premium increases, AFE becomes increasingly unattractive since the premium is not actuarially fair from a client's perspective. We restrict ourselves to the remaining regimes that satisfy Assumption (7).

Furthermore, we focus on the parameter space where never enrolling (AZE) is an equilibrium. This assumption imposes very weak restrictions. It is violated only in Regime 4 in Figure 2, and only for the most risk averse client - i.e. the limiting case with risk aversion going to infinity. For the wide range of parameter combinations characterizing the remaining regimes, the value of taking insurance once when peers never enroll is strictly below the value of never enrolling, V^i_{AZE}:

$$\sum_{f=0}^{n^*} p_f U^i(e - ph - c(f)) < V^i_{AZE}(1 - \beta P_{n^*}),\ i \in \{l, h\} \tag{8}$$

The left-hand term represents the one-time utility when a client is the only one to be insured. In that case, the group continues borrowing with probability P_{n^*}, i.e. the probability that at most n^* peers - excluding oneself - fail to repay.

C. Free-riding and Coordination Problems

Regimes 2 and 3 satisfy both (7) and (8), meaning that full enrollment (AFE) is a Pareto-improvement on the zero enrollment (AZE) equilibrium. This section

[4]The figure fixes other parameters to the values as adopted in the game. We experimented with other values for n, n^* and e with qualitatively similar predictions.

investigates whether in these regimes the insurance decision entails a free-riding or coordination problem. We define these concepts as follows. Free-riding occurs if an individual forgoes insurance when she believes all peers will enroll in the present loan cycle. A coordination problem arises if it is optimal to take insurance if and only if a sufficient number of peers are believed to enroll forever.

Under group insurance, these social dilemmas are absent:

PROPOSITION II.2: *Under group insurance, individuals do not free-ride and there is no coordination problem.*

Group insurance requires a unanimous decision to enroll. Without unanimity, nobody enrolls or pays the insurance premium. Given Proposition II.1 and Assumption (7), both high and low RA types are best off if all group members enroll. Forgoing insurance would bar all peers from insurance, increasing the risk of contributing for peers and group default. The coordination problem is absent as well because clients only pay for insurance if all peers choose to enroll. Taking insurance is therefore a weakly dominant strategy for both types.[5]

In contrast, under individual insurance, free-riding and coordination failure exist. This harms group welfare even if there is partial and not zero enrollment:

LEMMA II.3: *Partial enrollment cannot be Pareto-efficient.*

The intuition for this lemma is as follows. Because insurance is actuarially fair, total earnings in the group under partial enrollment are a mean-preserving spread of joint earnings under full enrollment. While partial enrollment raises expected earnings for uninsured clients, expected earnings for insured clients are reduced by an equal amount because they need to contribute for ill uninsured peers. Thus, under the assumption of concave utility, partial enrollment cannot increase one's expected utility without reducing expected utility for others.[6]

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

[6]This holds even in the presence of side transfers to delinquents beyond loan repayment. Since insurance is actuarially fair from the perspective of total group earnings, side transfers cannot provide the same level of insurance at a lower cost.

The next proposition gives necessary and sufficient conditions for free-riding.

PROPOSITION II.4: *Under individual insurance, a client in Regime 2 will free-ride if and only if she has low risk aversion. A client in Regime 3 will free-ride if and only if i) she has low risk aversion and ii) group members do not condition current enrollment on peers' prior insurance decisions.*

If all peers are believed to enroll, they will ensure continuation to the next loan cycle, irrespective of one's own insurance decision. An individual faces a trade-off between the risk-free insurance option and a gamble with higher but uncertain earnings. By (3), high RA clients prefer to enroll, but by (4), low RA clients are tempted to free-ride on contributions from their insured peers. This cannot be Pareto-efficient by Lemma II.3.

Path-dependent equilibrium strategies may solve this social dilemma. Clients are able to sanction free-riders by staying uninsured in the future themselves.[7] This is a credible threat since the AZE equilibrium (never enrolling) exists by Assumption (8). Dynamic incentives need to be sufficiently strong for this grim trigger strategy to be effective. A low RA client will enroll only if her current utility gain from free-riding is smaller than future losses if peers remain uninsured:

$$(1-p)U^l(e) - U^l(e-ph) \leq \beta \left(V^l_{AFE} - V^l_{AZE} \right) \tag{9}$$

In Regime 2 with relatively low discount factors, (9) is not satisfied so that low RA clients cannot be committed to full enrollment. Regime 3 with higher discount factors satisfies (9) for any concave utility function.

Although free-riding will not occur in groups with only high RA types, such groups may have suboptimal demand due to a coordination failure:

[7]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.

PROPOSITION II.5: *Under individual insurance, a client faces a coordination problem if i) she has high risk aversion and ii) all peers have high risk aversion.*

A high RA client enrolls if she believes that all her peers will enroll, but may forgo insurance if she fears that peers will not enroll. Under Assumption (8), it is costly to enroll in otherwise uninsured groups. This is why groups with only high RA members may fail to coordinate on the social optimum.

In essence, the coordination problem is similar to alternative explanations for low take-up of microinsurance that refer to background risk, basis risk in index insurance or limited credibility of insurance providers. These concepts all highlight a problem inherent to many insurance products: the worst-case scenario for a client is to have paid for insurance but not to get reimbursed in case of a loss. This may occur because there are other uninsured risks (Gollier and Pratt, 1996), because insured losses are insufficiently correlated with the index (Cole et al., 2010), or because the insurance company defaults (Dercon, Gunning and Zeitlin, 2011). In our case, clients are hesitant to enroll in insurance because they are afraid of paying both the premium and contributing for peers.

An additional determinant of microinsurance take-up is the incidence of previous shocks, making the risk more salient. Although we assume rational beliefs about the health shock probability, clients may in practice use past health shocks to update these beliefs. This will increase demand both under individual and group insurance and as such cannot affect our main theoretical predictions.

Finally, communication between group members may enhance coordination and reduce free-riding (Sally, 1995). First, it can shape beliefs about peers' insurance decisions, create focal points and thereby minimize a coordination failure. Second, empirical evidence suggests that communication can reinforce social norms and limit free-riding even when oral agreements are not enforceable, for instance because individuals perceive a cost of lying or feel guilt from blame (Battigalli and Dufwenberg, 2007; Vanberg, 2008; Charness and Dufwenberg, 2011).

To summarize, we hypothesize that incomplete risk-pooling in microcredit groups results in suboptimal demand for individual insurance. Groups with only high RA clients face a coordination problem. Groups with low RA clients face a free-riding problem, unless clients effectively coordinate on a grim trigger strategy and condition own insurance decisions on their peer's prior enrollment.

III. Method

A. Design

To test these propositions, 355 microcredit clients from a microfinance institution (MFI) in Dar es Salaam, Tanzania, played microinsurance games. The experimental identification consists of two steps. First, an individual game measures a participant's risk aversion. A second microinsurance game elicits their demand for group versus individual insurance. This public good game frames the insurance decision in a jointly liable microcredit group and closely resembles the theoretical framework described in Section 2. Because participants are used to group lending, this frame may trigger different norms and behavior compared to an abstract public good game.

Game 1: Measure for risk aversion. — Participants first played an 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)[8] and falls ill with probability $p = 1/5$. Healthy participants, able to repay their loan, earn $e = 22,500$ after loan repayment. Ill participants incur health expenditures that fully absorb their earnings before loan repayment; $h = 62,500$. As a result, they earn nothing and cannot repay their loan.

Before the realization of the health shock, participants are offered insurance at a premium equal to $ph = 12,500$. An insured player earns $e - ph = 10,000$ with

[8]The exchange rate for 1,500 TZS was approximately US \$ 1 at the time of the experiment.

certainty after loan repayment. The participant hence faces a trade-off between lower risk-free earnings versus higher but risky earnings.[9] A client who enrolls is relatively risk averse compared to participants in Holt and Laury (2002), with a CRRA parameter estimated to be $r > 0.725$.

By Definitions (3) and (4), a client enrolls if and only if she has high risk aversion. Because there is no joint liability, this measure reflects risk attitudes rather than social preferences or beliefs about peers' decisions. Although we do not separate risk aversion from a certainty or framing effect, the decision in the first game is sufficient to identify the two theoretical participant types.

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, and defaulting groups do not continue to the next loan cycle. All other parameters are the same as in the introductory game.

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

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.[10] Or, as stated by one of the participants:

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

[10]Because of time constraints, at most 6 rounds were played in practice. Clients were not informed

> *"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."* (based on transcripts from participants' communication during the games).

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

$$\beta_t = 1 \text{ if } t < 4 \text{ and } \beta_t = \frac{5}{6} \text{ if } t \geq 4 \tag{10}$$

The cross in Regime 3 of Figure 2 indicates the game-specific parameter values. In theory, both free-riding and coordination problems exist but a coordinated grim trigger strategy is credible and effective.[11] Because participants will anticipate that the game cannot continue forever, $\beta = 5/6$ is an upper bound for rounds 4 and higher. Nonetheless, free-riding and coordination problems also exist at lower values of β in Regime 2 and 3.

Participants are informed of their peers' decisions in the first individual game, used to elicit risk aversion. After every round, clients also receive information on the insurance decisions and the health status of each group member. Hence, they can update their beliefs about peers' actions. Each group member is represented by a non-changing symbol that is known only to herself. Thus, effects of future outside interactions on behavior in the game should remain limited unless participants in the communication treatments disclose their identity themselves.

The experiment varies in two dimensions. First, under individual insurance (II), enrollment is an individual decision. Under group insurance (GI), group

that the sixth round was the last round.

[11]The figure applies to rounds 4 and higher, in which β remains constant. However, calculations generalize to all rounds with β as in (10). Calculations are available upon request.

members enroll if and only if all group members express their willingness to join in an anonymous vote. Their demand reveals whether full enrollment is welfare-enhancing on zero enrollment in the joint liability context. Given that demand is optimal under group insurance, it serves as a benchmark against which we can compare demand under individual insurance. Alternative treatments such as mandatory insurance and individual liability are unable to verify this key assumption. In the first alternative, clients cannot reveal their preference, and under individual liability, insurance is valued differently as there is no risk-sharing within the group.

Second, the experiment varies the possibility to communicate. In treatments without communication (NC), group members cannot talk to each other. Demand will reflect their individual preferences under either group or individual insurance. In the communication treatments (C), group members can talk for two minutes preceding every round. As in the NC treatment, clients indicate in private whether they would like to enroll. They are seated with their group in both treatments.

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

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

B. 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 the weekly loan repayment. During these meetings, clients were invited to come to one of the sessions, introduced as interactive seminars about health insurance. They could bring along 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.

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

Clients were randomly assigned to groups. They knew with whom they were playing. Private insurance decisions were however only disclosed through the anonymous symbols. Further, the threat of immediate removal from the session without compensation upon violation of the 'no communication' rule during the games was sufficient to ensure high compliance to this rule. Communication was recorded, transcribed and translated to English.

Every game started with Kiswahili instructions, a practice game, and standardized test questions that participants had to answer correctly before continuing. Individual earnings throughout the game were stored in closed boxes (piggy-banks). This enhanced clients' understanding of the game and the implications of their decisions. Earnings 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), which equals on average 2.5 days of profit.

IV. Data

A. Study population and participant characteristics

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

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

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

Panel C presents credit-related variables. The average monthly business profit is TZS 225,944 (US \$ 145) and represents a considerable proportion of total household income. Eleven percent of participants is waiting to take out their next loan. Approximately one third indicates that at least one of their credit group members defaulted during a meeting in the past three months. Respondents contributed for these persons in almost all cases. In contrast, only around half of respondents who failed to repay themselves report that group members contributed for them. Participants are either more supportive to their group members than non-participants, or answer socially desirable to these sensitive questions.

Panel D shows game-related variables. The first two variables examine the social ties between group members in the games. Participants were randomly assigned to groups that included on average one other person they knew by sight, but only 0.5 of their game group members were also a member of their real credit group. Pre-existing social ties could potentially affect enrollment decisions through trust, cooperation and beliefs. However, all our results are robust to the in- or exclusion of these two variables.

Finally, the introductory game classifies 25.6 percent of the participants as 'low risk averse'; 46.2 percent have 'high risk aversion' and at least one low RA peer; and the remaining 28.1 percent are high RA participants with only high RA peers. This large share of high RA participants implies that the sample is relatively risk averse compared to participants in conventional laboratory experiments (e.g. Holt and Laury, 2002) given that our definition of high risk aversion is associated with a CRRA parameter $r > 0.725$. Framing the lottery as an insurance decision may have induced loss-averse behavior or a preference for certainty.[12] This does not confound our identification strategy, which only requires that decisions in the first game predict equilibrium strategies in the second game.

B. Balance of characteristics over treatments

To examine the comparability of treatment groups, Table 2 compares the characteristics of the participants in each of the four treatments. The first two columns compare individual and group insurance without communication. The last two columns compare the two treatments with communication. The significance levels

[12]Because of time constraints, we were unable to play a Holt and Laury lottery.

are based on wild bootstrap t-percentiles and are clustered by session.

Participants in each of the treatments are very similar in terms of a large number of key characteristics. Only a few characteristics are not well balanced over the four treatments at the 10%-significance level, which may be due to chance alone. Thus, the assignment of treatments seems to have resulted in four comparable treatment groups.

Nevertheless, some of the game-related variables in Panel D vary in absolute values across treatments. Although the risk types are well-balanced across treatments, high RA participants in the individual insurance treatment were less often grouped with peers of the same type. Potential bias will be limited because the main equations control for the number of low RA peers and are estimated separately for high RA types with and without low RA peers.

Further, while health shocks are random in the games and occurred for around 20 percent of the observations as predicted by the law of large numbers, the prevalence of illness is not perfectly balanced. The difference does not appear until round 4, in which a higher incidence of illnesses occurred under group insurance. Any bias should hence remain limited. We nevertheless test for the robustness of our results to the in- or exclusion of illness in the previous round as a control variable.

V. Results

A. Descriptive outcomes

The main outcome variable is demand for insurance, d_{igst}, a dummy variable equal to 1 if and only if member i of group g in session s is willing to join in round t. The willingness to join group insurance is based on the individual votes. These reveal whether participants prefer full group enrollment over zero enrollment.[13] The discussion on actual enrollment is postponed to Section 6.

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

Figure 3 presents the demand for health insurance by session. It distinguishes between the group insurance treatments without and with communication (GI-NC and GI-C respectively) and individual insurance without and with communication (II-NC and II-C). The average share of participants willing to join group insurance is very high at 96.0 percent. This finding, combined with Lemma II.3, suggests that full group enrollment is Pareto-efficient. Demand under individual insurance is substantially lower at 79.6 percent on average. A one-sided Mann-Whitney rank sum test rejects the hypothesis of equal demand in GI and II sessions ($p < 0.01$).

Figure 4 disaggregates demand by round for each of the three risk type subsamples. Panel (a) shows that the majority of low RA clients, 91.6 percent, is willing to join group insurance, while demand for individual insurance is substantially lower at an average of 45.3 percent. This difference between II and GI sessions is significant using the Mann-Whitney test (with $p < 0.05$ for round 5 and $p < 0.01$ for other rounds).

Panel (b) shows the willingness to join group versus individual insurance among high RA group members with at least one low RA peer. Their demand throughout the game is high under both group and individual insurance at 95.9 and 89.1 percent, respectively. Demand is highest under group insurance, especially in later rounds, but a one-sided Mann-Whitney test rejects the hypothesis of equal demand in II and GI sessions only for the third round ($p < 0.01$).

Panel (c) presents the willingness to join insurance for high RA participants with only high RA peers. Demand for insurance is highest among this subset of participants. Under group insurance, 99.2 percent is willing to join, and 93.1 percent joins individual insurance. Demand is highest in the group treatment, but Mann-Whitney tests fail to reject equal demand in II and GI sessions.

B. Testing for suboptimal demand for individual insurance

To formally test whether demand is suboptimal in the individual insurance treatments, we estimate the following linear probability model for demand d_{igst}:

$$d_{igst} = \beta_0 + \beta_{II} II_s + \beta_{\mathbf{x}} \mathbf{x}_{igst} + r_t + \eta_{igs} + \varepsilon_{igst} \ \forall \ y_{gst} = 1,\, t \geq 1 \tag{11}$$

The dummy variable II_s equals 1 under individual insurance and 0 under group insurance, $\mathbf{x}_{igst}$ is a vector of controls, r_t a round fixed effect, η_{igs} an unobserved individual random effect, uncorrelated with the regressors, and ε_{igst} the residual.

Since demand for group insurance is optimal, we test whether $\beta_{II} < 0$ by estimating Equation (11). Table 3 Panel A presents the results for different subsamples of participants. Column (a) indicates the number of observations for each subsample and (b) their average demand under group insurance. Column (1) estimates Equation (11), controlling for round-fixed effects and the number of low RA peers. The next column controls for pre-existing differences in participant characteristics. Column (3) adds an indicator for illness in the previous round. Although the health shock probability was constant across treatments, the observed number of health shocks was higher under group insurance. As a final robustness check, the fourth column adds a participant's cumulative prior earnings to control for differential wealth effects.[14]

The table presents the estimated difference between group and individual insurance, β_{II}, followed by its clustered standard error (by session) in parentheses, and the probability that demand for individual insurance is suboptimal, $\beta_{II} < 0$. Standard errors are clustered at the session level. Due to a relatively small number of 14 sessions, the probability that $\beta_{II} < 0$ is estimated using a wild bootstrap-t procedure. Cameron, Gelbach and Miller (2008) show that this procedure improves inference even when there are as few as five clusters and that this gener-

[14]Prior earnings are driven partly by lag demand. Hence, the coefficient on this variable cannot be interpreted as a causal effect.

alizes to cases where the dependent variable is binary instead of continuous.[15]

The first row in Panel A restricts the sample to low RA participants. By Proposition II.4, they free-ride under individual insurance unless their peers coordinate on a trigger strategy. This yields suboptimal demand among this subsample. Consistent with this hypothesis, a large share is willing to join group but not individual insurance. In Column (1), individual insurance reduces demand significantly by 47.2 percentage points. This estimate is robust to the inclusion of participant characteristics in Column (2), and lag illness in Column (3). In Column (4), the estimated difference remains large at 38.4 percentage points.

The second row estimates the main equation for high RA clients with low RA peers. In theory, free-riding of low RA participants may reduce demand among this subsample. Given the parameters in the game, 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 more peers are believed to free-ride, increasingly risk-averse clients will decide not to enroll either.[16] Clients with risk aversion going to infinity will however forgo insurance only if all group members stay uninsured. We hence predict non-increasing demand among this subsample, $\beta_{II} \leq 0$.

Although the sign of the individual insurance coefficient in Table 3 is consistent with this hypothesis, the difference is small and estimated with low precision. Thus, high RA clients in mixed groups are not significantly less likely to join individual insurance. This is partly because not all low RA peers are free-riding. Some high RA clients correctly believe that all peers will enroll. Further, and more important, high RA clients with uninsured low RA peers do not opt out of individual insurance themselves. They do not condition insurance decisions on past actions of their peers, and hence there is no evidence of a grim trigger strategy or conditional cooperation.

The third row tests the hypothesis that high RA clients with only high RA peers

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

[16] Calculations are available upon request. Predictions also apply to a wider range of discount rates β, and to the specification for β in (10).

face a coordination problem in the individual insurance treatment (Proposition II.5). Under group insurance, this subset of participants has very high demand throughout the game. Only 3 of the 390 observations opted out. Individual insurance reduces demand by 6.1 percentage points in Column (1). This difference is small but statistically significant, also when adding controls in Columns (2) to (4). While groups with only high RA members mostly coordinate on the social optimum, a few of them fail to do so, leading to suboptimal demand.

Panel B estimates Equation (11) including the first round only. Differential wealth effects, selective attrition and prior enrollment decisions cannot distort the findings in this round. The first row restricts the sample to low RA clients. Each specification shows a negative and significant coefficient for the individual insurance variable. The second row estimates demand among high RA clients with low RA peers. Their demand for group insurance is high at 92.6 percent, and demand is not significantly reduced under individual insurance. Also the third row, focusing on groups with high RA members only, finds no significant effect of individual insurance. Thus, only low RA clients have suboptimal demand in this early stage of the game.

Panel C shows estimates of β_{II} for subsequent rounds. The size and significance of the estimates is similar to that of the estimates in Panel A. We conclude that demand is suboptimal among low RA participants, that demand among high RA participants with low RA peers is not significantly suboptimal, and that few groups with only high RA members fail to coordinate on the social optimum.

C. Selective attrition

Demand for insurance is however observed only for groups that are still borrowing in round t. A few mixed groups with both high and low RA members default, which may result in selective attrition. This occurs especially in the GI sessions, in which either all or no group members enroll and the risk is more concentrated within credit groups. If mainly participants unwilling to join group insurance drop out, the estimate for individual insurance, β_{II}, will be biased. For that reason, Table A1 in Appendix 3 performs three robustness checks for rounds 2 and higher, focusing on the subsamples of low RA participants and their high RA peers. Defaults did not occur in groups with only high RA types.

First, Equation (11) is estimated using a two-step Heckman model to correct for selective attrition. Default is partly driven by random health shocks, especially in the GI treatment where either all or no group members enroll. The first step therefore includes the number of ill peers in the previous round, and its interaction with a dummy variable for group insurance, to identify a selection bias. The second stage estimates Equation (11), controlling for the inverse Mill's ratio from the first stage. The table presents t-percentiles from a wild bootstrap of the second stage, clustering observations at the session level.

Estimates are similar to the findings presented in Table 3 Panel C. In Panel A, 93.2 percent of low RA clients is willing to join group insurance, while demand is 48.4 to 40.7 percentage points lower under individual insurance. In Panel B, on the other hand, high RA clients with low RA peers are around 7 percentage points less likely to join in the II treatments, which is not statistically significant.

The Heckman estimates are similar to the estimates in Panel C either because there is no selective attrition, or because the instruments perform poorly. The second row of Panels A and B therefore present an additional robustness check. We estimate β_{II} assuming that participants who defaulted would have repeated their last-round decision if they had still been in the game. In other words, $d_{igst} = 0$ is imputed for participants unwilling to join in their last round, and $d_{igst} = 1$ for participants willing to join. This robustness check does not reject our main conclusion that only low RA participants have suboptimal demand.

Lag demand is not necessarily the correct predictor for a defaulted participant's decision, had she still been in the game. A substantial number of participants who are initially unwilling to join and do not default change their mind. They become willing to join insurance in later rounds. For that reason, the table adds a third specification in which missing observations are replaced by the predicted probability of joining. We estimate a probit model for demand using non-missing observations and predict out of sample the probability that a defaulting participant would have been willing to join, conditional on lag demand, treatment, round-fixed effects, lag illness, and lag number of ill peers.

Also in this specification, the low RA have suboptimal demand in the individual insurance treatments. The difference in demand for group versus individual insurance among high RA participants with low RA peers is mainly driven by selective attrition. If defaulted high RA participants would still be in the game in later rounds, there would not have been a significant difference in the demand for group and individual insurance.

D. Communication and social ties

Communication and close social ties between participants may both serve as a commitment or coordination device. Table 4 tests whether our main findings are robust to these two variables. The table pools the three types of participants. All estimates of β_{II} in Equation (11) are corrected for round fixed effects, the number of low RA peers and dummy variables for low RA participants.

The first row in Panel A estimates demand in the no communication treatments. 94.8 percent of participants are willing to join group insurance. Their demand for individual insurance is suboptimal by 14.8 percentage points in Column (1), although this estimate is imprecise. Also the second, third and fourth column find a negative effect of individual insurance. The results are thus robust to the inclusion of additional controls.

The second row in Panel A estimates the model for clients in the communication treatments. While 96.9 percent is willing to join group insurance, individual insurance reduces demand by 19.0 percentage points in Column (1). This effect is significant, also in the remaining three columns. Communication apparently does not serve as a commitment device.

Why do clients have suboptimal demand even when participants are able to communicate? The transcripts of the recorded communication demonstrate that participants are very much aware of the free-riding problem:

> *"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, it is not straightforward to commit free-riding individuals to the social optimum. Although participants condemn their peers for not taking insurance, and these peers promise to take insurance as a result of social pressure, 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."* [to whom the participant indicates whether she will take insurance]

Further, whereas the group discussions mostly create focal points to take up insurance, in a few instances the discussions move the group away from full enrollment:[17]

> 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."*

Finally, Panel B tests whether the results can be explained by an absence of pre-existing social ties within a group. Social capital may enhance commitment and coordination in microcredit groups (Cassar, Crowley and Wydick, 2007). Because

[17] 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."*

participants were randomly assigned to groups, the number of peers from their real credit group is exogenous within sessions. We can hence test whether free-riding and coordination problems occur in groups whose members have close social ties.

The first row restricts the sample to participants assigned to a group without any of their real microcredit group members. The second row focuses on participants grouped with at least one of their real peers. Demand for individual insurance is suboptimal in both cases, even for group members who have close social ties outside the games.

To summarize, we find evidence of a social dilemma in mixed groups with both high and low RA members. While both risk types have high demand for *group* insurance, low RA clients consistently decide to forgo *individual* insurance. In contrast, few groups with only high RA members fail to coordinate on the social optimum. Finally, we find that demand for individual insurance remains at suboptimal levels even in the presence of communication and in groups whose members have social ties outside the games. The social dilemma is hence not an artifact of the anonymous laboratory setting.

E. Free-riding versus coordination failure

The question is whether suboptimal demand among low RA participants is due to free-riding or coordination failure. To test the theoretical prediction that low RA participants are free-riding, the following linear probability model is estimated for this subsample:[18]

$$d_{igst} = \delta_0 + \delta_{II} II_s + \delta_{LRA} II_s \times LRA_{igs} + \delta_{\mathbf{x}} \mathbf{x}_{igst} + \omega_{igst} \ \forall,\ t \geq 2 \tag{12}$$

This model applies to rounds 2 and higher, and includes the number of low RA peers, LRA_{igs}, interacted with individual insurance, II_s, as a proxy for the num-

[18]For ease of notation, this equation leaves out the round fixed effects and the individual random effects. The estimation will however include round fixed effects.

ber of peers believed *not* to enroll. Due to the random assignment to groups within a session, the number of low RA peers is exogenous. This variable is also a relevant proxy for beliefs under two conditions. First, mainly low RA but not high RA group members forgo individual insurance as demonstrated above. Second, participants update their beliefs based on peers' prior decisions in the game.

Under these two conditions, the free-riding hypothesis is rejected if $\delta_{II} = 0$, that is, if suboptimal demand is not due to individual insurance itself, but to the number of low RA peers ($\delta_{LRA} < 0$). A free-riding participant opts out of individual insurance even when she believes that all her peers will enroll; in other words, if no peer is of the low RA type.

Columns (1)-(4) estimate Equation (12) using the same controls as Table 3. The first row presents the coefficient for individual insurance, β_{II}, i.e. the difference in demand for the only low RA participant in a group. Consistent with the free-riding hypothesis, this coefficient is significantly lower than zero in Column (1). This suggests that a low RA participant opts out even if she beliefs that her peers will all enroll.

The second row indicates by how much every additional low RA peer reduces demand for individual insurance. Members of social risk-sharing networks may sort on risk attitudes (Genicot and Ray, 2003; Attanasio et al., 2012). Although the experiment did not allow for assortative matching, we find a robust and significant negative effect of having an additional low RA peer under individual insurance. This suggests that assortative matching would have magnified the social dilemma among the low RA.

To conclude, our findings are consistent with the free-riding hypothesis. While the low RA are willing to join group insurance, a large share forgoes individual insurance at the expense of their insured peers. Apparently, the repeated nature of the game did not induce high RA group members to reduce their demand in response to free-riding. This stands in contrast to findings from conventional laboratory experiments, where high punishments are observed even in the last round of public good games. This tolerance for free-riders may for instance be due to existing social norms of solidarity among microfinance clients.

VI. Policy implications and external validity

The previous section discussed the willingness to join insurance. Does free-riding also lead to suboptimal enrollment rates in insurance and worsen other financial performance indicators? To answer these questions, this section analyzes the implications of the various demand patterns from three different perspectives: the insurer, the MFI and its clients.

A. The insurer: enrollment rates

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

To quantify this effect in the microinsurance games, the first two rows in Table 6 estimate Equation (11) for demand and actual enrollment among the full sample. The analyses include the same covariates as Table 4.

Consistent with the previous section, the vast majority, 96 percent, is willing to join group insurance. Individual insurance significantly reduces demand by 16.9 percentage points. However, there is no significant difference in actual enrollment rates between individual and group insurance. A few individuals continuously opt out of group insurance in each round, reducing overall enrollment rates in this treatment. Although their absolute number is small, a mere four percent of negative voters in the sample decreases group enrollment by approximately eight percent.

B. The MFI: 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 accordingly. Under individual insurance, unprotected risk is scattered over the population. Group insurance leads to a concentration of uninsured participants within a few microcredit groups, which might increase groups' vulnerability to collective default.

Panel B in Table 6 estimates Equation (11) for group defaults, using as dependent variable actual group defaults in the first row, and expected group defaults, i.e. the probability that a group defaults given the number of insured members, in the second row. Estimates are corrected for selective attrition.

Actual group defaults are lower under individual insurance but this is mainly due to a higher health shock incidence in the individual insurance sessions. Expected group default does not significantly differ between individual and group insurance. Apparently, the greater vulnerability to shocks for the uninsured in the group treatment is offset by a higher probability of being insured.

Whereas in practice individual delinquency is common, group default rates in most MFIs are low. For instance, 98% of Tujijenge groups repay their loan. Higher default rates in the games can be partly attributed to a relatively higher probability of catastrophic expenditures than in real life. In the games, uninsured participants faced a one-fifth probability of incurring catastrophic health expenditures. In contrast, only 10.2 percent of participants reported health expenditures equal to or above monthly per capita income. Nonetheless, given the value of the discount rate β, Figure 2 shows that the game represents a social dilemma for all $p < 0.33$ in Regimes 2 and 3.

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

C. The client: profits

Clients are concerned with earnings levels and income fluctuations. Panel C in Table 6 estimates the effect of individual insurance on expected profits within a round and the variance of these profits (in 10,000 TZS). Because low RA clients will have less disutility of variance, the estimates are presented for each of the three types separately. Profits are calculated based on a client's own insurance status and the number of insured peers.

As expected, low RA clients earn more under individual insurance. Free-riding increases their profits by on average 26,300 TZS. Also the variance of profits is higher for this type of participant, but the increased variance does not affect a low RA client's decision to forgo 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.

Panel C2 shows that such free-riding is at the expense of their high RA peers. Their profits are significantly lower and vary more in the individual insurance treatments, although the latter is not statistically significant. For groups with high RA clients only, we find no significant differences in expected profits, nor in the variance.

To summarize, the lower demand under individual insurance does not translate into significantly lower enrollment rates. As a result, individual insurance does not reduce the group default risk. Its main cost from the client perspective is a redistribution of profits from high to low RA clients, which will harm welfare of especially the more risk averse individuals.

D. Risk attitudes in the population

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

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

Game participants are more likely to be female, have larger households, less education and are less likely to be insured. They are also twice as likely to have visited a health provider in the past three months and they spent substantially more on health care. This could be due to an explosion in a munition depot near one of the study areas just prior to the games. This accident caused injuries for a substantial proportion of households in the surrounding neighborhoods.

To extrapolate results to the target group, it is necessary to know which variables correlate with risk aversion. The last column in Table 1 estimates a probit model for low risk aversion. Women as well as participants with higher household health expenditures - both overrepresented in the games - are more risk averse. Participants with health insurance - underrepresented in the games - are less risk averse. The latter finding is most likely due to a wealth effect because in the absence of microinsurance only formally employed or very wealthy households have access to insurance in Tanzania.

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

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

VII. Conclusion

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

We showed that the introduction of individual insurance in jointly liable credit groups creates a social dilemma. First, individuals with low risk aversion are tempted to forgo individual insurance and free-ride on contributions from peers when they fall ill even if full group enrollment is socially optimal. Second, credit groups with only high risk averse members may fail to coordinate because it is costly to enroll if peers remain uninsured.

Microinsurance games played by 355 microcredit clients in Tanzania elicited their demand for individual versus group insurance. This experiment yielded substantial support for the free-riding hypothesis but only weak support for the existence of a coordination problem. Under group insurance, nearly all participants enrolled in insurance. A majority of participants with low risk aversion however opted out of individual insurance. In groups with only high risk averse clients, most groups coordinated on the social optimum.

Overall enrollment rates were not significantly lower under individual insurance because a small minority of individuals consistently voted against group insurance. In addition, individual insurance did not increase the probability of group default or reduce expected earnings. Individual insurance did however increase the variance of earnings compared to group insurance, harming welfare of high risk averse clients with a preference to smoothen earnings over time.

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

Group insurance is not the only way to solve the social dilemmas inherent to individual insurance decisions. Alternatives are for example mandatory enrollment, stronger social sanctions, individual liability for loan repayment, or an individual insurance product with a deductible that would only step in if too many group members simultaneously incur a health shock.

This study sheds light on the replicability of findings from conventional public good games played with university students. Although the microinsurance games resemble the real world of the Tujijenge microcredit groups as close as possible, external validity will remain a caveat. The extent to which free-riding creates suboptimal demand for microinsurance will depend on many more factors than can possibly be modeled in a game, some of which were already discussed in the previous section. In future research, we hope to cross-validate our findings with enrollment decisions in the field.

To conclude, we find suboptimal demand for individual insurance when jointly liable microcredit group members are free-riding 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 communities, extended families or cooperatives. As such, our findings are relevant to the design and implementation of microinsurance schemes in a wide variety of contexts.

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Figures and Tables

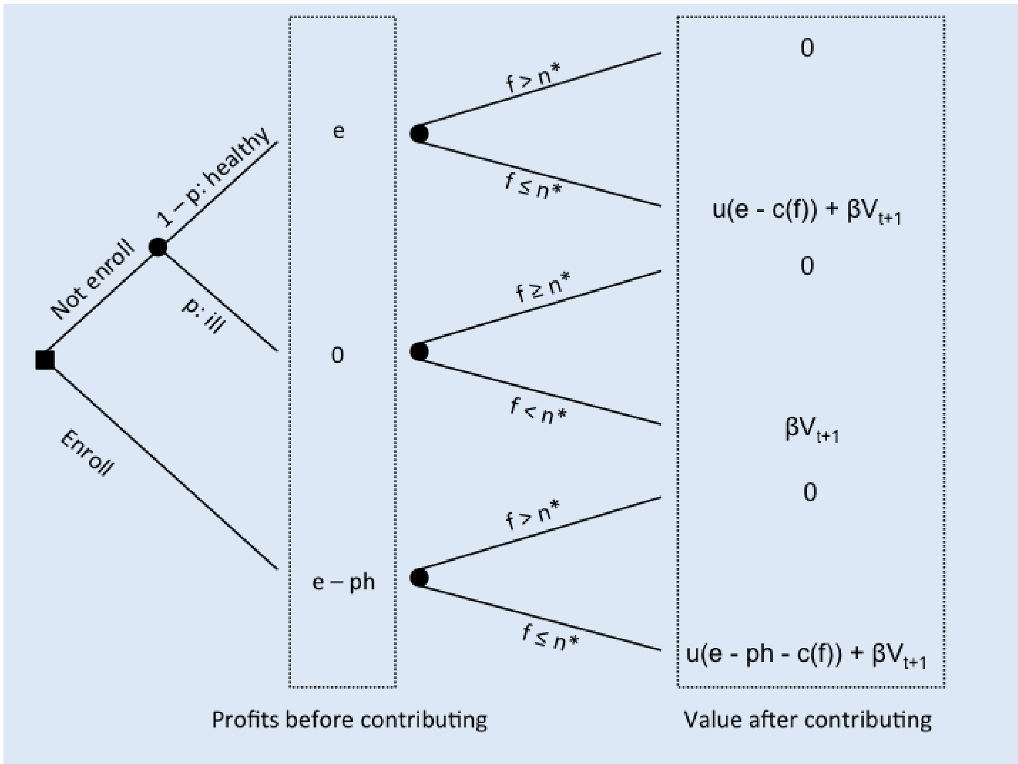


Figure 1. : Game tree.
Clients receive a loan l and earn $e + l$ before loan repayment. The symbol p represents the health shock probability, e earnings, $h \in (e, e + l]$ health expenditures, $n^* \in \{1, ..., n - 1\}$ the maximum number of members for which a group can contribute, $c(f) = f(h - e)/(n - f)$ the contribution for f delinquent peers, $\beta < 1$ the discount rate and V_{t+1} the value of continuing to the next loan cycle.

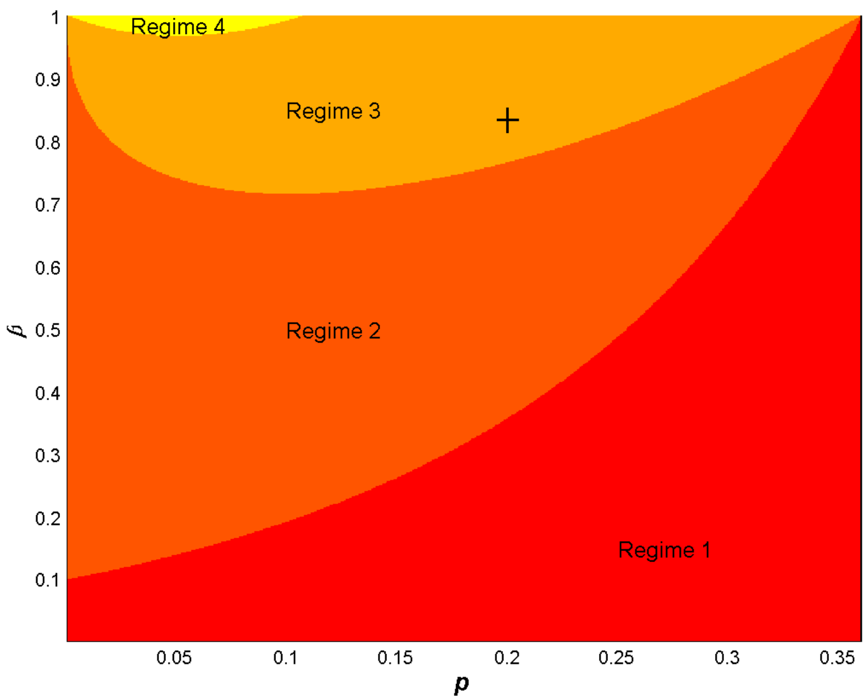


Figure 2. : Solution regimes if $e = 9/16l$, $h = e + l$, $n = 5$ and $n^* = 1$.
Regime 1: insurance is welfare-improving for high ra types only. Regimes 2-4: insurance is welfare-improving for both high and low ra types. Regime 2 (3 and 4): dynamic incentives are too weak (sufficiently strong) for trigger strategy to be effective. Regime 4: zero enrollment not an equilibrium if a group member's risk aversion is going to infinity. A grim trigger strategy is therefore not a credible threat.

Figure 3. : Demand for individual (II) versus group (GI) insurance by session

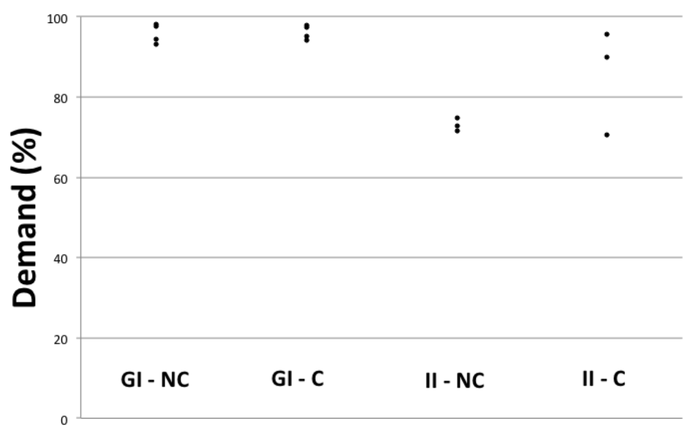
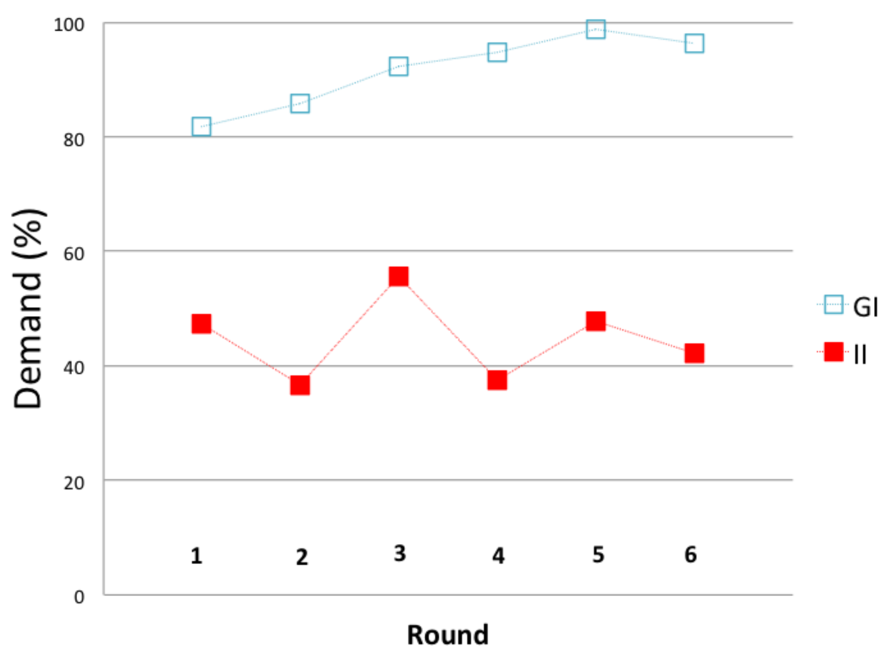
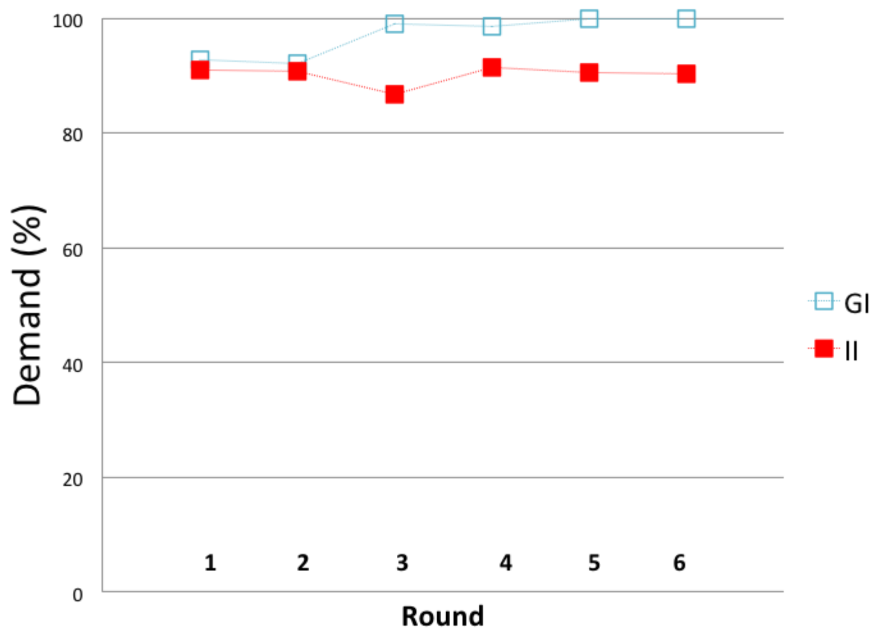


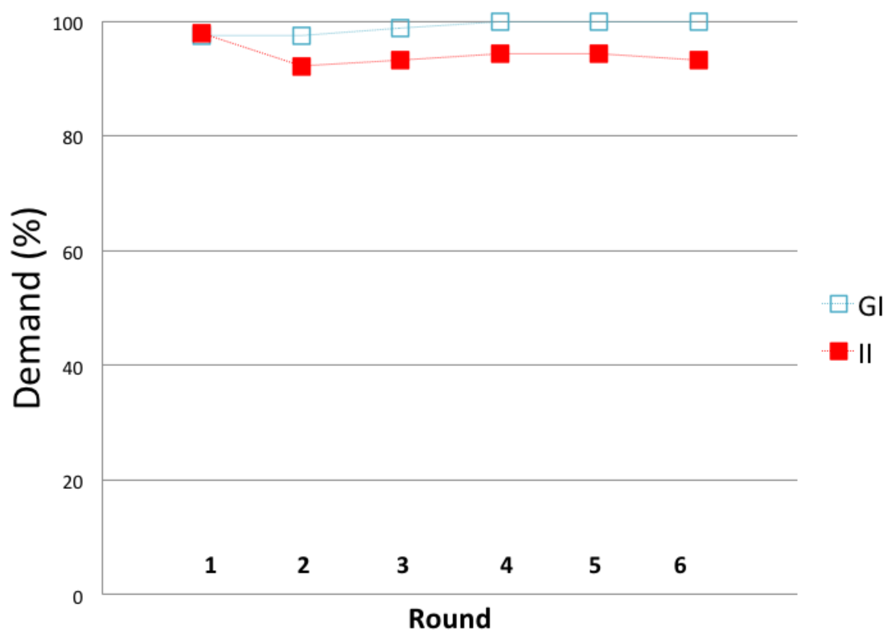
Figure 4. : Demand under individual (II) versus group (GI) insurance by type



(a) Low RA



(b) High RA with at least one LRA peer



(c) High RA only

Table 1—: Descriptives of participants and the target group

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

[1]Out-of-sample prediction. Confidence interval based on Delta standard errors: [23.3,38.2].

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

Table 2—: Balance of participants' characteristics and game-related variables

	No communication		Communication	
	GI mean	II mean	GI mean	II mean
A. Demographic and socio-economic characteristics				
Female	70.0	74.7	76.5	77.3
Age	36.0	35.8	36.0	36.1
Household size	5.3	5.2	4.9	5.2
Married	75.6	81.3	71.3	78.7
Years of education	7.4	8.0	7.8	7.7
Per capita HH income	85,011	83,956	82,155	87,554
B. Health characteristics				
Knows health insurance	31.1	45.3*	40.9	49.3
Has health insurance	3.3	8.0	7.0	12.0
Visited provider	52.2	52.0	54.8	61.3*
Health expenses	11,963	12,046	13,542	16,182
Other visited provider	73.3	73.3	74.8	72.0
Health expenses others	32400	28532	28136	27146
Nr. times foregone care	0.6	0.5	0.5	0.7
C. Microcredit variables				
Membership years	1.0	1.1	1.0	1.0
Profit business	227,415	274,541	193,906	240,507
Has an outstanding loan	93.3	85.3	89.6	86.7
Last loan	450,000	552,329	410,797	455,946
Delinquent in group	28.9	25.3	36.5	37.3
Contributed for peer	24.4	28.0	26.1	32.0
Has been delinquent	12.2	9.3	17.4	10.7
Peers contributed	6.7	4.0	11.3	2.7
Nr. known personally	0.9	0.8	1.2	1.1
Nr. in credit group	0.4	0.5	0.6	0.6
D. Game-related variables				
Low RA	31.1	26.7	22.6	22.7
High RA, LRA peer	41.1	53.3	38.3	57.3
High RA only	27.8	20.0	39.1	20.0
Ill	23.1	17.3	21.5	17.0
Number of observations	90	75	115	75

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$: t-percentile in wild cluster-bootstrap; clustered by session. Binary variables in percentages. All monetary variables are in Tanzanian Shillings (TZS). US $ 1 was approx. 1,500 TZS during the study.

Table 3—: Demand for insurance by participant type

	N	Mean GI	Difference II (β_{II})			
	(a)	(b)	(1)	(2)	(3)	(4)
A. All rounds						
Low RA	463	0.916	-0.472	-0.461	-0.462	-0.384
			(0.117)	(0.101)	(0.101)	(0.101)
			0.005***	0.002***	0.001***	0.004***
High RA with LRA peer	827	0.959	-0.064	-0.063	-0.064	-0.088
			(0.039)	(0.041)	(0.041)	(0.034)
			0.103	0.118	0.118	0.028**
High RA only	565	0.992	-0.061	-0.063	-0.062	-0.068
			(0.017)	(0.013)	(0.013)	(0.016)
			0.080*	0.010**	0.009***	0.013**
B. Round 1 only						
Low RA	91	0.852	-0.377	-0.357	-0.351	-0.266
			(0.125)	(0.12)	(0.122)	(0.119)
			0.025**	0.020**	0.021**	0.038**
High RA with LRA peer	164	0.926	-0.030	-0.020	-0.030	-0.009
			(0.053)	(0.057)	(0.054)	(0.051)
			0.313	0.361	0.292	0.454
High RA only	100	0.986	-0.019	-0.019	-0.025	-0.026
			(0.027)	(0.033)	(0.035)	(0.031)
			0.296	0.329	0.318	0.282
C. Round 2 and higher						
Low RA	372	0.932	-0.497	-0.487	-0.489	-0.411
			(0.125)	(0.11)	(0.11)	(0.109)
			0.004***	0.002***	0.001***	0.003***
High RA with LRA peer	663	0.967	-0.072	-0.072	-0.072	-0.110
			(0.041)	(0.042)	(0.042)	(0.038)
			0.080*	0.091*	0.100	0.024**
High RA only	465	0.994	-0.070	-0.072	-0.070	-0.077
			(0.022)	(0.012)	(0.011)	(0.02)
			0.066*	0.007***	0.008***	0.011**
Round fixed effects			✓	✓	✓	✓
Number of LRA peers			✓	✓	✓	✓
Participant characteristics				✓	✓	✓
Lag ill					✓	✓
Prior earnings (in 10,000 TZS)						✓

Dep. var.: willing to join insurance. 1st line: OLS estimate. 2nd line: std. errors clustered by session. 3rd line: one-sided t-percentile in wild cluster-bootstrap (999 reps), * $p < .1$, ** $p < .05$, *** $p < .01$. Participant char's: female, visited provider, knows health insurance, peers contributed for participant, grouped with member of real credit group. Lag ill uses health in practice round for round 1. Prior earnings include earnings from first game.

Table 4—: Communication and social ties

	N (a)	Mean GI (b)	Difference II (β_{II}) (1)	(2)	(3)	(4)
A. Communication						
No Communication	875	0.948	-0.148	-0.145	-0.145	-0.144
			(0.069)	(0.066)	(0.064)	(0.054)
			0.120	0.128	0.105	0.080*
Communication	980	0.969	-0.190	-0.191	-0.190	-0.135
			(0.047)	(0.051)	(0.052)	(0.051)
			0.009***	0.005***	0.006***	0.033**
B. Social ties						
Without real group member	1184	0.956	-0.154	-0.156	-0.156	-0.147
			(0.05)	(0.05)	(0.05)	(0.047)
			0.010**	0.011**	0.013**	0.006***
With credit group member	671	0.967	-0.192	-0.189	-0.188	-0.149
			(0.056)	(0.058)	(0.058)	(0.049)
			0.002***	0.001***	0.003***	0.004***
Round fixed effects			✓	✓	✓	✓
Low RA, nr. of LRA peers			✓	✓	✓	✓
Participant characteristics				✓	✓	✓
Lag ill					✓	✓
Prior earnings (in 10,000 TZS)						✓

Dep. var.: willing to join insurance. 1st line: OLS estimate. 2nd line: std. errors clustered by session. 3rd line: one-sided t-percentile in wild cluster-bootstrap (999 reps), * $p < .1$, ** $p < .05$, *** $p < .01$. Participant char's: female, visited provider, knows health insurance, peers contributed for participant, grouped with member of real credit group. Lag ill uses health in practice round for round 1. Prior earnings include earnings from first game. All rounds are used in the estimation.

Table 5—: Renewal decisions among Low RA participants for rounds 2 and higher

	N (a)	Mean GI (b)	Heckman estimates (1)	(2)	(3)	(4)
Individual Insurance (β_{II})	431	0.932	-0.356	-0.311	-0.318	-0.206
			(0.119)	(0.11)	(0.11)	(0.115)
			0.010**	0.021**	0.014**	0.070*
Nr. low RA peers x II (β_U)			-0.130	-0.162	-0.156	-0.182
			(0.054)	(0.042)	(0.04)	(0.038)
			0.028**	0.009***	0.004***	0.006***
Round fixed effects			✓	✓	✓	✓
Number of LRA peers			✓	✓	✓	✓
Participant characteristics				✓	✓	✓
Lag ill					✓	✓
Prior earnings (in 10,000 TZS)						✓

Dep. var.: willing to join insurance. 1st line: OLS estimate. 2nd line: std. errors clustered by session. 3rd line: one-sided t-percentile in wild cluster-bootstrap (999 reps), * $p < .1$, ** $p < .05$, *** $p < .01$. Participant char's: female, visited provider, knows health insurance, peers contributed for participant, grouped with member of real credit group. Lag ill uses health in practice round for round 1. Prior earnings include earnings from first game.

Table 6—: Demand for insurance (1)

	N	Mean GI	Difference II (β_{II})			
	(a)	(b)	(1)	(2)	(3)	(4)
A. The insurer: demand and enrollment						
Demand	2010	0.960	-0.169	-0.166	-0.147	-0.164
			(0.042)	(0.042)	(0.038)	(0.043)
			0.020**	0.010**	0.008***	0.010**
Enrollment	2010	0.881	-0.092	-0.087	-0.067	-0.085
			(0.047)	(0.047)	(0.04)	(0.052)
			0.092*	0.122	0.146	0.122
B. The MFI: default rates						
Actual defaults	2010	0.043	-0.035	-0.037	-0.037	-0.037
			(0.011)	(0.011)	(0.011)	(0.012)
			0.016**	0.005***	0.008***	0.016**
Expected defaults	2010	0.031	-0.005	-0.006	-0.007	-0.007
			(0.009)	(0.01)	(0.009)	(0.011)
			0.584	0.614	0.436	0.572
C1. Low RA clients						
Expected profit	463	1.024	0.263	0.254	0.206	0.263
			(0.063)	(0.053)	(0.052)	(0.062)
			0.002***	0.000***	0.006***	0.004***
Variance profit	463	0.141	0.345	0.322	0.278	0.328
			(0.101)	(0.091)	(0.089)	(0.1)
			0.022**	0.018**	0.004***	0.014**
C2. High RA clients with low RA peers						
Expected profit	827	1.025	-0.131	-0.135	-0.117	-0.112
			(0.033)	(0.031)	(0.024)	(0.029)
			0.002***	0.003***	0.004***	0.004***
Variance profit	827	0.144	0.047	0.047	0.070	0.037
			(0.065)	(0.067)	(0.049)	(0.062)
			0.496	0.498	0.238	0.561
C3: High RA clients with only high RA peers						
Expected profits	565	1.006	-0.004	-0.004	0.001	-0.005
			(0.003)	(0.012)	(0.008)	(0.003)
			0.267	0.716	0.910	0.212
Variance profit	565	0.033	0.064	0.068	0.074	0.063
			(0.029)	(0.023)	(0.024)	(0.029)
			0.238	0.130	0.125	0.238
Round fixed effects			✓	✓	✓	✓
Low RA, nr. of LRA peers			✓	✓	✓	✓
Participant characteristics				✓	✓	✓
Lag ill					✓	✓
Prior earnings (in 10,000 TZS)						✓

Dep. var.: willing to join insurance. 1st line: OLS estimate. 2nd line: std. errors clustered by session. 3rd line: one-sided t-percentile in wild cluster-bootstrap (999 reps), * $p<.1$, ** $p<.05$, *** $p<.01$. Participant char's: female, visited provider, knows health insurance, peers contributed for participant, grouped with member of real credit group. Lag ill uses health in practice round for round 1. Prior earnings include earnings from first game.

Appendix 1 - Proofs

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

PROOF:

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

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

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

Proposition II.2 *Under group insurance, individuals do not free-ride and there is no coordination problem.*

PROOF:

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

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

If an individual forgoes insurance while others are willing to join, the entire group remains uninsured. If worthwhile in one period, there will be an incentive to also forgo insurance in all future loan cycles. Hence, the net present value from full enrollment needs to be compared with the net present value of never enrolling:

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

By Proposition II.1, $V^h_{AFE} > V^h_{AZE}$. Moreover, outside Regime 1 where Restriction (7) holds, full enrollment is also welfare-improving for clients with low risk aversion: $V^l_{AFE} > V^l_{AZE}$. Thus, both types have no incentive to forgo insurance when all individuals are willing to join and there is no free-riding problem.

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

Lemma II.1 *Partial enrollment cannot be Pareto-efficient.*

PROOF:

Partial enrollment means that some but not all group members enroll. Imagine that there is a social planner who is able to distribute total group earnings such that partial enrollment is a Pareto-optimum. We illustrate the proof for $n-1$ enrolled group members, but it generalizes to the case where $n-x$ members, $x \in \{1, n\}$, enroll.

Since $n - 1 \geq n - n^*$, the enrolled group members secure continuation to the next round. In a given round, the total payoff within the group is:

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

There are $n-1$ group members enrolled, earning $e - ph$. The uninsured client earns e with probability $1-p$ and loses $h-e$ with probability p.[19]

[19] The ill client earns $e+l$, pays health expenditures h, repays any remaining earnings, $e+l-h$, and

Total payoff in this case is a mean-preserving spread of the joint payoff in the full enrollment case, $n(e - ph)$. Given the assumption of concave utility, Jensen's inequality implies that total expected utility within the group must be lower than utility from the risk-free earnings under full enrollment. The social planner cannot distribute total group earnings such that all group members are better off compared to full enrollment.

If more than one member chooses not to enroll, a similar reasoning applies. As long as the number of uninsured members is at most n^*, total expected earnings cannot be higher than under full enrollment. The higher level of risk will however yield lower expected utility even if the social planner would optimally distribute earnings.

If the number of uninsured members is greater than n^*, the group may fail to repay the entire group loan. This increases total expected earnings by a small amount, because there is limited liability. The probability of continuation is however reduced from 1 to $1 - p^{n^*+1}$, which offsets the present utility gain if Assumption (7) is satisfied.

Thus, partial enrollment cannot be Pareto-efficient. Because it reduces expected utility at the group level, partial enrollment is welfare-decreasing for at least one member.

Proposition II.3 *Under individual insurance, a client in Regime 2 will free-ride if and only if she has low risk aversion. A client in Regime 3 will free-ride if and only if i) she has low risk aversion and ii) group members do not condition current enrollment on peers' prior insurance decisions.*

PROOF:

First, we prove that in Regime 2, a client has an incentive to free-ride if and only if she has low risk aversion. The expected utility for type i under full enrollment

the group contributes $h - e$. As a result, the net payment is $h - e$.

is:

$$U^i(e - ph) + \beta V^i_{AFE} \tag{17}$$

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

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

$$(1 - p)U^i(e) + \beta V^i_{AZE} \tag{18}$$

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

The utility difference between enrolling and free-riding is:

$$U^i(e - ph) - (1 - p)U^i(e) + \beta \left(V^i_{AFE} - V^i_{AZE}\right) \tag{19}$$

In Regime 2, where (9) is not satisfied, (19) is strictly negative for a client with low risk aversion. This type therefore has an incentive to free-ride. For a client with high risk aversion, this difference is strictly positive by Definition (3) and Proposition II.1. The high RA type will therefore enroll if all other members are believed to enroll. Thus, in Regime 2, a client free-rides if and only if she has low risk aversion.

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

If group members enroll conditionally on peers' prior cooperation, the utility of conforming to full enrollment is strictly higher than the utility of free-riding because (9) is satisfied in Regime 3. By Definition (3), (19) is also strictly positive for high risk averse types. Therefore, both types with high and low risk aversion have an incentive to enroll if they believe all group members to enroll.

If there is no such path-dependence in strategies, clients with low risk aversion cannot be committed to the social optimum and are tempted to free-ride. In the absence of a trigger strategy, the net present value of free-riding on insured peers is $(1-p)U^l(e)+\beta V^l_{AFE}$. The difference with the value of conforming to full enrollment (17) is:

$$U^i(e-ph)-(1-p)U^i(e) \tag{20}$$

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

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

PROOF:

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

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

where P_{n^*} the probability that at most n^* peers - excluding oneself - fail to repay. This inequality is satisfied by Assumption (8). Thus, if a client and all her peers have high risk aversion, both full enrollment and zero enrollment are equilibria and clients face a coordination problem. ■

Appendix 2 - Experimental script

This Appendix provides the most important elements of the instructions back-translated from Kiswhili.

Game 1: Individual liability and individual insurance

Introduction The game starts as follows: You are one of five members of a micro credit 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 can repay the loan, you will repay it and you will be able to borrow for the second time and therefore you will play this game twice. You will not be able to play again if you don't repay the loan.

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 get a card from an envelope. There are 5 cards in an envelope. Four (4) of the cards have no writings on them and one card has a picture. If you get a card with a picture of a doctor, 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 and another person should do the same so that every person has the same opportunity 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 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 will be allowed to 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 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 green 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[20]

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 getting or not getting a 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 the group wants 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 insurance. You will vote on this card saying 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

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

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 repay their 40,000 shilling loan and spend the rest of their profits to help defaulting group members. Their final profits in this round are 0. Thus, each group is required to have four or more members 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.

Number of rounds in the game We will play this game for several rounds. We are not certain how many rounds. If you pay for insurance policy, you will be able to play at least four times. From the fourth round, 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 it settles on number 1.

Appendix 3: Tables

Table A1 - Robustness check: Correcting for selective attrition

	N	Mean GI	Difference II (β_{II})			
	(a)	(b)	(1)	(2)	(3)	(4)
A. Low RA participants						
Heckman selection model	431	0.932	-0.484	-0.471	-0.479	-0.407
			(0.122)	(0.107)	(0.109)	(0.110)
			0.001***	0.004***	0.001***	0.002***
Imputing last-round demand			-0.417	-0.404	-0.409	-0.352
			(0.121)	(0.111)	(0.108)	(0.112)
			0.014**	0.003***	0.006***	0.013**
Imputing predicted demand			-0.466	-0.456	-0.456	-0.384
			(0.113)	(0.103)	(0.101)	(0.105)
			0.006***	0.002***	0.002***	0.003***
B.High RA participants with low RA peers						
Heckman selection model	759	0.967	-0.067	-0.069	-0.069	-0.115
			(0.041)	(0.042)	(0.043)	(0.039)
			0.099*	0.105	0.109	0.023**
Imputing last-round demand			0.003	0.005	0.007	0.012
			(0.059)	(0.063)	(0.063)	(0.06)
			0.496	0.438	0.449	0.459
Imputing predicted demand			-0.022	-0.020	-0.017	-0.009
			(0.054)	(0.058)	(0.059)	(0.056)
			0.362	0.395	0.408	0.444
Round fixed effects			✓	✓	✓	✓
Number of LRA peers			✓	✓	✓	✓
Participant characteristics				✓	✓	✓
Lag ill					✓	✓
Prior earnings (in 10,000 TZS)						✓

Dep. var.: willing to join insurance. 1st line: OLS estimate. 2nd line: std. errors clustered by session. 3rd line: one-sided t-percentile in wild cluster-bootstrap (999 reps), * $p < .1$, ** $p < .05$, *** $p < .01$. Participant char's: female, visited provider, knows health insurance, peers contributed for participant, grouped with member of real credit group. Prior earnings include earnings from first game.