Intermediated Loans: A New Approach to Microfinance*

Pushkar Maitra†, Sandip Mitra‡, Dilip Mookherjee§
Alberto Motta¶, Sujata Visaria‖

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Abstract

This paper studies TRAIL, a variation on traditional microfinance, where a microfinance institution appoints local intermediaries (traders or informal moneylenders) as agents to recommend borrowers for individual liability loans. Agents earn commissions that depend on loan repayments. There are no peer monitoring, group meetings or savings requirements. The loans are designed to finance agricultural working capital and so are of longer duration than standard microfinance loans. Borrowers who repay loans are eligible for larger loans in future loan cycles. We develop a model of the credit market with adverse selection, in which borrowers vary with respect to (unobservable) project risk and (observable) landholdings, and the informal credit market is locally segmented. The model generates detailed predictions about informal interest rates, borrower selection, take-up and repayment patterns that vary with respect to both risk and landholding categories. These are successfully tested using data from a randomized evaluation currently being conducted in West Bengal, India. Traditional group-based joint liability loans (GBL) serve as the control. TRAIL generates higher repayment rates, while GBL is more pro-poor. TRAIL also achieves higher take-up rates, suggesting that TRAIL overcomes problems faced by microfinance clients that are inherent in group-based lending.

Key Words: Microfinance, Agent Based Lending, Group Lending, Selection, Takeup, Repayment

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†Pushkar Maitra, Department of Economics, Monash University, Clayton Campus, VIC 3800, Australia. Pushkar.Maitra@monash.edu.

‡Sandip Mitra, Sampling and Official Statistics Unit, Indian Statistical Institute, 203 B.T. Road, Kolkata 700108, India. sandipm@gmail.com.

§Dilip Mookherjee, Department of Economics, Boston University, 270 Bay State Road, Boston, MA 02215, USA. dilipm@bu.edu.

¶Alberto Motta, School of Economics, University of New South Wales, NSW 2052, Australia. a.motta@unsw.edu.au.

‖Sujata Visaria, Department of Economics, Academic Building, Room 2340, Hong Kong University of Science and Technology, Clear Water Bay, Hong Kong. svisaria@ust.hk

1 Introduction

Microfinance is often regarded as a panacea for the problem of low credit availability for the poor in developing countries around the world. However despite the rapid growth in outreach of microfinance institutions (MFIs), financial inclusion is far from universal, and a large proportion of the world's poor continue to be effectively excluded from credit markets. In particular, microfinance typically cannot be used for investments in projects with large gestational lags, thereby restricting the set of project choices available to the borrower. This stems from traditional microfinance's rigid high-frequency repayment schedules and low tolerance for risk-taking (Karlan and Mullainathan, 2010). In fact, Banerjee and Duflo (2011) have blamed these aspects for the recent microfinance crisis in India.[1] In our field visits in West Bengal, microfinance clients frequently mentioned the different limitations of microfinance: restrictions on project choice; free riding within groups; contagious defaults; and harmful effects on social capital. They also mentioned the high cost of attending weekly meetings and achieving savings targets mandated by MFIs and the fact that microfinance was not available for agricultural investment.

These considerations motivated us to design a new approach to microfinance that seeks to overcome the problems described above. In our variant, the loan duration matches the agricultural production cycle, which allows the loans to be used for smallholder agriculture. There is no collateral requirement, which makes the loans accessible to the very poor. Savings requirements are dispensed with and groups play no role whatsoever. Borrowers receive individual liability loans and this avoids the problems created by differences in risk aversion, free-riding, contagious defaults or deleterious effects on social capital across members of a joint liability group.

At the same time, our approach continues to rely on the utilization of local information and social capital, the key basis of microfinance. Informed third-party individuals from the local community, such as traders, shopkeepers or lenders or persons suggested by the local village council are appointed as agents by the microfinance institution. The

[1] The evidence on the importance of a rigid repayment schedule is however mixed. Field and Pande (2008) find that when they change the repayment schedule from every week to every month, there is no significant effect on client delinquency or default. They also find no evidence of the group meetings contributing to higher repayment rates. On the other hand Feigenberg, Field, and Pande (2010) find that frequent interaction among group members builds social capital and improves their financial outcomes and that clients who met more frequently were less likely to default in subsequent loan cycles.

agent recommends borrowers for individual liability loans, subject to the criterion that the recommended person must own less than a specified threshold of land. The agent is incentivized through commissions that depend on the loan repayment of the borrowers he recommends. The interest rate is pegged below the average informal credit market rate. Borrowers have dynamic incentives to repay: future eligibility for loans depends on repayment of the current loan, and loan offers become progressively larger if the previous loan was repaid. The loan contract also provides index insurance: the amount to be repaid is adjusted downwards if there are village-level adverse shocks to crop revenues. Additional features reduce transactions costs for borrowers: the MFI's loan officers visit borrowers in their homes to deliver the loans; borrowers do not have to attend mandated meetings with agents or MFI officers, and they do not have to open bank accounts.[2] Both the transactions costs for borrowers and the administrative costs for the lender are substantially lower as a result. We call this the *Agent Intermediated Lending* or AIL scheme. Our larger project examines two versions of this scheme: Trader Agent Intermediated Lending (TRAIL), where traders, shopkeepers or lenders are invited to become agents; and Gram Panchayat Agent Intermediated Lending (GRAIL) where the local village council recommends individuals as agents. The current paper only evaluates the TRAIL version of the scheme.

To analyze this new variant of microfinance, we develop a theoretical model of borrower adverse selection and then test its predictions using data from a randomized evaluation that is currently being conducted in West Bengal, India. Our model extends Ghatak (2000) in two dimensions: first, borrowers vary both with regard to the (unobservable) riskiness of their projects as well as their (observable) landholdings. Second, the informal credit market is characterized by segmentation, where each segment has a lender with exclusive information about the risk types of borrowers in their own segment. This allows each lender to extract the surplus from safe borrowers in their own segment, while competing with all other lenders in the village over lending to risky types. In the TRAIL scheme, these same lenders are employed as agents. When choosing which households to recommend the agents might have an incentive to not recommend their own segment low-risk clients for fear of losing their business. The TRAIL scheme seeks to overcome this incentive problem by introducing a repayment-based commission. The model predicts that TRAIL agents

[2]These costs can be quite substantial for borrowers. See Park and Ren (200) for some evidence on this cost.

select safe borrowers from their clientele if they do not collude with the borrowers and the commission they receive is sufficiently high. In this case, they recommend their own-segment clients who pay the lowest interest rate in the informal market. These tend to be clients with an intermediate level of landholding. In contrast, under the group based lending (GBL) scheme, it is clients who pay the highest interest rates in the informal credit market (who tend to have the lowest landholdings) who typically self-select into the scheme. Additionally, GBL may attract risky as well as safe borrowers. Hence the model predicts that (assuming the agents are suitably incentivized) the TRAIL scheme generates superior targeting with respect to risk category of borrowers, while GBL targets poorer clients. Empirically this would imply that TRAIL would achieve higher repayment rates, while GBL would be better targeted to the poor.

For any given client, TRAIL is predicted to generate higher benefits to borrowers on many counts: they do not have to bear the burden of repaying on behalf of their group members if they default. They also do not have to incur the costs of attending group meetings, achieving savings targets, or face the problems of free-riding and social tensions that GBL generate. Empirically, this should be manifested by higher takeup rates under TRAIL.

We test the predictions of our model with data from a field experiment we are currently running in 72 villages in the Hugli and West Medinipur districts of West Bengal, India. In October 2010, Shree Sanchari (henceforth SS), an MFI that has been working in the rural areas of several districts in West Bengal, introduced one of three alternative micro-credit schemes in each of these villages. The two versions of the AIL scheme (TRAIL and GRAIL) were each introduced in 24 villages. In the TRAIL villages, agents were selected from among prominent traders in the villag. These agents were asked to recommend borrowers, and the MFI offered loans to a randomly selected subset of the persons recommended. Agents paid a small deposit to the MFI per recommended borrower who took the loan. At the end of each 4 month cycle, repayments were collected and agents received commissions equal to the total interest earned from their recommended borrowers, subject to a minimum repayment amount. In the subsequent 4-month cycle, borrowers were eligible to take new loans of a larger size, subject to their repayment behavior. In the remaining 24 villages SS introduced a group-based lending scheme similar to the traditional microfinance model, with a few modifications: both men and women were allowed

to borrow, and the repayment duration was 4 months, to match the AIL schemes. In the GBL scheme villages, all villagers were invited to form joint liability groups, and members of 2 randomly chosen groups were offered loans. Groups followed savings requirements and had mandated bi-monthly meetings with the MFI loan officers. At the end of each 4 month cycle, repayments were collected and borrowers were eligible to take new loans of a larger size subject to their repayment behavior.

Our empirical analysis generates the following results. First it appears that TRAIL agents were properly incentivized: they recommended borrowers who were either their own clients or whom they had better information about (through past interactions and/or through caste/religion networks). Households recommended by TRAIL agents but unlucky in the lottery to receive a TRAIL loan turned out to be paying an interest rate substantially below that paid by those not recommended by the agent. In other words, TRAIL agents recommended safe borrowers. In GBL villages we compare sample households who formed groups (but did not receive loan) and sample households that did not. Members of GBL groups paid lower informal interest rates than the average non-member, suggesting that GBL groups also tended to consist of safer borrowers. However, in line with the theoretical predictions there is reason to believe that TRAIL has been better at targeting safe borrowers than GBL: at the end of one year (three repayment cycles), the repayment rate from TRAIL borrowers exceeds 95 percent; in contrast to a lower 85 percent repayment from GBL borrowers. Second, selection across landholding levels also matches theoretical predictions: GBL groups consisted of the poorest clients (landless households), whereas TRAIL borrowers tended to own between 0.5 to 1 acre. Third, as predicted (because of the lower cost of participation in the TRAIL scheme), takeup rates are slightly higher in TRAIL than GBL, and the difference has become statistically significant from the fourth cycle onwards. Takeup rates in either scheme are above 80%.

These early results are encouraging: at the end of three loan cycles the TRAIL scheme has achieved high take-up and repayment rates, in a manner consistent with theoretical expectations. The agents appointed as intermediaries seem to have been incentivized by the commissions to select safe types from among their clientele and the evidence does not suggest collusive behavior. A complete welfare evaluation requires us to go beyond the standard performance metrics that tend to be used by most MFIs, and also estimate the

impacts on the lives of the borrowers and on agricultural operations and incomes. Those can be studied after the experiment has run its full course of 6 loan cycles. We therefore defer a more detailed analysis of borrower impacts to subsequent papers.

2 Relation to the Literature

Our paper adds to the current (policy and academic) debate on individual versus joint liability loans in microfinance. Several MFIs (like the Grameen Bank in its Grameen II model, Asa and BancoSol) have recently adopted models of individual liability lending. Several recent studies evaluate the relative merits and demerits of the two approaches. In their study conducted in Philippines, Giné and Karlan (2010) find that moving from joint liability contracts to individual liability contracts (or offering individual liability contracts from scratch) did not affect repayment rates. On the other hand, in a study in Mongolia Attanasio, Augsburg, Haas, Fitzsimons, and Harmgart (2011) find that joint liability contracts are more likely to increase food consumption and entrepreneurship (they attribute this to the disciplining effect of joint liability contracts).[3] Here it is important to note that although the TRAIL scheme provides borrowers with individual liability loans, the contractual structure of the loans make them very different from the individual liability loans discussed by the authors above. The primary difference with respect to Attanasio, Augsburg, Haas, Fitzsimons, and Harmgart (2011) is in terms of collateral. In their study although the lender did not impose predetermined collateral requirements, it took collateral if available. In consequence *91% of the individual loans were collateralized, with the average collateral value close to 90% of the loan amount* (page 15). This was contrary to the original microfinance objective of lending without collateral. As noted above, TRAIL borrowers were not asked for collateral and could not have posted collateral even if they had wished to. if they were recommended by the agent and chosen through the lottery, then MFI officials visited them at their door-step and offered them the loan. The second difference is in terms of financial inclusion. In the individual lending program that Giné and Karlan (2010) study, borrowers did not have to fulfill any specific collateral

[3] Using data from a natural experiment from India where a MFI converted individual liability loans to group liability loans, Carpena, Cole, Shapiro, and Zia (2010) argue that group liability contracts improve upon individual liability, particularly in ensuring repayment and increasing savings discipline among clients. They argue that their *results suggest a careful rethinking of ... policy direction* (page 4) towards individual liability contracts.

requirement, but they had to accummulate a minimum amount of savings, which could be used if they failed to repay. However the extent of financial inclusion provided by the scheme is considerably lower: the loan officers could influence whether the bank should enter each community and ultimately the bank entered only 54% of the communities randomized. The authors report that either due to loan officers' unwillingness or inability to enter the villages assigned to individual liability, the center size was significantly smaller for individual liability groups. In contrast, in the TRAIL scheme, the agents are local residents and therefore there is no selection arising from the unwillingness or inability of external loan officers to entering the community. The selection that does occur is in the agents' choice of whom to recommend as borrowers and this is an intentional feature of the design. Additionally there are no savings and collateral requirements.

Our idea that members of the local community could be employed to recommend and monitor borrowers follows naturally from a large literature documenting the role of middlemen and managers in contexts with asymmetric information problems (Melumad, Mookherjee, and Reichelstein, 1995; Laffont and Martimort, 1998, 2000; Faure-Grimaud, Laffont, and Martimort, 2003; Mookherjee and Tsumagari, 2004; Celik, 2009; Motta, 2011). Much of this literature has found that the use of an informed third party as intermediary increases the principal's pay-off even if there is collusion between the intermediary and the agents they supervise. Additionally, our AIL model resembles a lending approach that India's central bank has been promoting recently. With a view to increasing financial inclusion for India's rural population, the Reserve Bank of India has recommended that a network of banking correspondents (BCs) and banking facilitators (BFs) be set up. The agents in our model play the same role that the RBI envisions for BFs: they refer clients to the formal lender, pursue the clients' loan applications and facilitate the transactions between the lender and the client. The final decision on whether to approve the loan rests with the lender.[4] There has been limited expansion of such programs in Thailand (Onchan, 1992), Philippines (Floro and Ray, 1997), Bangladesh (Maloney and Ahmad, 1988), Malaysia (Wells, 1978) and Indonesia (Fuentes, 1996).[5] The framework is also similar to what

[4]Banking Correspondents (or BCs) on the other hand can disburse small loans and collect deposits as well and they can make the final decision on whether to provide the loan or not. See Srinivasan (2008) for more detail.

[5]The programs were not particularly successful, even though given the complementarity between the formal and the informal financial sectors in the economy, this kind of programs could potentially increase competition in the formal financial sector. Floro and Ray (1997) argue that in the Philippines the problem arose from the fact that the major group of informal lenders engaged in strategic cooperation thereby

Floro and Yotopoulos (1991) refer to as credit layering, parallel to the distribution chain in marketing. Our paper provides evidence from a randomized trial on the feasibility and outcomes of such a scheme.

3 Design

We are in the process of conducting a randomized intervention in 72 villages in 2 districts (Hugli and West Medinipur) of West Bengal in India. The intervention started in October 2010 and is expected to continue until at least December 2012. The main credit intervention involves agricultural loans at an annual interest rate of 18 percent, with repayment due at the end of 4 months (120 days). The starting loan size (in Cycle 1) was Rs 2000 and if borrowers repay, the loan size increases in each subsequent cycle. Specifically, the repayment amount (in each cycle) is 1.06× Outstanding loan. If the amount due is fully repaid at the end of any cycle, the loan offer in the next cycle is 133% of the loan size in the previous cycle. For example, a household that fully repays the amount due (initial loan of Rs 2000 plus interest of 1.5 % a month) of Rs 2120 at the end of the 4 months following the initial loan disbursement would receive a loan of Rs 2620 in Cycle 2. Borrowers who repay less than 50% of the repayment obligation in any cycle are terminated and are not allowed to borrow again; and if there is less than full repayment but more than 50% of repayment, then the borrower is eligible for 133% of the amount repaid. Cycle 1 started in October-November 2010, coinciding with the planting of the potato, which is the major cash crop in this area.[6] Borrowers are allowed to repay the loan in the form of potato bonds rather than cash.[7] In this case the amount repaid is calculated at the prevailing price of potato bonds. While the loans are for agricultural purposes, households are not required to document to the lender what the loan was actually used for. See Table 1 for more on the credit program.

limiting competition. In the presence of this kind of anti-competitive behavior, programs that promote formal-informal sector linkages are open to extreme rent seeking behavior by informal lenders.

[6]This happens to be the major potato growing region of India, producing approximately 30% of all potatoes cultivated in India.

[7]Potato "bonds" are receipts issued by cold storage facilities when potatoes are stored there. These bonds are traded by farmers and traders.

3.1 The TRAIL Scheme

In TRAIL villages, SS employed a trader based in the local community as the agent. Only one agent was chosen per village. There were restrictions on who could serve as an agent. Specifically traders who had at least 50 clients in the village, and/or had been operating in the village for at least 3 years were given the first priority. Traders who had fewer than 50 clients or had been working in the village for fewer than 3 years were given second priority and finally if an agent could not be obtained from either the first or the second category of traders, one could be chosen from among others who offered to participate as agents. SS created a list of traders with the help of prominent persons in the village and then randomly selected one trader from this list. They approached the first randomly chosen trader and offered him the contract. If this trader refused to serve as an agent, SS would have gone back to the list and randomly chosen a second trader and approached him. In practice the first trader who was approached always accepted the contract. The agent was required to recommend names of 30 potential borrowers in the entire village.[8] All recommended borrowers had to be residents of the village and had to own less than 1.5 acres of agricultural land. Landless households could also be recommended. Ten out of these individuals 30 recommended were randomly chosen (through a lottery held in the presence of village leaders) and offered an individual liability 4-month (120 days), low interest loan by SS.

The agent incentives were both monetary and non-monetary. First, the contract with the agent specifies that that he would receive as commission 75 percent of all interest payment received from borrowers he recommended. For example, at the end of Cycle 1 if all 10 households that received the loan repaid in full, the agent would receive Rs 900 as commission. Second, there is a system of deposits and bonuses aimed at ensuring that the agent recommends good borrowers. This works as follows: the agent is required to deposit Rs 50 per (recommended and selected) borrower with SS. This deposit was to be paid at the time the Cycle 1 loans were sanctioned, and is refundable at the end of two years provided the agent has not been terminated. Termination occurs if 50 percent of the borrowers failed to repay in any one cycle. If the borrower repays $x\%$ of the loan, then the agent receives a bonus equal to $x\%$ of the deposit. For example, if the total repayment

[8] Almost 96% of the TRAIL agents state trade/business as their main occupation and the agents are overwhelmingly upper caste Hindus.

from 10 borrowers is one-half of the amount due, then the agent receives a bonus equal to one-half of Rs 500 deposited, i.e., Rs 250. The actual program can however continue even beyond the 2 years. Third, in our conversations, agents noted that they expected that their participation in the TRAIL scheme to increase their visibility within the village community and through that, increase their market share. Fourth, at the end of 2 years the program provides the agent and his family (up to 4 members) a special holiday package in Puri or Digha (sea-side resorts near Kolkata, the capital of the state of West Bengal), provided he has participated until the very end. Finally, several agents view this scheme as improving their long term reputation within the community and a boost to their ego.

3.2 The GBL Scheme

The trader-agent intermediated lending (TRAIL) treatment is compared to a Group Based lending (GBL) model, which uses the standard lending protocol used by SS (and indeed almost all microfinance organizations in India): groups of size 5, joint liability and initial savings requirement. However there is one major variation - repayment is due after 120 days, not a fortnight after loans disbursed. This implies that unlike in the traditional model, the borrowers are able to invest in projects with a longer gestational period, such as agriculture, should they wish.[9] Of the groups that were formed and survived until the cut-off date of October 15, 2010, 2 were randomly selected via public lottery to receive GBL loans. Members of these groups receive a total of Rs 10,000, which is divided (typically equally) among the group members. These are joint liability loans of 4-month duration, have similar dynamic lending criteria and the same loan cycles as the agent intermediated loans.

4 Data and Descriptive Statistics

Our data consists of extensive household level surveys of 50 households in each of the intervention villages. The survey collects information on household demographics, assets, landholding, cultivation, land use, input use, allocation of output, sales and storage, credit, incomes, relationships within village. We plan to have 6 surveys over the period 2010 - 2012

[9]There were some other minor variations - for example both men and women were eligible to form groups.

(matching the credit cycles). Sample households are of three types: *Treatment* households are recommended households that receive loans (in TRAIL) or members of groups that are chosen to receive joint liability loans (in GBL). *Control 1* households are those that were recommended but did not receive loans (in TRAIL) or members of groups that did not receive loans (in GBL). In each village we also surveyed 30 additional households. These are the *Control 2* households. These were chosen as follows: first, it was ensured that all households that were in the sample in a related previous study conducted in 2007-2008 in the same villages (see Mitra, Mookherjee, Torero, and Visaria, 2012, for more details) were included in the sample. Once this was done, additional sample (maximum of 30) slots were filled through a random draw of households from the villages. Table 2 presents the sample sizes of the *Treatment*, *Control 1* and *Control 2* households in each of the sample villages. Each village is subject to only one treatment and we refer to villages that receive the TRAIL (GBL) treatment as TRAIL (GBL) villages.

Villages were randomly assigned to the treatment. Panel A in Table 3 shows that at the village level, there are no significant differences in village size, number of potato cultivators in the village and the number of potato cultivators in the different landholding categories across the two treatment groups: the differences TRAIL − GBL are never statistically significant.

In terms of household characteristics, comparison across the different treatments is not straight forward. This is because treatment households are selected through agent recommendations in TRAIL villages and voluntary group formation in GBL villages and so the sample of households in each village is not random. Instead we restrict ourselves to the set of households in these villages selected in 2007-2008 for a different and related project conducted in these village (see Mitra, Mookherjee, Torero, and Visaria, 2012, for more details). In Panel B of Table 3, we present the characteristics of this set of households, as reported in the 2010 Cycle 1 surveys. There are a few systematic differences in terms of the household characteristics in the TRAIL and GBL villages. GBL huseholds were more likely to be non-Hindu and were likely to have a larger household size.

Figure 1 provides a picture of the sources of credit for the sample households. The majority of loans are from traders - 56% for the full sample, followed by cooperatives (12.6%) and SS (11%). There are some interesting differences across the two districts - the fraction of

loans from the trader is higher in West Medinipur (58%) compared to Hugli (54%) and this is balanced by the fact that borrowing from the cooperative is higher in Hugli, relative to West Medinipur. The average interest rate and the size of the loan varies significantly across the different lender categories. Interest rates vary from almost 34% per annum for loans from money lenders to 10.5% per annum for borrowing from the bank. It is also interesting that while only 3.5% of all loans are bank loans, the average amount of bank loans is more than Rs 31,000. It appears that while formal sector (bank) loans are difficult to obtain, if they can be obtained, the loan amount can be substantial.

Before proceeding further, it is worth discussing the relationship between landholding and the interest rate that households have to pay on loans from informal sources and on the relationship between landholding and project returns. These empirical relationships have implications for the assumptions that we make in the model (in Section 5). First, Figure 2 presents the predicted value of interest rate in the informal market on landholding and shows that there is a u-shaped relationship between the interest rate in the informal market and landholding. This is corroborated by the regression results presented in column 1, Table 5. Table 4 presents evidence in support of this. Project returns (here defined as crop profit from potato cultivation) are indeed convex in the amount of landholding. This effect persists even when we control for the variety of potato cultivated (column 2).

5 The Model

In this section we develop a theoretical framework to highlight the particular characteristics of the AIL scheme. To compare more effectively with the commonly used microfinance models, we build on Ghatak (2000). The action in that model stems from the combination of asymmetric information and lack of collateralizable wealth. Borrowers have some information about the riskiness of each other's projects that lenders do not. All projects require one unit of capital but a safe project has probability of success $p_s \in (0, 1)$, which is strictly higher than the probability of success of a risky one, p_r. If a lender cannot identify a borrower's type then they have to offer the same interest rate to all borrowers. Owing to limited liability and the lack of collateralizable wealth, borrowers repay the loan only if the project is successful. Hence, a lender dislikes risky borrowers whose repayment rates are inherently low. As a consequence, the interest rate in the credit market rises.

If the interest rate ends up being high enough, the safe borrowers might decide not to borrow even if their project would make a positive contribution to social surplus. This is known as the under-investment problem in credit markets with adverse selection (Stiglitz and Weiss, 1981). Ghatak (2000) shows that adopting a GBL scheme, a lender can utilise information borrowers may have about each other and achieve high repayment rates. It does so by offering a menu of contracts and allows individuals to self select.

How does GBL compare with AIL in such a context? To answer this question and to accommodate the peculiar features of AIL, we need to extend Ghatak (2000). In his model all lenders are equally uninformed, so local lenders have no additional information about risk types of borrowers, compared with external lenders. In practice, local lenders have extensive past experience in lending to their respective clienteles and have thereby accumulated substantial knowledge about their relative reliability in repaying loans. This is exactly the comparative advantage of local lenders *vis-a-vis* external lenders, which makes it difficult for formal financial institutions with access to capital at lower costs from driving local lenders out of business. To accommodate this we need to allow local lenders to have better information about risk types of local borrowers they have dealt with in the past, compared to other lenders who do not have that experience.

We therefore posit that local credit markets are segmented, with each segment occupied by one lender who lends habitually to borrowers in that segment and thus comes to learn their respective risk types. This information is not available to lenders in other segments of the market. Lenders therefore acquire a measure of monopoly power within their respective segments as a result of their ability to discriminate between safe and risky types from past experience. All segments involve the same ratio θ of risky to safe types of borrowers.

The other direction we extend the Ghatak model is to introduce an additional dimension of heterogeneity, with respect to level of landholding $a \geq 0$ of each borrower. This characteristic is observable. This is necessary to examine the relative success of AIL and GBL with respect to targeting poor versus very poor borrowers.

To keep the analysis simple, we preserve other aspects of the Ghatak model. All borrowers and lenders are risk neutral. Lenders face no capacity constraints and have the same cost ρ_I per unit of money loaned. All projects involve a fixed scale of cultivation with a given need

for working capital, so loan sizes do not vary.[10] Let the scale of cultivation be normalized to one unit of land, and the required loan size to one rupee. If $a < 1$, the borrower needs to lease in $1 - a$ in order to cultivate. Project returns will be assumed to be increasing in a, owing to the reduction in distortions associated with tenancy, ranging from inferior quality of leased in land to Marshallian undersupply of effort.[11] If successful, a borrower of type $i \in \{r, s\}$ with landholding a obtains a payoff $R_i(a)$. Additional assumptions on this payoff will be provided below. We also make the simplifying assumption that the probability of success is independent of landholding.[12]

Higher landholdings are also associated with a higher autarkic outside option, should the farmer in question decide not to pursue the cultivation project. For instance, the owner of the land always has the option of leasing it out. It is reasonable to suppose that the outside option is linear in a. We normalize and postulate that the outside option equals a.

Using his privileged information, a lender operating in any given segment can make personalized offers to her own clients. But he can also try to attract borrowers belonging to other segments. Since loan sizes do not vary, the terms of the loan are summarized entirely by the interest rate. A contract $\Gamma = \{r_s(a), r_r(a), r(a)\}$ specifies the interest rates respectively for own-segment safe borrowers, own-segment risky borrowers, and other-segment borrowers, for any given landholding a. Interestingly, the same conditions that give rise to the asymmetric information problem in Ghatak (2000) also ensure existence of an equilibrium in the segmented informal market. These conditions are

$$R_r(a) - \frac{a}{p_r} \geq R_s(a) - \frac{a}{p_s} \tag{1}$$

$$R_s(a) - \frac{a}{p_s} < \frac{\rho_I}{\overline{p}} \tag{2}$$

$$p_s R_s(a) > \rho_I + a \tag{3}$$

where equation (1) ensures that any interest rate that satisfies the safe borrowers' par-

[10] The model can be extended to allow for variable scale of cultivation and thereby variable loan sizes. Although the results would remain qualitatively similar to the ones presented here, the analysis would become considerably more complicated.

[11] Tenurial laws in West Bengal mandate tenants' share should be at least 0.75, unless the landlord shares in provision of material inputs in which case they share 50 : 50 in both inputs and outputs. The latter arrangement is rare, as most landlords are not involved in cultivation (see for example Banerjee, Ghatak, and Gertler, 2003)

[12] This assumption can be relaxed at the cost of increasing the complexity of the analysis and weakening the sharpness of the predictions. Moreover, the data shows no tendency for loan repayment rates to vary with landholdings.

ticipation constraint also satisfies the risky borrowers' participation constraint (i.e., there is no interest rate that attracts only safe borrowers); equation (2) implies that the participation constraint of safe borrowers is not satisfied when the interest rate, r, is greater or equal to $\rho_I/\overline{p}$, with $\overline{p} \equiv \theta p_r + (1-\theta)p_s$; equation (3) entails that the safe project is socially productive. If the lenders charge all borrowers the same interest rate r, and both types of borrowers borrow in equilibrium, the lenders need to charge at least $r = \rho_I/\overline{p}$ to break even. Hence, from equation (1) and equation (2) follows that there does not exist a pooling contract that attracts both types of borrowers and satisfies the break even condition of the lenders. The only possible individual liability contract then is the one that attracts risky borrowers.

Equation (3) implies that safe borrowers would make a positive contribution to social surplus. Hence, the equilibrium in the informal market where only risky borrowers borrow is socially inefficient. The repayment rates and welfare are strictly less than that under full-information.[13]

Why are these conditions necessary for the existence of an equilibrium in the informal market? Owing to her privileged information, an informal lender can identify her safe clients and offer them an interest rate low enough to convince them to accept (the safe project is after all socially productive, so such an interest rate exists), but high enough to extract all their surplus. The asymmetric information problem is assumed to be severe and therefore the other lenders are not willing to compete for these safe clients because it is not possible to attract them without attracting the risky clients as well. Hence, asymmetric information shields the lender from the competition. This result is encapsulated in the following Lemma. The formal proof is presented in the Appendix.

Lemma 1 *In equilibrium, the safe borrowers do not borrow from other-segment lenders.*

Using Lemma 1 it is possible to show that there is a unique equilibrium where the lenders

[13]Note that our model is also equipped to deal with the over-investment problem analyzed in Ghatak (2000). In the over-investment case equation (1) and equation (3) hold but equation (2) doesn't. In addition we need $p_r R_r(a) < \rho_I + a$ to ensure that the risky project is socially unproductive. Then there is a pooling contract that attracts both types of borrowers and satisfies the breakeven condition of the lenders. But this is an inefficient outcome for society because the risky project should not be financed. Risky projects thrive only because they are cross-subsidized by the safe ones. Under these circumstances, we prove in Proposition 2 that an equilibrium in the informal credit market does not exist.

offer a relatively low interest rate to their safe clients, and extract all their surplus. In equilibrium, the lenders also offer a relatively high but fair interest rate to their risky clients. This is the result of the competitive tension between different lenders who actively attempt to undercut each other. Proposition 2 presents this result more formally:

Proposition 2 *There is a unique equilibrium outcome in the informal market, in which safe types owning land a borrow from their own-segment lender at interest rate* $r_s(a) \equiv R_s(a) - \frac{a}{p_s}$*, while risky types borrow (from any lender) at interest rate* $r_r \equiv \frac{\rho_I}{p_r}$ *which does not depend on their landholding.*

It is worth noting that the equilibrium interest rate for the risky borrowers is higher than the one for the safe borrowers (owing to (A2)). Moreover, the former does not depend on the level of landholding. On the other hand, the interest rate for the safe borrowers depends on the level of landholding. The nature of this relationship depends on the shape of the return function $R_i(a)$: it is rising or falling in a depending on whether $R_i'(a)$ exceeds or falls below $\frac{1}{p_s}$. If $R_i(a)$ is convex in a, the interest rate is likely to exhibit a u-shape. As we have already seen in Table 4, the evidence does support this assumption. The model thus provides an explanation of the observed u-shape of the interest rate.

The u-shaped interest rate curve in Figure 3 has an intuitive interpretation: It can be seen as the surplus that the lender extracts from his safe clients. Initially the surplus is large because the lender is in a strong bargaining position owing to the client's outside option, a, which is low. An increase in a boosts the value of the project, and consequently the surplus that the lender can extract. But it also increases the client's outside option, weakening the bargaining position of the lender. If $R_i(a)$ is convex, the second effect could dominate for low values of a, while it would be dominated for high values of a.

Note also that (3) implies that safe types will operate the project, irrespective of their landholding. On the other hand, risky types may or may not participate at any given level of landholding, depending on how $R_r(a) - \frac{a}{p_r}$ relates to $\frac{\rho_I}{p_r}$. Figure 4 depicts a possible scenario where the risky project has higher returns than the safe one, but it is not socially productive for low values of a. This case is consistent with a situation where participation rates for risky types increase rapidly with landholding for low values of a and stabilize afterward. The overall pattern of interest rates that would be observed in the informal

market would then flatten out (or even rise) once risky types enter the market. Once they have all entered, the u-shaped pattern will then resume.

Finally, note that the payoff in the informal credit market represents the outside option for borrowing from external lenders. For a borrower of type (i, a), let us denote this outside option by $\overline{u}_i(a)$. Proposition 2 implies that borrower (s, a) obtains a payoff equal to a, whereas a borrower (r, a) obtains a positive payoff $p_r R_r(a) - \rho_I > a$. Lenders make positive profits on their own-segment safe borrowers. In equilibrium $\Pi_r(a) = 0$ and $\Pi_s(a) = p_s R_s(a) - \rho_I - a$, where $\Pi_i(a)$ denotes the profit from borrower (i, a).

5.1 Implications of GBL

Now suppose an MFI enters and offers joint liability loans to qualifying groups of borrowers. In order to benchmark AIL against GBL, we revisit Ghatak (2000) in light of the endogenous outside options analyzed in the previous section. As in Ghatak we simplify and assume that GBL requires the borrowers to form groups of two: there is an individual liability component, r, and a joint liability component, c. Limited liability still applies, but if a borrower's project is successful, and the other member of the group fails, the former has to pay the additional joint liability component, c. The contracting problem is the following sequential game: first, the bank offers a finite set of joint liability contracts $\{(r_1(a), c_1(a)), (r_2(a), c_2(a)), ...\}$; second, borrowers who wish to accept any one of these contracts select a partner and do so; finally, projects are carried out and outcome-contingent transfers as specified in the contract are met. Borrowers who choose not to borrow enjoy their reservation payoff of $\overline{u}_i(a)$. Instead of looking at the optimal joint liability contract we take $r(a) = c(a) = r_T$ as given and we study the impact of this group loan on the credit market.[14] Further, borrowers have to attend group meetings, and meet saving requirements in order to qualify for a group loan. This imposes cost γ_i for risk type i. Ghatak (2000) proves that any joint liability contract (r, c), with $r > 0$ and $c > 0$, induces assortative matching in the formation of groups. This result extends to our framework: the borrowers that self-selected in a group are of the same risk type.

[14] Without loss of generality Ghatak (2000) restricts attention to the set of contracts which have non negative individual and joint liability payments, $\mathcal{F}^{JL} = \{(r, c) : r(a) \geq 0, c(a) \geq 0\}$. Gangopadhyay, Ghatak, and Lensink (2005) shows that ex-post incentive-compatibility requires $r = c$. Accordingly they further restrict attention to the set $\mathcal{F}^{JL} = \{(r, c) : r(a) = c(a) \geq 0\}$.

The expected gain for type (i, a) from a group loan instead of the informal market loan is

$$U_i(r_T, a) - \overline{u}_i(a) = p_i \left[R_i(a) + (p_i - 2)r_T\right] - \gamma_i - \overline{u}_i(a). \tag{4}$$

The borrowers accept the group loan if the above expression is positive and the limited liability constraint is satisfied:

$$2r_T \leq R_i(a), \ i = r, s. \tag{5}$$

For a safe type borrower with land a, this expression reduces to

$$U_s(r_T, r_T, a) - \overline{u}_s(a) = p_s[r_s(a) - (2 - p_s)r_T - \gamma_s] \tag{6}$$

which implies that the gain is higher if the borrower faces a higher interest rate in the informal sector. *Among safe types, therefore, we expect higher participation rates from those landholdings that correspond to higher interest rates.*

For a risky type borrower who participates in the informal market, the gain is

$$U_r(r_T, a) - \overline{u}_r(a) = \rho_I - p_r(2 - p_r)r_T - \gamma_r \tag{7}$$

the difference between the expected interest costs, less the cost c_r of qualifying for the group loan. This expression is independent of a. On the other hand, for a risky type borrower excluded from the informal market the gain is

$$U_r(r_T, a) - \overline{u}_r(a) = p_r R_r(a) - a - p_r(2 - p_r)r_T - \gamma_r \tag{8}$$

which is likely to vary with a in ways that depend on the curvature of R_r.

The relative benefits from a group loan for safe and risky types (for given a) are also ambiguous. Safe types could gain more as they earn a lower payoff in the informal market. On the other hand, their expected repayment is higher. To see this, rearrange equation (4) and compare the gains of two borrowers (s, a) and (r, a):

$$\underbrace{p_s R_s(a) - p_r R_r(a)}_{\text{ambiguous}} + \underbrace{\left[(2p_r - p_r^2) - (2p_s - p_s^2)\right] r_T}_{\text{negative (by assumption)}} + \underbrace{\gamma_r - \gamma_s}_{\text{ambiguous}} + \underbrace{\overline{u}_r(a) - \overline{u}_s(a)}_{\text{non-negative (in equilibrium)}},$$

5.2 Agent-Intermediated Lending: TRAIL

Under TRAIL, the contracting problem is as follows: first, the bank offers a contract (r_T, K) to the informal lender or the agent/intermediary; second, the lender recommends a borrower who either accepts or refuses the loan; finally, projects are carried out and outcome-contingent transfers as specified in the contract are met; the borrower repays r_T if the project is successful and zero otherwise; the lender obtains a fraction K of the repayment, r_T. Borrowers who choose not to borrow receive their reservation payoff of $\overline{u}_i(a)$. We take r_T and K as given and we study the impact of this loan on the credit market.

Suppose the agent and the borrowers (he recommends) play non cooperatively. The lender's expected commission from recommending the own-segment safe borrower is $Kp_s r_T$. This is higher than the expected commission from other-segment borrowers, $K\overline{p}r_T$, which is in turn higher than the commission from recommending the own-segment risky borrower, $Kp_r r_T$. The opportunity cost of recommending risky and other-segment borrowers is zero, ensuring that the latter option is always preferred by the lender. On the other hand, recommending the own-segment safe borrower entails losing the opportunity to serve her in the informal market, and to earn the associated profit $\Pi_s(a)$. Note that the lender can minimize the opportunity cost $\Pi_s(a)$ by selecting a safe client with a suitable level of landholding. The level of landholding which minimizes $\Pi_s(a)$ is $a^* = \arg\min r_s(a) \equiv R_s(a) - \frac{a}{p_s}$, i.e, the landholding corresponding to the lowest interest rate for a safe type borrower. It is optimal for the lender to recommend own-segment safe borrowers (s, a^*) if the commission rate is high enough to outweigh the foregone profits from lending to a^*:

$$K \geq \frac{p_s R_s(a^*) - \rho_I - a^*}{r_T(p_s - \overline{p})} \equiv \overline{K} \tag{9}$$

The borrower (i, a) accepts the offer if the MFI interest rate is lower than the one in the informal market, i.e., the $r_T \leq r_i(a)$. In what follows, we make the following assumption.

Assumption 1: r_T is lower than the maximum interest rate offered in the informal market.

This assumption is consistent with our data. It implies that it is always profitable for the lender to recommend some borrower. The following proposition summarizes these results:

Proposition 3 *Suppose Agent-Intermediated Lending is not subject to collusion.*

a) *If $K \geq \overline{K}$, lenders recommend own-segment safe borrowers with a level of landholding corresponding to the lowest informal sector interest rate such that $r_s(a) \geq r_T$.*

b) *If $K < \overline{K}$ or $r_T > r_s^*(a)$ for all a, lenders recommend other-segment borrowers with any level of landholding.*

Now consider what happens when AIL is subject to collusion.[15] The collusion process is modelled as follows: the lender makes a take-it-or-leave-it offer to the borrower. This offer requires the borrower to pay a bribe b in exchange for being recommended. If the borrower refuses the offer, the game is played non-cooperatively. The lender keeps in mind that he must leave the borrower with at least the same level of utility she would obtain by rejecting the collusive offer, i.e., $\overline{u}_i(a)$. It turns out that:

Proposition 4 *If Agent-Intermediated Lending is subject to collusion, it is never optimal for a lender to recommend own-segment safe borrowers. On the other hand, it is always optimal to recommend a borrower from other segments. In some circumstances it can also be optimal to recommend risky borrowers in one's own segment with any level of landholding.*

The intuition behind this Proposition is the following. Given that the lender has all the bargaining power, he can extract the entire surplus generated by the AIL recommendation. This is achieved by asking a bribe that leaves the borrower with exactly the same level of utility she would obtain by rejecting the collusive offer. When it comes to the own-segment safe borrower, the lender becomes effectively the residual claimant of the project. The lender obtains a gain equal to $Kp_s r_T + \rho_I - p_s r_T = \rho_I - (1-K)p_s r_T$ by recommending the own-segment safe borrower. Analogously the gain from recommending an own-segment risky type is $\rho - (1-K)p_r r_T$. These are the saving of the lender's cost of capital ρ_I as the

[15] The latter could be costly for several reasons including reputation losses if collusion is uncovered (with an exogenous probability), and transaction costs that represent deadweight losses (e.g., bribes could be costly to exchange.) We refrain from modelling these costs explicitly; instead we consider two polar cases where the size of these costs is respectively negligible and very large. Having these polar cases in place, we study the consequences of collusion on our variables of interest. Including collusion costs more explicitly would not change our main results.

borrower switches to borrowing from the MFI, less the net expected repayment $(1-K)p_i r_T$ by the coalition of the lender and the borrower type i. The expected repayment is lower for the risky type. Hence the agent prefers to recommend a risky rather than safe type from his own segment. Selecting safe clients is never optimal, in stark contrast with the no-collusion case.

But an even more attractive option is to report other-segment farmers. If possible, it is optimal for the lender to ask a bribe that attracts only the safe borrowers from other segment. Denote this by option (i). This is the first-best option for the lender because it combines high expected commission with zero opportunity cost. If this option is not available the lender considers two alternatives: (ii) ask a bribe that attracts both the risky and safe borrowers from other segments or (iii) ask a bribe that attracts only the risky borrowers. The trade off is between obtaining a higher expected commission (that is, $K\overline{p}r_T$ instead of $Kp_r r_T$), and setting a lower bribe, which is required to attract both risky and safe borrowers from other segments. If option (i) or (ii) is selected, the lender recommends other-segment borrowers with level of landholding such that $p_s R_s(a) - a$ is maximized. In option (i) this comes from the fact that the lender is the residual claimant of the project and wants to maximize the expected returns. In option (ii) this result is due to the fact that the lender tries to maximize the bribe. There can also be circumstances where option (iii) is best, which explains the last statement in the Proposition.

5.3 Summary of Theoretical Predictions

TRAIL effectiveness: The predictions of the TRAIL model depend on whether agents collude with borrowers, and also on the size of the commission. Say that *TRAIL is effective* if there is no collusion and $K > \overline{K}$. In that case, the agent recommends safe types paying the lowest informal interest rate (among those for whom this interest rate is higher than the AIL interest rate). And if TRAIL is not effective (note that this may occur either because agent commissions are too small or because agents do not collude with borrowers), then the agent recommends more risky clients.

This indicates a way of testing whether TRAIL is effective. First, we can check whether the average interest rate on informal loans paid by *Control 1* households (those recommended

by the agent but who did not receive the TRAIL loan) is systematically lower than that faced by *Control 2* households (who were not recommended by the agent). Note that we need to exclude *Treatment* households (those who were recommended by the agent and were randomly selected to receive credit) from the analysis here because the fact that these households received low interest loans from SS due to agent recommendation could make their type public information within the community, and they might now have access to low interest informal loans, which they would not have otherwise. By including *Treatment* households, in the analysis we could be conflating such an effect of the intervention with the underlying credit worthiness of the borrower. Additionally we can check whether

a. the agent actually uses the information on interest rates paid (i.e., knowledge about the type of the borrower) in the recommendation process; and

b. the agent exhibits a tendency to recommend clients about whom he has more information, either through prior economic interactions or through caste and religion networks.

Assuming that this test for effectiveness is passed, we then expect to find the following differences between TRAIL and GBL:

Informal Interest Rates: TRAIL *Control 1* households (recommended by not chosen to receive loan) pay lower informal interest rates than GBL *Control 1* households. This is because the agent recommends own-segment safe borrowers, where as the model predicts that GBL groups will involve positive assortative matching, so will consist of all safe or all risky borrowers. This implies an average risk level in GBL that is higher than in TRAIL.

Targeting: TRAIL agents will recommend those paying the lowest interest rates in the informal market (subject to the constraint of the TRAIL rate being lower than the average informal rate). This corresponds to households with an intermediate level of landholding. In contrast GBL selection will be biased in favor of landless households (paying the highest average informal interest rate).

Takeup: Controlling for landholding, takeup rates should be higher under TRAIL, since individual liability implies that TRAIL clients incur a lower repayment burden, and

there are no costs of attending meetings and achieving savings targets.

Repayment: Since TRAIL borrowers are safer than GBL borrowers, TRAIL should achieve higher repayment rates than GBL.

6 Empirical Results

To check if the predictions regarding selection, takeup and repayment are validated empirically we analyze the data on selection/recommendation of clients and on takeup/continuation and repayment over the first year of this ongoing project. In the empirical analysis we use non-parametric plots, and regressions, which control for household characteristics and village fixed effects.

TRAIL effectiveness

The basic premise of the TRAIL model is that the agent has information on the type of the borrower and will use this information to recommend safe (own-segment) borrowers. The interest rate paid by households on informal loans is a measure of the innate riskiness of the borrower. If TRAIL is effective, then the agent will recommend his own-segment safe types. To see if this is true, we compare the interest rates on informal loans (excluding loans from friends and family, many of which are zero interest loans in any event) paid by *Control 1* households to that paid by *Control 2* households. If TRAIL is effective then the average interest rate on informal loans paid by *Control 1* households should be significantly lower than that paid by *Control 2* households. This is clearly true irrespective of the level of landholding (see Panel A, Figure 5). This finding is further supported by the regression results presented in column 2, Table 5: controlling for landholding, *Control 1* households pay significantly lower interest rates on informal loans (weighted by loan size) than *Control 2* households.

Next we ask: are TRAIL agents likely to recommend own-segment safe clients? To answer this question, we examine the effect of risk types and prior interactions between the agent and the household on the likelihood of being recommended. We define a dummy variable *Prior Interaction*, which takes the value 1 if the agent has previously interacted with the

household (the household has previously bought from the agent or borrowed from the agent or worked for the agent) and interact this variable with the risk type of the household. We define two dummies to capture the risk type of the household: *Average Interest Low* if the average interest rate on informal loans is less than 18% and *No informal borrowing* if the household did not borrow from informal sources in the three months prior to the survey. This could of course mean either that the household voluntarily chooses not to borrow from informal sources or is involuntarily excluded from the informal market. However it does imply that in this case the risk type of the household cannot be determined.

The results from linear probability regressions are presented in Table 6. In all the regressions we control for landholding. The results in column 1 support our hypothesis that TRAIL agents are more likely to recommend households whom they had prior economic interactions with - prior interaction increases the likelihood of being recommended by 15 percentage points. The estimates in column 2 support the hypothesis that the agents recommend safe households: households with low average interest rate are 77 percentage points more likely to be recommended. The coefficient estimate associated with prior interaction becomes slightly weaker when we include the risk type dummies (column 3), but it continues to remain statistically significant. Overall however the information on the risk type of the household appears to be more important than prior interaction. The difference estimates Prior Interaction $\times$ No Informal Borrowing and Prior Interaction $\times$ Average Interest Low is never statistically significant. Irrespective of prior interaction, households that are able to borrow at a lower interest rate from the informal market are more likely to be recommended and prior interaction has no additional effect on the likelihood of being recommended. Columns 5 and 6 build on this by successively adding additional explanatory variables to capture networks between the agent and the recommended households. Agents belonging to high caste are significantly less likely to recommend scheduled caste (SC) households; Hindu agents are less likely to recommed non Hindu households; agents exhibit a slight bias in favor of households where the primary occupation is labor.

All of this suggests that TRAIL is indeed effective.

Informal Interest Rate

The interest rate paid by the household on informal loans is a measure of the average riskiness of the household. Recall that the model predicts that the informal interest rates of *Control 1* households should be lower in TRAIL than in GBL, since TRAIL is *effective* (i.e., the agent recommends own-segment safe types) while some GBL groups consist of all risky borrowers. The results presented in Table 5 show that the average interest rate (weighted by the loan size) paid by TRAIL *Control 1* households is 3.7 percentage points lower than that paid by TRAIL *Control 2* households (column 2); on the other hand the average interest rate paid by GBL *Control 1* households is 2.5 percentage points lower than that paid by GBL *Control 2* households (column 3). However the difference in the average interest rates paid by TRAIL and GBL *Control 1* households (captured by the interaction term TRAIL $\times$ *Control 1* in the pooled regression presented in column 4 in Table 5) while negative is not statistically significant. Therefore while theoretically it is possible for risky households to form groups in GBL, we see that *Control 1* households in TRAIL and GBL pay similar interest rates on informal loans. This suggests that safe households self select into GBL and risky households borrow from the informal market at higher interest rates. This is corroborated by Panel B of Figure 5, which shows that GBL *Control 1* households systematically pay lower informal interest rates than *Control 2* households.

Finally it is also worth noting that that there is a u-shaped relationship between landholding and the average interest rate on informal loans for both TRAIL and GBL.

Targeting by Landholding: Selection/Recommendation

We now consider land ownership of recommended/selected households. Overall around 96% of households who were recommended/formed a group owned no more than 1.5 acres of land. This requirement was imposed on the agents and in the group formation process in TRAIL and GRAIL. The corresponding proportion was around 81% for the *Control 2* (non-recommended/non-selected) households. Here sampling was stratified on the basis of the land distribution at the village level. There is no difference in the proportion of households that do not satisfy the landownership criterion across the different treatment

groups. In analyzing selection we therefore restrict ourselves to households owning no more than 1.5 acres of land.

The theoretical model predicts that TRAIL agents will tend to recommend those paying the lowest interest rates in the informal market, subject to the constraint that the interest rate offered under TRAIL is lower than the informal rate and that households with an intermediate level of landholding correspond to this category. In contrast GBL selected households will be those who pay the the highest average informal interest rate, i.e., the landless households.

Figure 6 presents the lowess plots of the likelihood of being recommended (or choosing to form a group) on landholding. There is an inverted u-shaped relationship between the likelihood of being recommended in TRAIL and landholding, with the likelihood of being recommended highest in the intermediate landholding range. The pattern of recommendation in TRAIL is consistent with the agent recommending his own-segment safe types, those who pay lower interest rates in the informal market. That said, the peak of the likelihood of recommendation is attained at a level of landholding of around 0.5 acres, slightly higher than the size (0.3 acres) associated with the lowest interest rate (Panel A in Figure 5). The likelihood of group formation (in GBL) decreases monotonically with an increase in landholding, indicating that GBL is more *pro-poor*.

These non-parametric patterns are corroborated in the regression results presented in Table 7. These are reduced form regressions for the likelihood of being recommended in TRAIL and the likelihood of forming a group in GBL. Consistent with the lowess plots in Figure 6, there is an inverted u-shaped relationship between landownership and the likelihood of the household being recommended. The probability of being recommended by a TRAIL agent is highest for households owning approximately 0.5 acres of land. In an alternative unreported specification we included a landless household dummy (as opposed to continuous landholding and landholding squared). The landless dummy was not significant in the recommendation regression for TRAIL, but landless households are significantly more likely to select themselves into groups under GBL.

There is also evidence that TRAIL agents are likely to recommend borrowers from specific religion, caste and occupation groups. This has already been reported in the test for

TRAIL effectiveness (Table 6). Hindu TRAIL agents were significantly less likely to recommend non-Hindu households. TRAIL agents who were businessmen were more likely to recommend households where the primary occupation of the household head is labor. Finally, prior interaction with the agent (bought from agent, borrowed money from agent and worked for agent to a lesser degree) significantly affected the likelihood of being recommended. In the case of GBL, prior interaction with the group leader (in the form of borrowing from the group leader) significantly increases the likelihood of being a group member. This is partly a result of the specific model of microfinance that is adopted by many MFIs in India (including SS), where the group leader is chosen first, who then has a say in inviting other members into the group.

Takeup

Controlling for landholding, takeup rates should be higher under TRAIL, since TRAIL clients incur a lower repayment burden (since TRAIL loans are individual liability, they do not have to repay on behalf of group-mates who are unable to repay) and avoid the cost of attending meetings and achieving savings targets. Figure 7 presents the takeup rate in Cycle 1 and the likelihood of continuation in subsequent cycles. Note that we measure continuation conditional on being offered a subsequent loan, since loan offers in each cycle depend on repayment behavior in the previous cycle. Takeup rates fall on average across the cycles. However, in contrast to our explanations, there is no clear pattern in Figure 7 to indicate differences in takeup rates between TRAIL and GBL. Column 1 in Table 8 presents the linear probability regressions for loan takeup in Cycle 1. There is, as one would expect from Figure 7, no difference in the takeup rate between TRAIL and GBL. The takeup rate is significantly lower in Hugli. This last result is interesting as it corroborates the anecdotal evidence obtained from field visits that suggest that access to microcredit is significantly higher in Hugli, which is closer to Kolkata (the state capital) and demand for additional credit is significantly lower in Hugli.

This Hugli effect persists over time and indeed becomes stronger. Columns 2, 3 and 4 in Table 8 presents the linear probability regression results for continuing to borrow in Cycles 2, 3 and 4 respectively, conditional on eligibility. Both the takeup and continuation probabilities are lower in Hugli compared to West Medinipur and this difference becomes

stronger over the first three cycles (increasing from 14 percentage points in cycle 1 to 20 percentage points in cycle 3), though falls in Ccycle 4 (down slightly to 15 percentage points, still statistically significant). There is no statistically significant difference in the takeup rate between TRAIL and GBL. Landholding has no effect on takeup/continuation rate in any cycle. The results are robust to the inclusion of intensity of microfinance activity in the village and presence of other MFIs in the village.

However these household level regressions do not tell the full story. If we are interested in overall financial inclusion, then we would like to know what proportion of the maximum eligible (10 in each village) actually receive the loan in each cycle. Ideally one would want everyone eligible to takeup the loan i.e., takeup rate to be 100%. However takeup rate is considerably less than 100% in all the cycles. This is partly due to the voluntary choice of some eligible households to not borrow and partly due to the involuntary circumstance that some households were unable to repay previous cycle loans and hence were not offered new loans and in some cases groups did not survive. In Figure 8 we present the average proportion of eligble households actually receiving the loan in each cycle, by treatment. While the proportion of households receiving the loans is always higher in TRAIL, the difference is only statistically significant in Cycle 4. This is corroborated by the regression results presented in Table 9, where the proportion of households in each village receiving the loan is regressed on the treatment dummy (TRAIL) and the district dummy (Hugli). While the takeup rate is always significantly lower in Hugli, the treatment difference, though always positive (takeup rate is higher in TRAIL compared to GBL) is only statistically significant in Cycle 4. In this cycle, the takeup rate (at the village level) is around 17 percentage points higher in TRAIL.

Repayment Patterns

The theoretical model predicts that if TRAIL is effective, TRAIL borrowers should have higher repayment rates than GBL borrowers. Figure 9 and Table 10 present the repayment rate over the course of the first year of the credit program (comprising three successive 4-month loan cycles). At the end of the first year (end of Cycle 3), repayment rates though high are less than 100%, whereas all loans had been fully repaid at the end of Cycles 1 and 2. The average repayment rate after one year is around 94% across all treatments. There

is a fair amount of variation: ranging from 87% in GBL to 99% in TRAIL. The regression results on repayment in Cycle 3 tell the same story. Repayment rates in TRAIL are almost 9.5 percentage points higher than in GBL, and the effect is statistically significant. The evidence is thus consistent with the theoretical prediction that TRAIL borrowers are safer than GBL borrowers. Again, landholding has no effect on repayment rate. The results are robust to the inclusion of cultivation status of and the area of land cultivated by the household.

Why are repayment rates higher in TRAIL? Consider first the theoretical predictions developed above. The model predicts that TRAIL agents will recommend safe borrowers from within their own segment. This means that recommended borrowers in TRAIL (*Control 1* and *Treatment* households) should pay lower informal interest rates than non-recommended borrowers (*Control 2*). This is borne out in Table 5, column 1, which shows that *Control 1* households in TRAIL pay interest rates that are on average 3.72 percentage points lower than *Control 2* households in TRAIL villages. The model for GBL predicts positive assortative matching: groups will be formed either consisting entirely of safe borrowers, or consisting entirely of risky borrowers. The set of GBL borrowers then consists of both types of groups and therefore the average risk-level of GBL borrowers should be lower than in TRAIL. However, as we see in Table 5, Column 3, there is no evidence in our data that GBL borrowers pay higher average informal interest rates than TRAIL borrowers do. There are two potential explanations for this. First, it is possible that with its low interest rate and high joint liability amount, this contract was only attractive to safe borrowers, and hence only safe groups formed. If so, then GBL *Control 1* households would be just as safe as TRAIL *Control 1* households. This is what the pooled regression results in Table 5 column 3, suggests: the average interest rate paid by TRAIL *Control 1* and GBL *Control 1* households is not significantly different. In this case however it is not the difference in average risk types of the TRAIL and GBL borrowers that results in the differences in the repayment rates (Table 10). For that we need to look at alternative explanations like contagion (in the case of GBL a random income shock to a few group members might result in all members of the group defaulting and thus the group failing) or moral hazard based explanations (differences in the ability of the agent and the group leader to enforce good behavior) or differences in project choice (loan utilization) between TRAIL and GBL loan recipients that might result in a lower repayment rate in

the case of GBL.

An alternative explanation would require a modification of the theoretical model. Assume that instead of there being only two risk-types of borrowers there are instead three types: super-safe, safe , and risky. Assume next that GBL generates positive assortative matching among all three types, leading to three types of groups: all super-safe borrowers, all safe borrowers and all risky borrowers. Then a random selection of treatment groups would imply that all three groups would be likely to be represented in the *Treatment* and *Control 1* groups. The average interest rate that is paid by the set of *Control 1* households in GBL could then equal the average interest rate paid by *Control 1* households in TRAIL, even if the composition of borrowers is different. This would then also be consistent with our finding in Table 13 where GBL borrowers (i.e. Treatment households) on average have a lower repayment rate than TRAIL Treatment households: repayment rates cannot exceed 100%, and assuming that both super-safe and safe borrowers repay 100% , TRAIL repayment rates would always be 100% whereas GBL repayment rates would be a (weighted) average of 100% (for super-safe and safe borrowers) and a lower number (for risky borrowers) and hence lower.

7 Discussion

The primary aim of this paper is to examine if it is possible to design a flexible system of microfinance that targets smallholder agriculture, without requiring collateral and without endangering financial sustainability. This system should allow individual liability loans, drop savings requirements, have less rigid repayment schedules (so that recipients can invest in high return projects with longer gestation period like agriculture) and reduce/eliminate costly meetings with MFI officials. To address these questions we design and implement an agent intermediated loan (AIL) scheme in a field experiment where local agents recommend borrowers to the MFI. Group-based lending (GBL) serves as the control. In this paper we compare targeting (selection), takeup and repayment rates in the two schemes. We build a theoretical model that allows us to understand the incentives of the agents and their recommendation behavior, and use the model to interpret the results. We extend the well-known model of Ghatak (2000) to incorporate an informal credit market with segmentation, where lenders in particular segments have a monopoly

over information about risk types of borrowers in their segments as a result of past experience from interacting with them, and we also allow the borrowers to be heterogenous in terms of landholding (an observable). This enables us to examine targeting patterns across different landholding levels under TRAIL and GBL, and test the predictions of our model.

The results presented in this paper suggest that TRAIL is effective (TRAIL agents recommend safe clients and there is no evidence of collusion); confirms predictions that: TRAIL agents select households with intermediate landholdings, while GBL selection is biased in favor of low landholdings; and repayment rates are higher in TRAIL as are takeup rates, although the differences are not statistically significant when it comes to takeup. However financial inclusion is higher in the case of TRAIL. The agent intermediated lending model is *working well* in terms of the conventional MFI metrics of takeup and repayment rates and there is also some evidence that it is performing better than GBL. It is difficult to compare TRAIL and GBL in terms of targeting, because GBL is more pro-poor (more likely to select landless households) but TRAIL and GBL both appear to target safe borrowers.

The process of targeting differs substantially between the two treatments. GBL is more pro-poor, with landless households most likely to form groups and avail of credit. Under TRAIL, agents tend to favor intermediate landholding groups, and targeting has been driven by the information set available to the agents. TRAIL agents in particular appear to use this information very effectively. This suggests that different means of credit delivery could be used to target different segments of the population - there is no *one size fits all* policy. For instance, GBL and TRAIL could be offered at the same time, with poorest (landless, minority caste and religion) households self-selecting into GBL contracts, and small and marginal landowners more likely to be recommended under AIL.

At this stage it is premature to comment on the broader welfare or policy implications of these different approaches. Before we can do this, we need to assess the impacts of the different treatments on cultivation, profits, household incomes and assets. This will be done in a subsequent paper.

A.1 Appendix

A.1.1 Proof of Lemma 1

Proof. Each lender can commit to a contract, consisting in a triple

$$\Gamma = \{r_s(a), r_r(a), r(a)\}.$$

This contract defines the interest rates respectively for own-segment safe borrowers, own-segment risky borrowers, and other-segment borrowers, for a given autarky option a. The other-segment interest rates can be thought as the competitive market interest rate. In the competitive market lenders compete a la' Bertrand. The lender maximizes the interest rate for the own-segment borrower, subject to the relevant constraints. In what follows, let us denote as $\widetilde{r}(a)$ the most competitive interest rate in the informal market. For a given autarky option a, the lender's best reponse is

$$r_i^*(a) = \arg\max_{r_i} r_i(a) \; i = r, s \tag{A-1}$$

subject to

$$r_i(a) \leq \widetilde{r}(a) \tag{A-2}$$

$$r_i(a) \leq R_i(a) - \frac{a}{p_i} \tag{A-3}$$

$$r_i(a) \geq \frac{\rho_I}{p_i}, \tag{A-4}$$

where the incentive-compatibility constraint (given by equation (A-2)) for each type of borrower requires that it is in the self-interest of a borrower to choose the own-segment lender's contract, rather than borrowing from the competitive market. The participation constraint (equation (A-3)) of each borrower requires that the expected payoff of a borrower from the contract is at least as large as the value of her autarky option. Finally, the break-even constraint (equation (A-4)) of the lender requires that the expected repayment from each loan is at least as large as the opportunity cost of capital, ρ_I. As long as the break-even (equation (A-4)) constraint is satisfied, the optimal interest rate can be written as

$$r_i^*(a) = \min\left\{\widetilde{r}(a), R_i(a) - \frac{a}{p_i}\right\} \tag{A-5}$$

Consider now the competitive market. Denote by α and $(1-\alpha)$ respectively the fraction of risky and safe types in the competitive market. Having this schedule in place, we can

show that in equilibrium $\alpha = 1$ is the only possible candidate. Suppose not. If $\alpha \neq 1$, a fraction of the safe borrowers borrow from the competitive market. For this to be the case, the most competitive interest rate in the informal market, $\widetilde{r}(a)$, must satisfy the participation constraint for the safe borrowers. Thus,

$$\widetilde{r}(a) \leq R_s(a) - \frac{a}{p_s}. \tag{A-6}$$

The break-even constraint of the lender requires that the expected repayment from each loan in the competitive market is at least as large as the opportunity cost of capital, i.e., $\widetilde{r}(a) \geq \frac{\rho_I}{\alpha p_r + (1-\alpha)p_s}$. Hence, from equations (A-5) and (A-6) it follows that $r_s^*(a) = \min\left\{\widetilde{r}(a), R_s(a) - \frac{a}{p_s}\right\} = \widetilde{r}(a)$. Given that $r_s^*(a) = \widetilde{r}(a) \geq \frac{\rho_I}{\alpha p_r + (1-\alpha)p_s} > \frac{\rho_I}{p_s}$ for each $\alpha \in (0,1)$,[16] the break-even constraint (equation (A-4)) is also satisfied. Hence, there is a strictly profitable deviation where the lenders offer $r_s^*(a)$ and attract all the own-segment safe borrowers. It follows that $\alpha \neq 1$ cannot be an equilibrium. QED ■

A.1.2 Proof of Proposition 2

If an equilibrium exists, Lemma 1 entails that it must feature $\alpha = 1$, i.e., the competitive market can be populated only by risky borrowers. Hence, the break-even constraint in the competitive market requires that $r(a) \geq \frac{\rho_I}{p_r}$. Moreover, it is possible to show that in equilibrium $\widetilde{r}(a) = \frac{\rho_I}{p_r}$. Suppose not. Then a lender could reduce $r(a)$, attract all the risky borrowers, and make a positive profit. If $R_r(a) - \frac{a}{p_r} < \frac{\rho_I}{p_r}$ there is no interest rate that satisfies both the break-even constraint and the risky borrowers' participation constraint in the competitive market. For simplicity, in this case, we assume the following:

Assumption 0: If $R_r(a) - \frac{a}{p_r} < \frac{\rho_I}{p_r}$, the lenders set $r(a) = r_r(a) = \frac{\rho_I}{p_r}$ and neither the own-segment nor the other-segment risky borrowers accept the contract.

Having this schedule in place, it is easy to see that, if an equilibrium exists, the equilibrium interest rates for the own-segment risky borrower, and the other segment borrower are

$$\begin{aligned} r^*(a) &\equiv \frac{\rho_I}{p_r} \\ r_r^*(a) &\equiv \frac{\rho_I}{p_r} \end{aligned} \tag{A-7}$$

[16] Note that from equation (1) follows that any interest rate that satisfies the safe farmers' participation constraint also satisfies the risky farmers' participation constraint. Hence, $\alpha = 0$ is not admissible.

We are now left to study the conditions such that an equilibrium exists where $\alpha = 1$. In what follows, we assume the safe borrowers' projects are socially efficient, i.e., equation (3) holds. We want to prove that the sufficient and almost necessary conditions for the existence of an equilibrium are equation (1) and equation (2)[17] and that the equilibrium is unique and consists of the triple $\{r_s^*(a), r_r^*, r^*\} = \left\{R_s(a) - \frac{a}{p_s}, \frac{\rho_I}{p_r}, \frac{\rho_I}{p_r}\right\}$.

From equation (3), (A-1), and (A-7) follows that $r^*(a) = r_r^*(a) = \frac{\rho_I}{p_r}$, and $r_s^*(a) = \min\left\{\frac{\rho_I}{p_r}, R_s(a) - \frac{a}{p_s}\right\}$.

Proof.

1. Consider first the case where $R_s(a) - \frac{a}{p_s} \geq \frac{\rho_I}{\overline{p}}$. If this condition holds, we will show that $\alpha = 1$ cannot hold in equilibrium because there is a profitable deviation where a lender can attract safe borrowers from other segments. Given that we proved that $\alpha \neq 1$ cannot hold in equilibrium either, we conclude that there is no equilibrium if $R_s(a) - \frac{a}{p_s} \geq \frac{\rho_I}{\overline{p}}$. To see this point note that from $\frac{\rho_I}{p_r} > \frac{\rho_I}{\overline{p}}$ follows that $r_s^*(a) \geq \frac{\rho_I}{\overline{p}}$. Consider now the following sub-cases:

   a) $R_r(a) - \frac{a}{p_r} < R_s(a) - \frac{a}{p_s}$. In this case there is a profitable deviation where a lender (i) offers any $r(a)$ in the interval $\left(\max\left[R_r(a) - \frac{a}{p_r}, \frac{\rho_I}{p_s}\right], r_s^*(a)\right)$ (ii) induces the risky borrowers from other segments to refuse the contract because $r(a) > R_r(a) - \frac{a}{p_r}$, (iii) induces the safe borrowers from other segments to accept because $r(a) < r_s^*(a)$ (vi) and makes positive profits because the break even condition is strictly satisfied, i.e., $r(a) > \frac{\rho_I}{p_s}$.

   b) $R_r(a) - \frac{a}{p_r} \geq R_s(a) - \frac{a}{p_s}$. To begin with assume that $R_s(a) - \frac{a}{p_s} > \frac{\rho_I}{\overline{p}}$. Hence, $r_s^*(a) > \frac{\rho_I}{\overline{p}}$. In this case there is a profitable deviation where a lender (i) offers any $r(a)$ in the interval $\left(\frac{\rho_I}{\overline{p}}, r_s^*(a)\right)$ (ii) induces the risky borrowers from other segments to accept the contract because $r(a) < r_r^*(a) = \frac{\rho_I}{p_r}$ (iii) induces the safe borrowers from other segments to accept because $r(a) < r_s^*(a)$ and (vi) makes positive profits because the break even condition is strictly satisfied, i.e., $r(a) > \frac{\rho_I}{\overline{p}}$. Note that this profitable deviation exists only if $R_s(a) - \frac{a}{p_s} > \frac{\rho_I}{\overline{p}}$. On the other hand, in the non-generic case where $R_s(a) - \frac{a}{p_s} = \frac{\rho_I}{\overline{p}}$, there

[17] These conditions are *almost* necessary. To see this point note that there is a non-generic case where $R_s(a) - \frac{a}{p_s} = \frac{\rho_I}{\overline{p}}$ and an equilibrium exists such that $\{r_s^*(a), r_r^*, r^*\} = \left\{\frac{\rho_I}{\overline{p}}, \frac{\rho_I}{p_r}, \frac{\rho_I}{p_r}\right\}$. The details are provided in the proof.

is no profitable deviation. Indeed, $r_s^*(a) = \min\left\{\frac{\rho_I}{p_r}, \frac{\rho_I}{\overline{p}}\right\} = \frac{\rho_I}{\overline{p}}$ and the only profitable deviation would involve offering $r(a) = \frac{\rho_I}{\overline{p}}$ and attracting both types of borrowers. This deviation yields zero profit. Hence an equilibrium exists where $\{r_s^*(a), r_r^*, r^*\} = \left\{\frac{\rho_I}{\overline{p}}, \frac{\rho_I}{p_r}, \frac{\rho_I}{p_r}\right\}$.

2. Consider now the case where $R_s(a) - \frac{a}{p_s} < \frac{\rho_I}{\overline{p}}$. Given that $\frac{\rho_I}{\overline{p}} < \frac{\rho_I}{p_r}$, this implies that $R_s(a) - \frac{a}{p_s} < \frac{\rho_I}{p_r}$ and so $r_s^*(a) = R_s(a) - \frac{a}{p_s} < \frac{\rho_I}{\overline{p}}$. Consider now the following sub-cases:

   a) $R_r(a) - \frac{a}{p_r} < R_s(a) - \frac{a}{p_s}$. In this case, there is a profitable deviation where a lender (i) offers any $r(a)$ in the interval $\left(\max\left[R_r(a) - \frac{a}{p_r}, \frac{\rho_I}{p_s}\right], R_s(a) - \frac{a}{p_s}\right)$ (ii) induces the risky borrowers from other segments to refuse the contract because $r(a) > R_r(a) - \frac{a}{p_r}$, (iii) induces the safe borrowers from other segments to accept because $r(a) < r_s^*(a) = R_s(a) - \frac{a}{p_s}$ (iii) makes positive profits because the break even condition is strictly satisfied, i.e., $r(a) > \frac{\rho_I}{p_s}$.

   b) $R_r(a) - \frac{a}{p_r} \geq R_s(a) - \frac{a}{p_s}$. In this case there is no profitable deviation. Increasing $r(a)$ above $r^*(a) = \frac{\rho_I}{p_r}$ entails (i) losing all the risky borrowers to the competition in case $R_r(a) - \frac{a}{p_r} \geq \frac{\rho_I}{p_r}$, or (ii) no effect at all if $R_r(a) - \frac{a}{p_r} < \frac{\rho_I}{p_r}$ (i.e., the risky borrowers are not willing to borrow in the first place.) Decreasing $r(a)$ below $r^*(a)$ would violate the break even condition unless the lower interest rate would manage to attract safe borrowers form other segments. Given that $R_s(a) - \frac{a}{p_s} < \frac{\rho_I}{\overline{p}}$ (i.e., the safe borrowers are not willing to accept the interest rate $\frac{\rho_I}{\overline{p}}$), the lender should reduce $r(a)$ below $\frac{\rho_I}{\overline{p}}$ in order to attract the safe borrowers from other segments. Note that the risky borrowers are also willing to borrow at $r(a)$ because (i) any interest rate that satisfies the safe borrowers' participation constraint also satisfies the risky borrowers' participation constraint, i.e., $R_r(a) - \frac{a}{p_r} \geq R_s(a) - \frac{a}{p_s}$, and (ii) the risky borrowers prefer $r(a)$ to the own segment interest rate, i.e., $r(a) < \frac{\rho_I}{\overline{p}} < r_r^*(a) = \frac{\rho_I}{p_r}$. Hence, offering $r(a) < \frac{\rho_I}{\overline{p}}$ would violate the break even constraint, i.e., $r(a) \geq \frac{\rho_I}{\overline{p}}$. It follows that triple $\{r_s^*(a), r_r^*, r^*\} = \left\{R_s - \frac{a}{p_s}, \frac{\rho_I}{p_r}, \frac{\rho_I}{p_r}\right\}$ is an equilibrium if $R_s - \frac{a}{p_s} < \frac{\rho_I}{\overline{p}}$ and $R_r(a) - \frac{a}{p_r} \geq R_s(a) - \frac{a}{p_s}$. QED

■

A.1.3 Proof of Proposition 4

These are the options available to the lender:

Proof.

a) By recommending the own-segment safe borrower (s, a) and setting

$$b_s^*(a) \equiv p_s R_s(a) - p_s r_T - a$$

the lender ensures that the safe borrower is indifferent between accepting and refusing the offer.[18] The lender's expected gain is

$$\underbrace{Kp_s r_T}_{\text{commission}} - \underbrace{\Pi_s(a)}_{\text{lender's opportunity cost}} + \underbrace{b_s^*(a)}_{\text{bribe}} =$$

$$= Kp_s r_T - (p_s R_s(a) - \rho_I - a) + (p_s R_s(a) - p_s r_T - a)$$

$$= \rho_I - (1 - K) p_s r_T$$

b) The "socially productive" own-segment risky borrower (s, a) outside option from the collusive agreement is $\overline{u}_r(a) = p_r R_r(a) - \rho_I$. By recommending the "socially productive" own-segment risky borrower (r, a) and setting

$$b_r^* \equiv (p_r R_r(a) - p_r r_T) - (p_r R_r(a) - \rho_I) = \rho_I - p_r r_T$$

the lender ensures that the risky borrower is indifferent between accepting and refusing the offer. The lender's gain is

$$\underbrace{Kp_r r_T}_{\text{commission}} - \underbrace{\Pi_r(a)}_{\text{lender's opportunity cost}} + \underbrace{b_r^*}_{\text{bribe}} =$$

$$= Kp_r r_T + \rho_I - p_r r_T$$

$$= \rho_I - (1 - K) p_r r_T$$

c) The "socially unproductive" own-segment risky borrower (s, a) outside option from the collusive agreement is $\overline{u}_r(a) = a$. From the definition of "socially unproductive" it follows that the lender needs to offer a negative bribe $b^*(a) = p_r R_r(a) - p_r r_T - a < 0$

[18] The safe farmer is indifferent because she obtains an expected payoff equal to a in both cases. Indeed, the own-segment safe farmer (s, a) outside option from the collusive agreement is $\overline{u}_s(a) = a$.

in order to ensure that the risky borrower is willing to accept the offer. The lender's gain would be

$$\underbrace{Kp_r r_T}_{\text{commission}} - \underbrace{\Pi_r(a)}_{\text{lender's opportunity cost}} + \underbrace{b^*(a)}_{\text{bribe}} = \\ = Kp_r r_T + (p_r R_r(a) - p_r r_T - a).$$

d) If $b_s^* > b_r^*$, the lender can recommend the other-segment borrower, set the bribe to b_s^* and attract only the other-segment safe borrowers. Note that the risky borrowers are not attracted by the deal because $b_s^* > b_r^*$ and so they strictly prefer not be recommended. The lender's gain is

$$\underbrace{Kp_s r_T}_{\text{commission}} - \underbrace{0}_{\text{lender's opportunity cost}} + \underbrace{b_s^*}_{\text{bribe}} = \\ = Kp_s r_T + p_s R_s(a) - p_s r_T - a$$

e) If $b_r^* > b_s^*$, the lender can recommend the other-segment borrower, set the bribe to b_r^* and attract only the other-segment risky borrowers. Note that the safe borrowers are not attracted by the deal because $b_r^* > b_s^*$ and so they strictly prefer not be recommended (i.e., the bribe b_r^* is too high.) The lender's gain is the same as in point 2

$$\underbrace{Kp_r r_T}_{\text{commission}} - \underbrace{0}_{\text{lender's opportunity cost}} + \underbrace{b_r^*}_{\text{bribe}} = \\ = Kp_r r_T + \rho_I - p_r r_T \\ = \rho_I - (1-K)p_r r_T$$

f) If the lender set the bribe to $\min[b_r^*, b_s^*]$ both the other-segment safe and the risky borrowers are attracted. The lender's gain is

$$\underbrace{K\overline{p}r_T}_{\text{commission}} - \underbrace{0}_{\text{lender's opportunity cost}} + \underbrace{\min[b_r^*, b_s^*]}_{\text{bribe}} = \\ = K\overline{p}r_T + \min[p_s R_s(a) - p_s r_T - a, \rho_I - p_r r_T]$$

By assumption, option **a** is strictly dominated by option **b**. Therefore, option **a** is never selected. If $b_s^* > b_r^*$, the lender prefers option **d**; accordingly she recommends other-segment safe borrowers with a level of landholding a such that $p_s R_s(a) - a$ is maximized. If $b_r^* > b_s^*$, the optimal candidates are options **b, e** (which yield the

same gain) and **f**. The trade off is between obtaining a higher expected repayment (that is, $K\overline{p}r_T$ under option **f** but only $Kp_r r_T$ under option **b** and **e**)**,** and a lower bribe (that is b_s^* under option **f** and $b_r^*(> b_s^*)$ under option **b** and **e**). If option **f** is selected, then the lender targets other-segment borrowers with a level of landholding a such that $p_s R_s(a) - a$ is maximized. Otherwise, if options **b** or **e**are selected the lender targets risky borrowers with any level of landholding.

■

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Table 1: The intervention

Cycle	Date of Disbursal	Loan Amount* (Rs)	Duration	Interest Amount (Rs)	Amount to be Repaid (Rs)
TRAIL					
1	October 2010	2000	120 days	120	2120
2	February 2011	2660	120 days	160	2820
3	June 2011	3538	120 days	212	3750
4	October 2011	4705	120 days	282	4988
5	February 2012	6258	120 days	375	6633
6	June 2012	8323	120 days	499	8823
GBL					
1	October 2010	10000	120 days	600	10600
2	February 2011	13300	120 days	800	14100
3	June 2011	17690	120 days	1060	18750
4	October 2011	23525	120 days	1410	24935
5	February 2012	31290	120 days	1875	31465
6	June 2012	41615	120 days	2495	44110
To continue ...					

* : Conditional on Full Repayment of Earlier Loan

Table 2: Composition of the Sample

TRAIL:		
Treatment	Households recommended and randomly selected to receive credit	10
Control 1	Households recommended and not selected to receive credit	10
Control 2	Households Not Recommended	30
Total		50
GBL:		
Treatment	Members of groups that survived until lottery and randomly selected to receive credit (Sample at group level: 2 groups)	10
Control 1	Members of groups that survived until lottery but were not selected to receive credit (Sample at group level: 2 groups)	10
Control 2	Households that did not form group	30
Total		50

Table 3: Randomization

	TRAIL		GBL		Difference
	Mean	SE	Mean	SE	TRAIL - GBL
Panel A: Village Level Differences					
Number of Households	276.04	41.15	346.42	76.53	-70.38
Number of Potato Cultivators	164.63	26.60	208.29	48.57	-43.67
Total Landless	15.96	3.88	12.83	3.47	3.13
Total $0 - 1.25$	113.88	21.07	149.96	43.63	-36.08
Total $1.25 - 2.50$	25.58	3.32	31.54	4.47	-5.96
Total $2.50 - 5.00$	10.88	1.51	11.58	1.77	-0.71
Total $5.00 - 12.50$	1.38	0.37	2.38	0.67	-1.00
Total Above 12.50	0.00	0.00	0.00	0.00	0.00
Panel B: Household Level Differences					
Male Head	0.95	0.01	0.94	0.01	0.01
Non Hindu	0.21	0.02	0.16	0.02	0.06**
Scheduled Caste (SC)	0.23	0.02	0.25	0.02	-0.02
Scheduled Tribe (ST)	0.05	0.01	0.04	0.01	0.01
Other Backward Caste (OBC)	0.06	0.01	0.06	0.01	-0.01
Household Size	5.13	0.12	5.32	0.11	-0.19**
Age of Household Head	49.94	0.58	51.56	0.53	-1.61
Married Household Head	0.91	0.01	0.90	0.01	0.01
Head: Completed Primary School	0.50	0.02	0.49	0.02	0.00
Head Occupation: Cultivator	0.56	0.02	0.55	0.02	0.01
Head Occupation: Labour	0.22	0.02	0.22	0.02	-0.01
Head: Resident	0.99	0.01	0.99	0.01	0.00
Landholding (acres)	1.00	0.05	1.05	0.06	-0.05
Landless	0.07	0.01	0.08	0.01	-0.01
Received GP Benefit	0.54	0.02	0.62	0.02	-0.08***
Purchased on Credit	0.38	0.02	0.43	0.02	-0.05*
Joint Signficance of Household Variables‡					21.71

Total refers to total number of potato cultivators
$^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$
‡: χ^2_{16}
Panel A uses village census data collected in 2007-2008
Panel B uses the 2007-2008 sample, but data from the 2010 Cycle 1 survey

Table 4: Profits from Potato Cultivation

	(1)	(2)
Landholding	4,327.039*	3,738.737
	(2,498.595)	(2,557.375)
Landholding Squared	4,950.229**	5,269.364**
	(2,177.357)	(2,203.474)
Jyoti		684.059
		(1,401.377)
Pokhraj		-5,446.259***
		(1,627.646)
Chandramukhi		1,648.039
		(1,937.904)
Constant	6,888.438***	7,088.972***
	(540.215)	(1,473.575)
Sample Size	1,585	1,585
Village Fixed Effects	Yes	Yes

$^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$
Standard errors clustered at the household level in parentheses
Sample restricted to households with atmost 1.5 acres
Data are from the Cycles 1 and 2 of household survey.

Table 5: Informal Interest Rate

	Overall (1)	TRAIL (2)	GBL (3)	Pooled (4)
Control 1		-3.728**	-2.488*	-2.563*
		(1.539)	(1.340)	(1.501)
TRAIL × *Control 1*				-1.082
				(2.057)
Landholding	-8.359**	-6.049	-9.576*	-7.558*
	(3.951)	(5.779)	(5.194)	(3.924)
Landholding Squared	4.937*	2.439	6.363	4.191
	(2.917)	(4.247)	(3.855)	(2.898)
Constant	35.660***	35.989***	38.305***	37.035***
	(1.081)	(1.699)	(1.561)	(1.166)
Sample Size	374	199	175	374
Village Fixed Effects	Yes	Yes	Yes	Yes
Mean *Control 2*	38.942	38.640	39.260	38.942

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Data are from the Cycle 1 of household survey.
Interest rate on new loans in the 3 months prior to the survey
Sample includes *Control 1* and *Control 2* households
Average interest rate on all informal loans for the household, weighted by loan size
Excludes loans from family and friends

Table 6: Test for TRAIL Effectiveness

	(1)	(2)	(3)	(4)	(5)	(6)
Prior Interaction with Agent	0.153***		0.108***	0.119	0.116	0.126*
	(0.042)		(0.039)	(0.077)	(0.077)	(0.077)
Average Interest Low		0.770***	0.753***	0.806***	0.766***	0.774***
		(0.084)	(0.084)	(0.113)	(0.114)	(0.114)
Prior Interaction × Average Interest Low				-0.119	-0.073	-0.075
				(0.158)	(0.159)	(0.158)
No Informal Borrowing		-0.072	-0.069	-0.065	-0.069	-0.063
		(0.046)	(0.046)	(0.065)	(0.065)	(0.066)
Prior Interaction × No Informal Borrowing				-0.007	-0.006	-0.015
				(0.082)	(0.082)	(0.082)
SC					0.489*	0.425
					(0.274)	(0.273)
SC × Agent High Caste					-0.536*	-0.499*
					(0.274)	(0.273)
ST					-0.139	-0.180
					(0.154)	(0.154)
OBC					0.016	0.009
					(0.074)	(0.074)
ST × Agent High Caste					0.119	0.127
					(0.173)	(0.172)
Non Hindu					-0.058	-0.073
					(0.113)	(0.112)
Non Hindu × Agent Hindu					-0.077	-0.058
					(0.132)	(0.132)
Head Cultivator						-0.099
						(0.211)
Head Cultivator × Agent Business						0.116
						(0.215)
Head Labor						0.022
						(0.197)
Head Labor × Agent Business						0.146
						(0.202)
Constant	0.204***	0.307***	0.265***	0.262***	0.305***	0.197**
	(0.034)	(0.048)	(0.050)	(0.064)	(0.070)	(0.079)

Continued ...

Table 6 (Continued)

	(1)	(2)	(3)	(4)	(5)	(6)
Total Effect						
Prior Interaction, No Informal Borrowing				1.54	1.63	1.79
Prior Interaction, Average Interest Low				33.41***	33.89***	34.76***
SC, Agent High Caste					1.21	2.88*
ST, Agent High Caste					0.06	0.42
Non Hindu, Agent Hindu					3.47*	3.29*
Head Cultivator, Agent Business						0.15
Head Labor, Agent Business						12.35
Sample Size	805	805	805	805	805	805
Village Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Linear Probability Estimates
$^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$
Standard errors clustered at the household level in parentheses
Sample excludes *Treatment* households
Sample restricted to households with atmost 1.5 acres
Regressions control for landholding and landholding squared

Table 7: Selection: Recommendation/Group Formation

	TRAIL	GBL
Landholding	0.231*	-0.182
	(0.129)	(0.131)
Landholding Squared	-0.241**	0.034
	(0.094)	(0.097)
Non Hindu	-0.022	-0.190***
	(0.124)	(0.068)
Non Hindu × Agent Hindu	-0.184	
	(0.141)	
SC	0.275	0.017
	(0.204)	(0.047)
SC × Agent High Caste	-0.362*	
	(0.205)	
ST	-0.355**	0.038
	(0.166)	(0.079)
ST × Agent High Caste	0.307*	
	(0.183)	
OBC	-0.006	0.142**
	(0.073)	(0.069)
Purchased on Credit	0.069*	0.042
	(0.036)	(0.034)
Received GP Benefits	0.030	-0.003
	(0.038)	(0.038)
Buy from Agent/Group Leader	0.070*	0.042
	(0.042)	(0.084)
Borrow from Agent/Group Leader	0.193***	0.320***
	(0.051)	(0.082)
Work for Agent/Group Leader	0.028	0.052
	(0.059)	(0.071)
Constant	0.251**	0.854***
	(0.119)	(0.099)
Total Effect		
Non Hindu Household, Hindu Agent	8.56***	
SC Household, High Caste Agent	3.62**	
ST Household, High Caste Agent	0.32	
OBC Household, High Caste Agent	0.00	
Head Cultivator, Agent Business	0.62	
Head Labour, Agent Business	4.71**	

Continued . . .

Table 7 (Continued)

	TRAIL	GBL
Sample Size	1,031	1,038
Number of Villages	24	24
Village Fixed Effects	Yes	Yes

Linear Probability Estimates
Robust Standard errors in parentheses
Sample restricted to households with at most 1.5 acres
$^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$
Regressions also control for age, gender, educational attainment,
and primary occupation of the household head
and interactions with the primary occupation of the agent,
and household size

Table 8: Takeup/Continuation: Cycles 1 - 4

	Cycle 1	Cycle 2	Cycle 3	Cycle 4
TRAIL	-0.009	-0.048	0.016	0.026
	(0.055)	(0.054)	(0.067)	(0.068)
Hugli	-0.136**	-0.173***	-0.194***	-0.146**
	(0.058)	(0.057)	(0.063)	(0.070)
Landholding	0.006	-0.001	0.007	-0.018
	(0.067)	(0.066)	(0.074)	(0.076)
Landholding Squared	-0.027	-0.022	-0.025	-0.020
	(0.027)	(0.026)	(0.028)	(0.028)
Constant	0.644***	0.612***	0.635***	0.420**
	(0.133)	(0.136)	(0.148)	(0.205)
Number of Households	460	460	459	433

Linear Probability Estimates
Standard errors in clustered at the group level in parentheses
Group is identical to individual in TRAIL
$^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$
Regressions control for age, gender, educational attainment,
and primary occupation of the household head,
household size, religion and caste of the household, landholding,
household access to credit and household access to GP benefits

Table 9: Total Number of Loans Disbursed

	Cycle 1	Cycle 2	Cycle 3	Cycle 4
TRAIL	0.070	0.034	0.079	0.170*
	(0.073)	(0.074)	(0.087)	(0.087)
Hugli	-0.171**	-0.208***	-0.200**	-0.191**
	(0.075)	(0.076)	(0.087)	(0.087)
Constant	0.887***	0.904***	0.846***	0.758***
	(0.065)	(0.065)	(0.084)	(0.087)
Number of Villages	48	48	48	48

Dependent Variable: Total number of loans disbursed
as a proportion of maximum eligible in each village
Regressions *not* conditional on eligibility
Village level regressions
$^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$

Table 10: Repayment Cycle 3

	Cycle 3
TRAIL	0.095**
	(0.046)
Hugli	-0.089
	(0.069)
Landholding	0.048
	(0.082)
Landholding Squared	-0.029
	(0.024)
Constant	0.681***
	(0.175)
Average Repayment in GBL	0.87
Number of Households	379

Repayment Rate is 100% in all treatments in Cycles 1 and 2
Linear Probability Estimates
$^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$
Standard errors in clustered at the group level in parentheses
Group is identical to individual in TRAIL
Regressions control for age, gender, educational attainment,
and primary occupation of the household head,
household size, religion and caste of the household, landholding,
household access to credit and household access to GP benefits

Figure 1: Loans by Lender Category

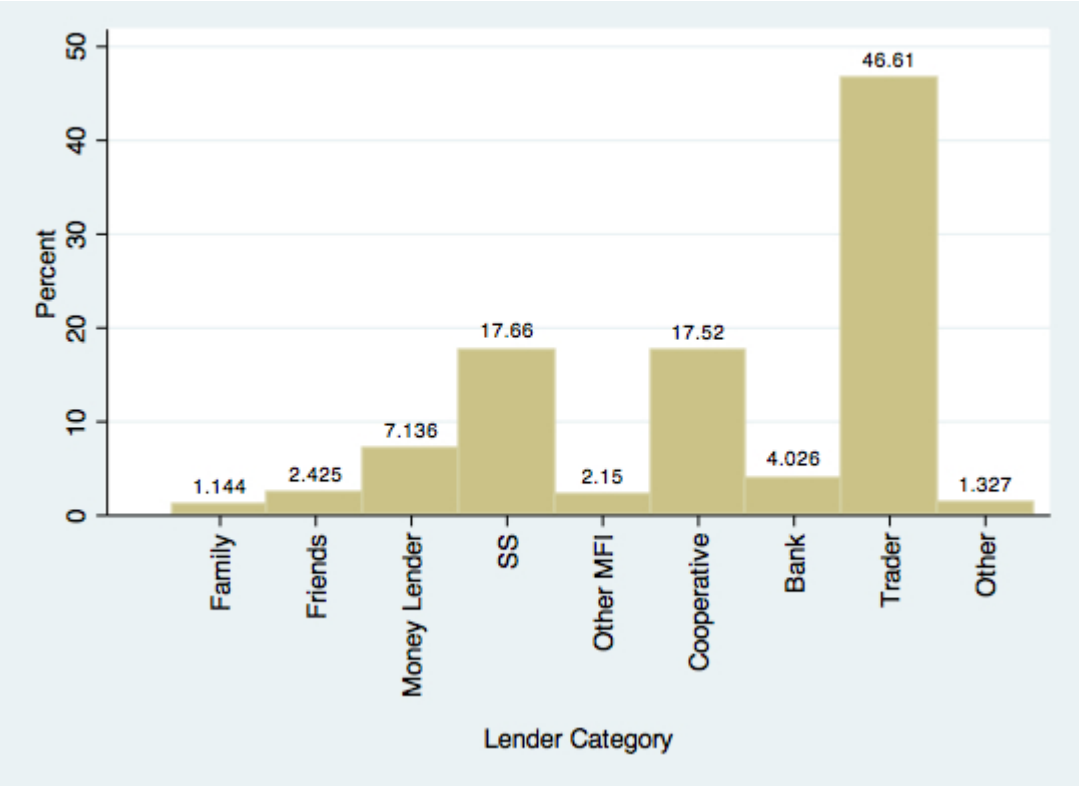


Figure 2: Informal Interest Rate and Landholding

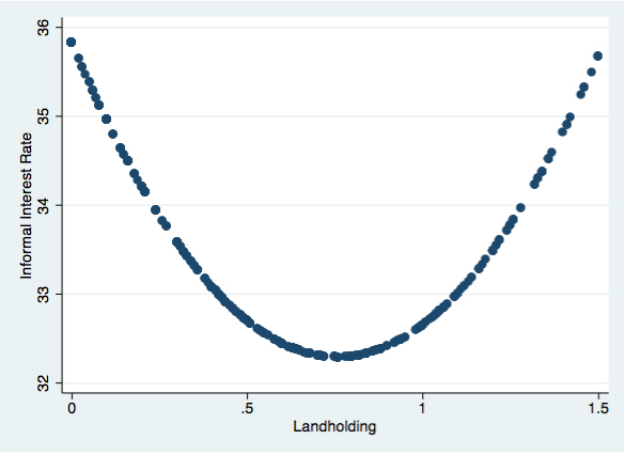


Figure 3: Interest Rate, Landholding and Production Function

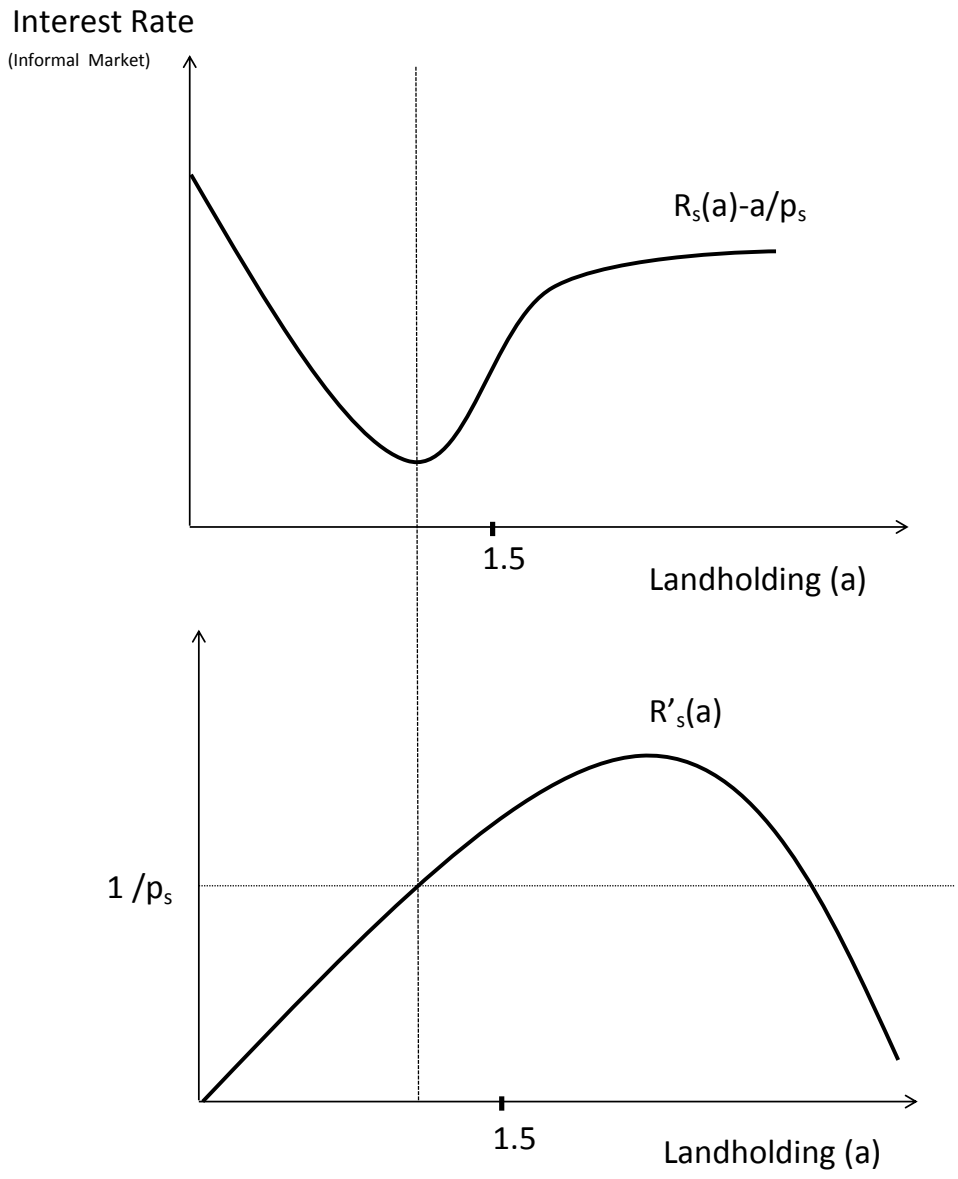


Figure 4: Individual Expected Surplus and Social Cost of Project

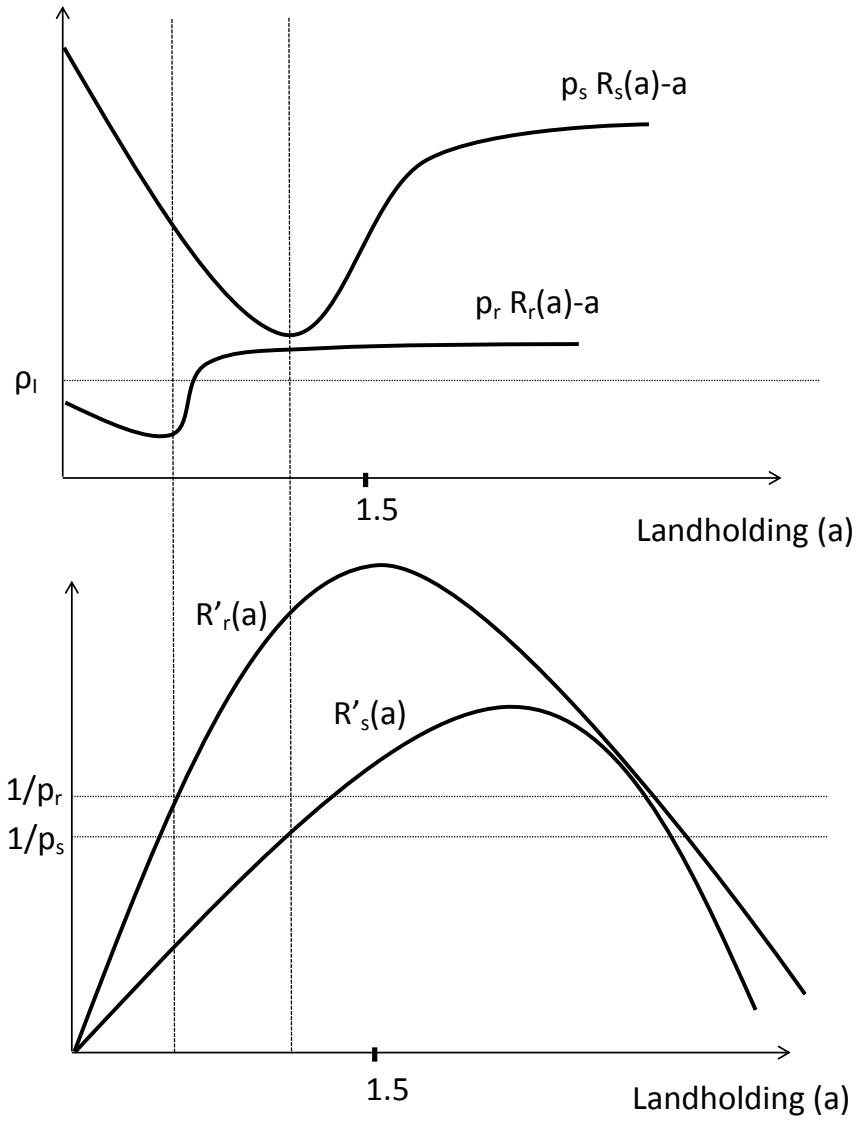


Figure 5: Informal Interest Market

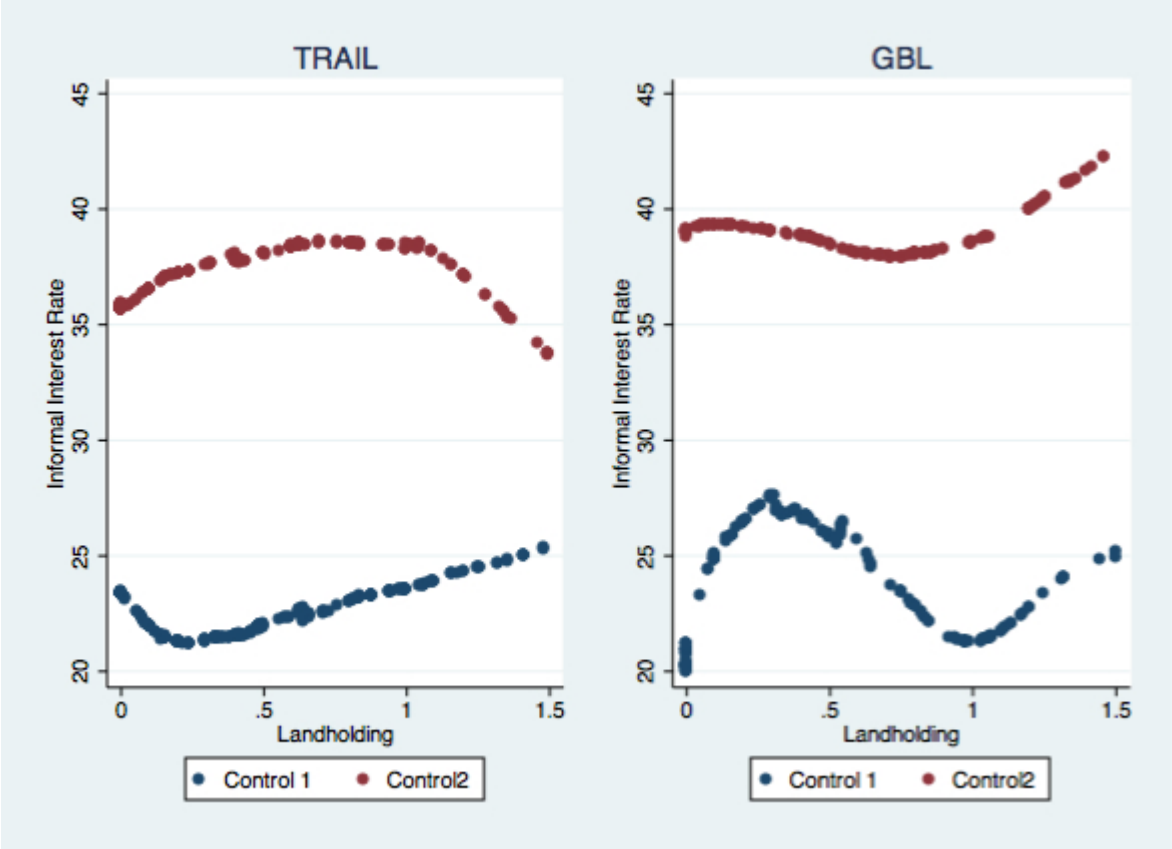


Figure 6: Selection: Recommendation/Group Formation

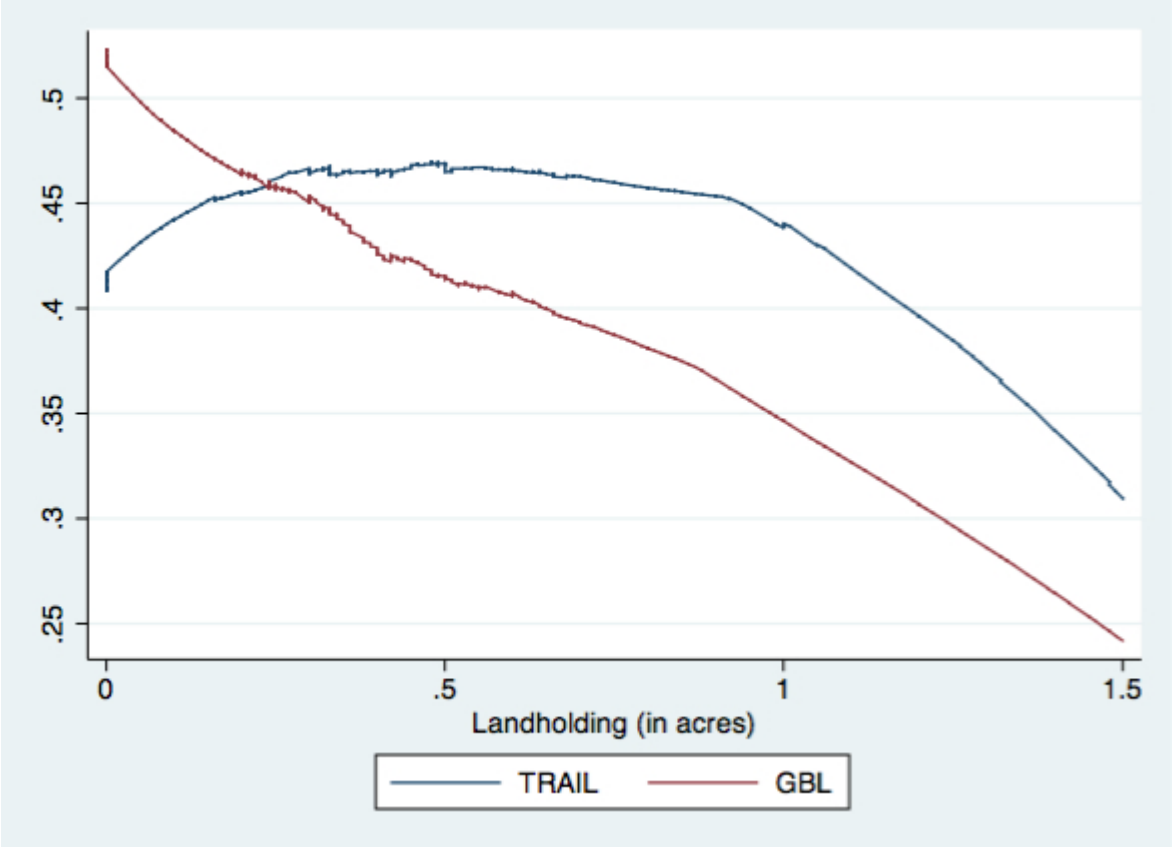
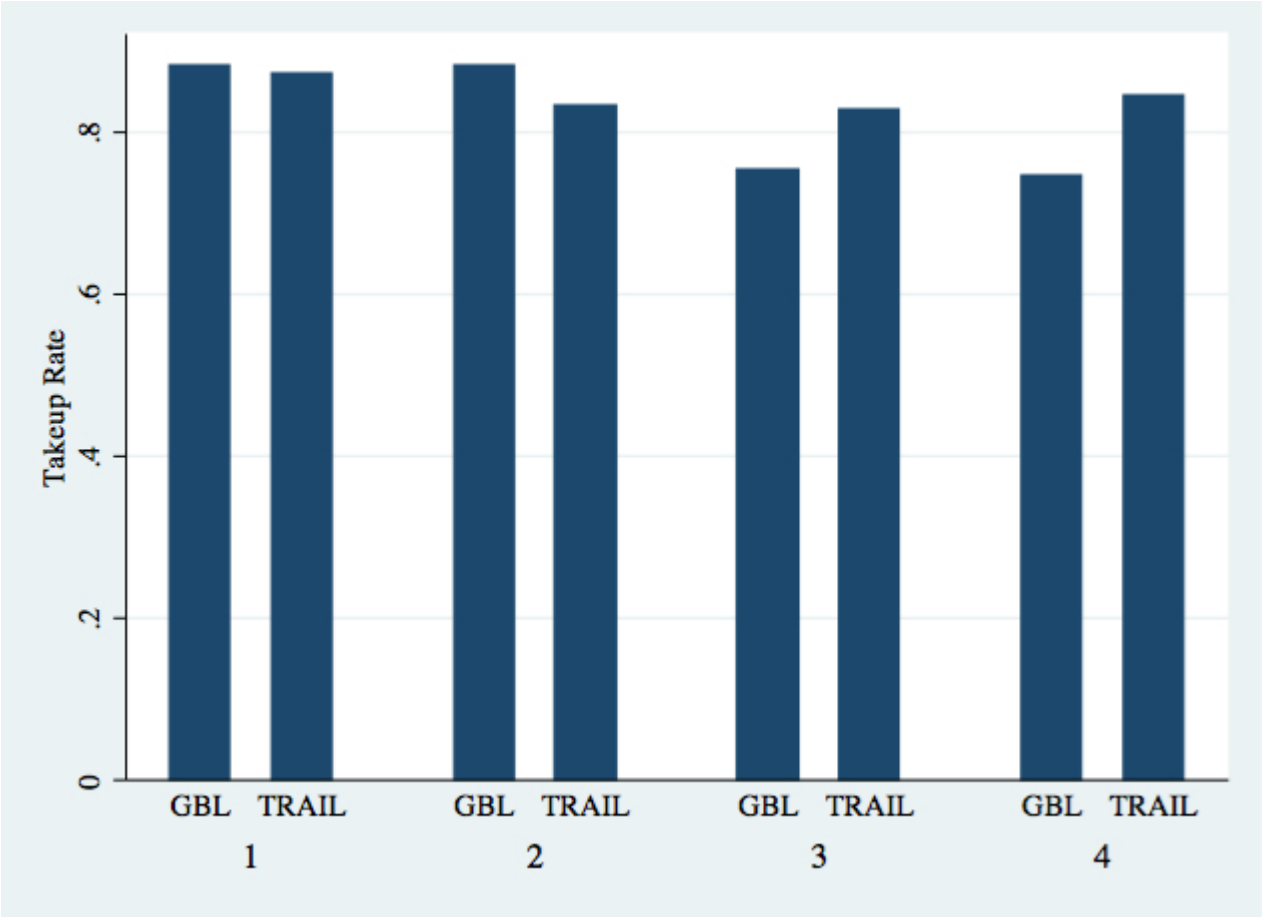
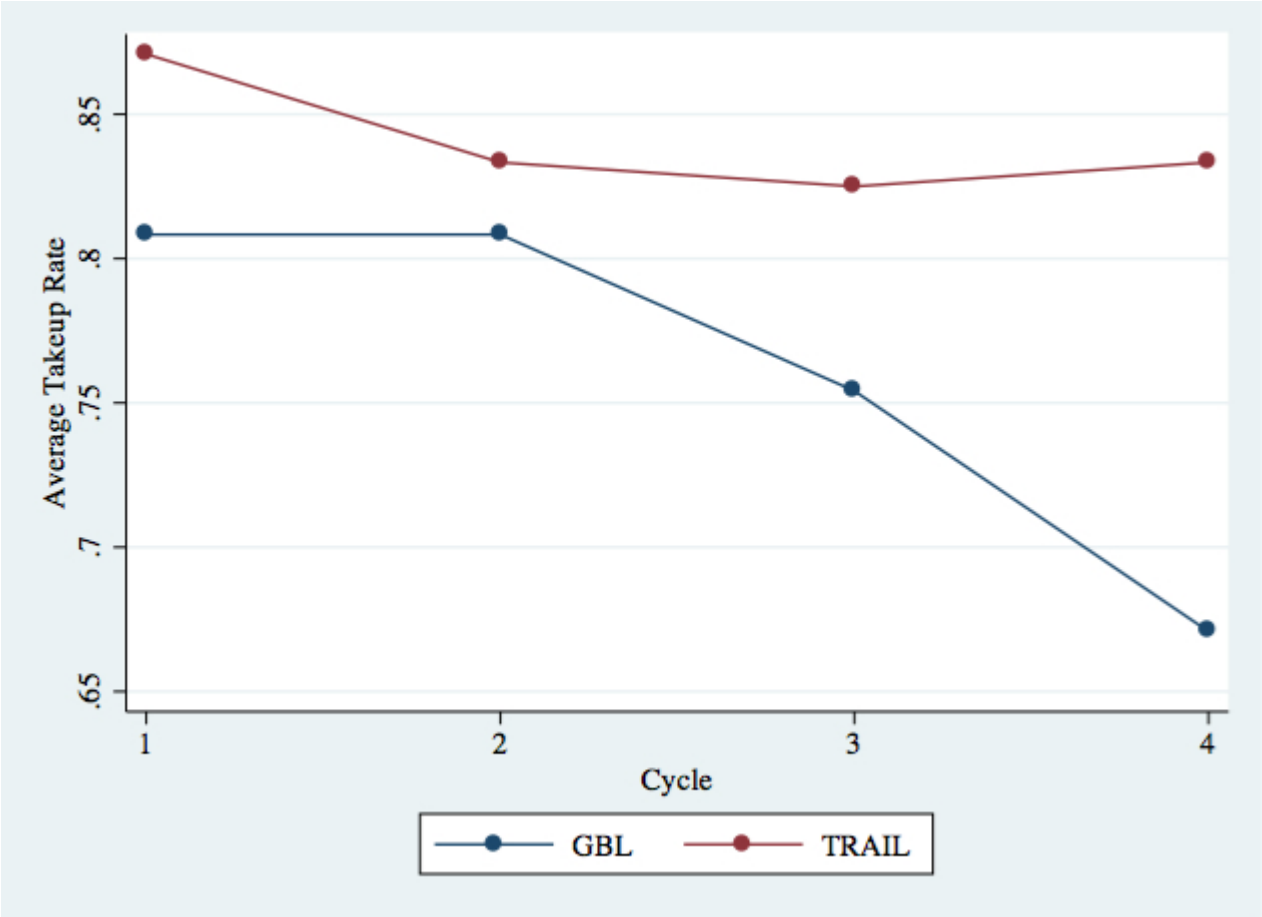


Figure 7: Takeup and Continuation over Cycles



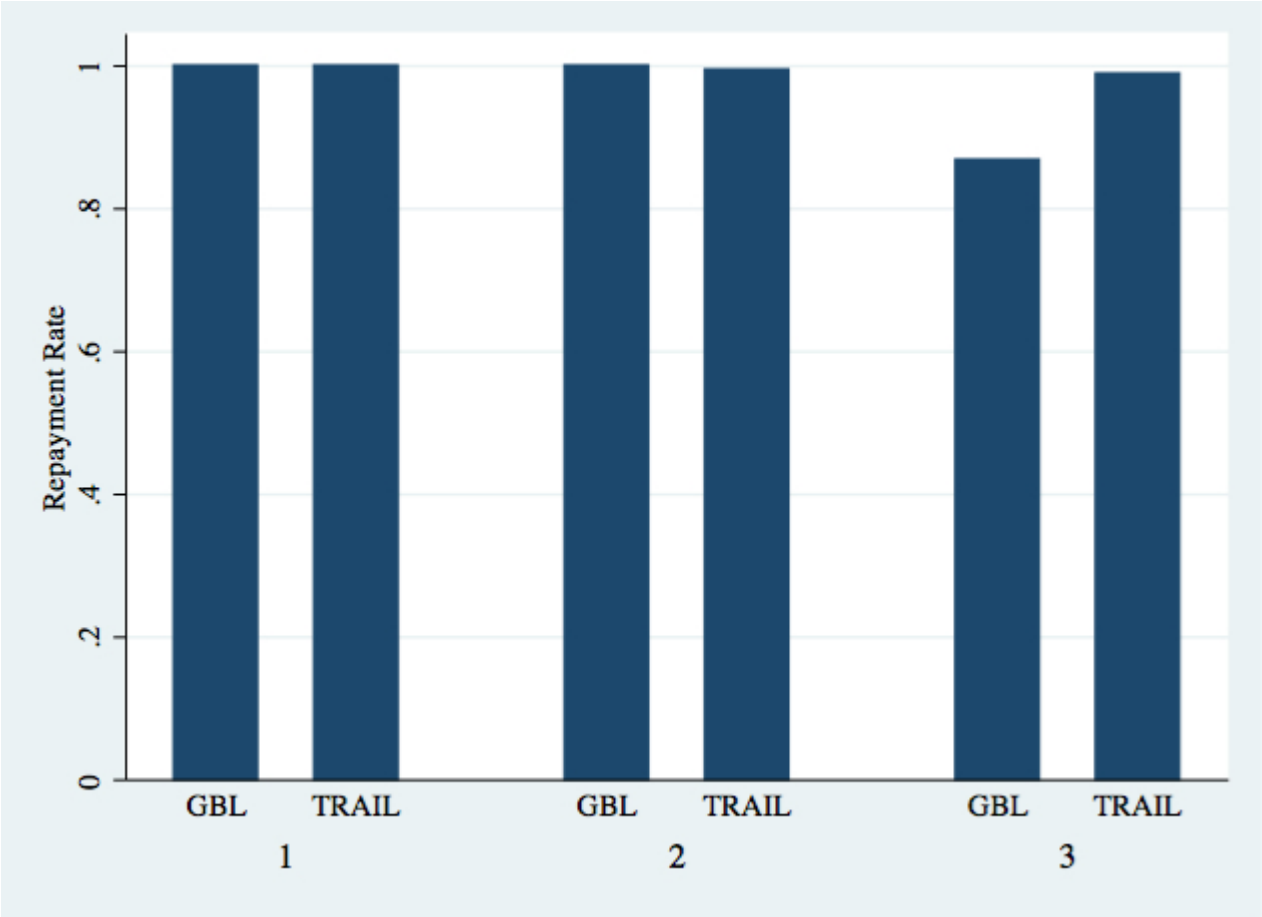
Takeup conditional on being eligible

Figure 8: Takeup rate as a Proportion of Maximum Eligible



Maximum number eligible in each village is 10

Figure 9: Repayment over Cycles



Repayment conditional on being eligible and continuation