Intermediated Loans: A New Approach to Microfinance*

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Abstract

This paper studies a variation on traditional microfinance, where a microfinance institution appoints local intermediaries (traders, lenders or local government representatives) to help select borrowers eligible for individual liability loans. The loans are of longer duration (4 month repayment cycles) compared to standard microfinance loans and are designed to help finance agricultural working capital needs. There is no peer monitoring and it avoids costly weekly meetings or savings requirements. Repayment incentives are provided by linking eligibility to future loans on a larger scale to current loan repayments. Loan intermediaries are incentivized via commissions based on loan repayments. We report from results of a randomized evaluation with two versions of intermediated lending that vary with respect to the agent appointed as the intermediary. In TRAIL a local trader/lender is appointed as a loan intermediary while in GRAIL the local government is requested to appoint the intermediary. The evaluation is conducted in 72 villages in West Bengal, India, with group-based joint liability loans (GBL) serving as a control group. This paper reports on patterns of selection of clients, loan takeup rates and repayment rates in the first year. TRAIL was effective in inducing agents to recommend safe borrowers from their own clientele. and also achieved the highest repayment rates (exceeding 95%, significantly higher than under GBL). All three approaches experienced similar takeup rates (exceeding 80%). TRAIL and GRAIL agents tended to exhibit a bias in favor of borrowers with intermediate landholdings, those with whom they have extensive past dealings and those with similar occupation, caste and religion. GBL in contrast was biased in favor of landless households, and did not exhibit any biases based on occupation, caste and religion. We develop and test a theoretical model in order to interpret these results. Relative impacts on borrower cultivation, incomes and assets is deferred to subsequent papers since the experiment is still ongoing.

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

JEL Classification Codes: D82, O16

1 Introduction

Over the last two decades microfinance has been viewed as a panacea for all ills faced by credit markets in developing countries around the world. The work-horse microcredit model (described in the literature as the Grameen I model) involves 12-month loans offered to groups of five poor women. Repayment terms and requirements are rigidly enforced through a process of dynamic incentives, joint liability and peer monitoring. However despite the rapid growth in outreach, financial inclusion is far from universal and a large proportion of the world's poor are effectively excluded from the credit market. In particular, microfinance has not succeeded in financing agriculture owing to the rigid repayment schedules and lack of tolerance for risk-taking. Banerjee and Duflo (2011) in their book *Poor Economics* argue that the recent microfinance crisis in India owed partly to limited scope for flexibility MFIs can afford with respect to repayments. Karlan and Mullainathan (2010) argue that one explanation as to why MFIs are yet to reach a large proportion of poor may be because of the fact that microfinance practitioners have been slow to implement innovations to the standard lending methodologies. How important is the rigidity in repayment schedule (and hence on project choice)? Economic theory suggests that a more flexible repayment schedule would benefit clients and potentially improve their repayment capacity; but MFIs argue that the fiscal discipline imposed by frequent repayment is critical to preventing loan default. Evidence on this is mixed. Field and Pande (2008) find that there is no significant effect of type of repayment schedule on client delinquency or default. 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.

In recent years, there appears to be a trend in microfinance to move beyond group lending and back to individual lending. For example the Grameen Bank in its Grameen II model, Asa, BancoSol, all have adopted models of individual liability lending. The literature cites a number of different reasons for this: restrictions on project choice; free riding within groups; contagious defaults; and harmful effects on social capital. Given this background, it is important to systematically compare models of individual and joint liability lending. Some recent studies have reported on results of such experiments, and the evidence is quite mixed. Giné and Karlan (2010) show that moving from joint liability contracts to individual liability contracts (or offering individual liability contracts from scratch) had no effect on repayment. Attanasio, Augsburg, Haas, Fitzsimons, and Harmgart (2011) on the other hand find that joint liability contracts have stronger effects on food consumption and entrepreneurship (they attribute this to the disciplining effect of joint liability contracts). However it is crucial to note that most of these individual liability loans were backed by collateral, contrary to the original microfinance objective of lending without collateral.

Additionally evidence on the impact of microfinance, from both observational and experimental studies suggest that while it true that access to microfinance has to some extent improved lives, the estimated impacts appear to be quite small and heterogeneous.[1] It is however not clear as to whether this is because of the restrictions on project choice imposed by rigid repayment schedules (loan features) or because of the problems associated with joint liability (monitoring and administration). In field visits we conducted in West Bengal all these limitations were frequently mentioned by households and farmers that we interviewed. Other problems they mentioned included problems in attending weekly meetings and achieving savings targets mandated by microfinance institutions.

The question now is, can a *better* model of microfinance be designed that will address these problems? Specifically, is it possible to design a more flexible system of microfinance that targets smallholder agriculture, without requiring collateral and without endangering financial sustainability? Ideally it 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. Is it possible to do all of these and still ensure high repayment rates? Designing such a model that functions is not easy because crucial issues like borrower selection and repayment incentives have to be addressed.

One possible solution is to draw upon one of the key premises of microfinance: harness local information and social capital. If there are individuals within the local community with information concerning creditworthiness of borrowers and with some ability to impose sanctions on non-performers, economic theory provides a potential answer. These individuals could be appointed as loan intermediaries. A large theoretical literature on hierarchical contracting networks in procurement, marketing and internal organization of firms has developed models in which middlemen or managers play exactly this kind of role (Melumad, Mookherjee, and Reichelstein, 1995; Laffont and Martimort, 1998, 2000; Faure-Grimaud, Laffont, and Martimort, 2003; Mookherjee and Tsumagari, 2004; Celik, 2009; Motta, 2011). Appointing informed third parties as intermediaries is typically found to be beneficial for a principal in dealing with adverse selection and moral hazard problems, even in the presence of collusion between intermediaries and the agents they supervise. It seems appropriate therefore to consider a similar approach for microfinance.

These considerations motivated us to design and experimentally implement and evaluate an approach which we call *Agent Intermediated Lending* or AIL. The experiments are conducted in 72 villages in West Bengal, India. In this approach, the MFI selects an

[1] See Pitt and Khandker (1998), Holvoet (2004), Schuler, Hashemi, and Riley (1997), Buttenheim (2006), Desai and Tarozzi (2011), Gertler, Levine, and Moretti (2009), Islam and Maitra (2012) and Kaboski and Townsend (2011) among others for evidence using observational data and Banerjee, Duflo, Glennerster, and Kinnan (2011), Crépon, Devoto, Duflo, and Parienté (2011), Desai, Johnson, and Tarozzi (2011), Karlan and Zinman (2011) and Augsburg, Haas, Harmgart, and Meghir (2011) for evidence using experimental data.

intermediary (or a loan agent) in a village, from those with familiarity with individual households. This agent is asked to recommend borrowers who would be entitled to receive individual liability loans with no peer-selection or peer-monitoring. The agents receive commissions based on loan repayments. Eligibility for these loans is resticted to landless and small/marginal landowners (owning less than 1.5 acres of land). The interest rate is set at 18% per annum, below average rates in the informal market (which vary considerably across the different landowning sizes, with an average of around 22%). The loans involve several dynamic features to encourage borrower repayment incentives: future eligibility for loans is linked to repayment of current loans, and loan sizes grow progressively with successful repayment. The loans are designed to finance cultivation and marketing of potatoes. Repayments are due in 4 months, as the length of the potato production cycle is approximately ten weeks. Borrowers can repay in the form of potato cold store receipts at harvest time, so they do not have to sell the crop at that time in order to repay the loans. An insurance aspect is included in the loan: repayment obligations are reduced following adverse village level covariate shocks to crop yields or revenues (which are verified by post-harvest surveys). Some additional features reduce transactions costs for borrowers: loans are made directly by the MFI, with MFI officials visiting each borrower in their homes. Borrowers do not have to open bank accounts, with all transactions taking place at their door-step. There are no savings requirements or mandated meetings with agents or MFI officials. The administrative costs of AIL are substantially lower owing to the elimination of these requirements, since MFIs do not have to hire officials who conduct weekly meetings and collect savings deposits from borrowers.

From a policy perspective the AIL approach resembles the recent policy recommendation by the Reserve Bank of India to set up a network of banking correspondents (BCs) and banking facilitators (BFs) in order to expand financial services to rural areas, remote locations and uncovered households. The agents in our framework could be viewed as BF's: they can refer clients, pursue the clients proposal and facilitate the bank to carry out its transactions, however the final decision on whether to actually provide the loan to the recommended household rests with the actual lender.[2] 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).

How to appoint the loan intermediary agent is an important question, since the selection process is likely to be very different depending on who the agent is. Policy makers are rightly concerned with the power and influence these agents or intermediaries are likely to wield and the consequences of the abuse of such power. In our experiment we consider two categories of potential agents: traders (TRAIL), and those recommended by the local

[2]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 on BCs and BFs.

government or village council/gram panchayat (GRAIL). The two types of agents have very different kinds of links with potential borrowers: the former mainly economic links, while the latter have social and political links.

The success or otherwise of the AIL program will crucially depend on the agent recommending good clients. So the obvious question is: what are the agent's incentives to recommend good clients? This is the question we address in this paper. In the case of TRAIL in particular, the agent is likely to have trading relations with the potential borrower - the agent may be lending to the clients at a profit, which would be foregone as the client switches to MFI loans. There are therefore incentives for the agent to recommend their worst clients and try to recoup lost profits from clients by manipulating other contractual relationships. There are many additional concerns. Would the repayment incentives of the borrowers be high enough despite the dynamic structure? Could there be collusion between the agent and the borrowers, which might generate perverse selection incentives and enable agents to extract advantages intended for the borrowers? In the case of GRAIL the agent is recommended by the village council. Such an agent might utilise this as a way of extending political patronage by the incumbent party, thereby reducing the extent of political competition it is exposed to. Alternatively the agent might view this program as an extension of the government anti-poverty programs and select/recommend households on the basis of need alone and not take ability to repay into account. Ultimately all of these are empirical questions that can be addressed by examining the evidence of how well these schemes work in practice.

We have therefore designed and implemented an intermediated loan system in a field experiment, with group-based lending as a control. We compare targeting (selection), takeup, repayment rates and impacts on borrowers. We build a theoretical model that addresses some of these issues relating to incentives and use the model to interpret the results. The model extends the well-known Ghatak (2000) model of a credit market with adverse selection to explain the value of peer monitoring induced by joint liability loans. We extend it to incorporate an informal credit market with segmentation, where lenders in particular segments have a monopoly over information about risk types of borrowers in those segments as a result of past experience from lending to them. These lenders can extract the surplus from safe borrowers in their own segments, while all lenders in the village compete for lending to risky types. We also extend Ghatak's model to incorporate a second dimension of heterogeneity: the level of landholding of borrowers which are publicly observable. This enables us to examine targeting patterns across different landholding levels under AIL and GBL, and test the predictions of our model.

Our model predicts that TRAIL is effective in inducing agents to selecting low risk borrowers from their clientele if they do not collude with the borrowers and the commission they receive is sufficiently high. if agents will are motivated to select safe clients (and consequently there is no collusion between the clients and the agent). However they also

exhibit a bias in favor of recommending clients paying the lowest interest rate in the informal market, who tend to be those with intermediate level of landholding. In contrast GBL tends to be biased in favor of clients that pay the highest interest rates in the informal credit market, who tend to have the lowest landholdings. In that sense TRAIL is less successful in targeting the poorest borrowers. The model thus predicts that provided agents are suitably incentivized, TRAIL achieves higher repayment rates. Finally, TRAIL loans experience higher takeup (controlling for landholding) as these clients do not have to bear the burden of making up for the repayment burdens of their group members if the latter default. Nor do they have to incur the costs of attending group meetings, achieving savings targets, or all the problems of free-riding and social tensions that GBL generate.

Empirically we find that TRAIL was effective in selecting safe types and in encouraging agents to recommend their own clients or those that they have better information about (through past interactions and/or caste religion networks). Interestingly unlike the theoretical predictions, more risky households are excluded from groups: there is evidence of positive assortative matching in group formation as safe households self select into groups and the more risky households borrow from the informal market at higher interest rates. However despite the fact that TRAIL and GBL are roughly similar in terms of selection, TRAIL achieves significantly higher repayment rates than GBL. While the experiment is still ongoing, TRAIL has achieved a repayment rate above 95% while GBL has achieved a rate of about 85% at the end of one year and three successive loan cycles. Selection across landholding levels resembled the theoretical predictions: GBL exhibited a greater bias in favor of the poorest clients (landless households), whereas TRAIL exhibited a greater bias for households owning between 0.5 to 1 acre. Takeup rates are slightly higher in TRAIL than GBL but the difference is not significant; and in both cases they are above 80%.

These early results are encouraging: the schemes are working well in the sense of achieving high takeup and repayment rates, in a manner consistent with theoretical expectations. The agents appointed as intermediaries do seem to have been incentivized by the commissions to select safe types from among their clientele and the evidence does not suggest collusive behavior. Nevertheless what should really matter is the impact of these loans on agricultural operations, and on the incomes earned by the borrowers. For that we need to wait for the experiment to run its full course. We therefore defer the analysis of borrower impacts to subsequent papers.

2 Design

We conduct a randomized intervention in 72 villages in 2 districts (Hugli and West Medinipur) of West Bengal in India. The intervention, which is being conducted in association with Shree Sanchari (henceforth SS), a Kolkata based MFI, started in October 2010 and is

expected to continue until at least December 2012.[3] The main credit intervention involves providing agricultural loans, with repayment due in 4 months (120 days). Starting amount of loans (in Cycle 1) was Rs 2000 but the loan amount increases with timely repayment. Specifically the repayment amount (in each cycle) is 1.06 $\times$ Outstanding loan. If the amount due if fully repaid at the end of any cycle, loan offer in next cycle is 133% of that 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 only 133% of the amount repaid. Cycle 1 started in October-November 2010, coinciding with planting of potato (the major cash crop in this area).[4] Borrowers are allowed to repay the loan in the form of potato bonds rather than cash. 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.

We conduct 3 treatments

TRAIL: Agent Intermediated Lending - agent is a trader

GRAIL: Agent Intermediated Lending - agent is recommended/selected by Gram Panchayat or Village Council

GBL: Group Based Lending (almost microfinance as usual)

Each treatment was conducted in 24 villages (treatments were randomly allocated to the villages). We come back to the issue of sampling below.

TRAIL and GRAIL involved an agent. One agent was chosen in each village. In TRAIL villages, SS employed a trader based in the local community as the agent. There were restrictions on who could serve as an agent. Specifically traders who have at least 50 clients in the village, and/or have been operating in the village for at least 3 years were given the first priority. Traders who have fewer than 50 clients or have been working in the village for fewer than 3 years were given the second priority and finally if an agent could not be obtained from either the first or the second category of traders, others who come forward to participate as agents (they were given third priority). SS (in conjuction with village elders) created a list of traders and randomly selected from this list. They approached the first randomly chosen trader from this list and offered him the contract. If

[3]Kolkata is the capital of the state of West Bengal and is one of the largest cities in India.

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

this trader refused to serve as an agent, SS would go back to the list and randomly choose a second trader and approach him. In practice the first trader who was approached always accepted the contract. In GRAIL villages, SS asked a member of the Gram Panchayat (village council) to make an informal recommendation as to who could serve as an agent. The recommended individual needed to satisfy the following criteria: must have lived in the village for at least 3 years; must have some personal familiarity with small farmers in the village; and finally should be reputed to be a responsible person. The agent was required to recommend names of 30 potential borrowers/households in the entire village. All recommended borrowers must be residents of the village and must own less than 1.5 acres of agricultural land. Landless households may be recommended. 10 out of these 30 recommended were randomly chosen and offered individual liability, 4-month (120 days), low interest loan from SS.

What are the agent incentives? Part of the incentives is monetary. First, they would receive a commission. 75% of all interest payment received would accrue to the agent as commission. So 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 will be required to deposit Rs 50 per borrower with SS. This deposit must be received by SS at the time the loans are sanctioned. The bonus is calculated as follows: if the borrower repays $x\%$ of the loan, then the bonus equals $x\%$ of the deposit. (For example, if the borrower repays half of the loan, and the deposit is Rs 500, then the bonus is half of Rs. 500 = Rs. 250). The original deposit will be returned to the agent at the end of 2 years (at the end of the 6^{th} cycle), provided the agent has not been terminated from the scheme. The actual program can however continue even beyond the 2 years. Finally agents (in conversations during field visits) noted that they expected to increase their visibility within the village community and hence experience an increase in market share. The other part of the incentives is non-monetary. First, at the end of 2 years the program will offer the agent and his/her family (up to 4 members) a special holiday package in Puri or Digha (sea-side resorts near Kolkata), provided he has participated until the very end. Second, several agents view this activity as contributing towards an increase in their long term reputation within the community and a boost to their ego. Finally GRAIL agents might be politically motivated and might view this as an extension of the government anti-poverty programs and use this to increase the political dominance of the party in power within the village.

The two agent intermediated lending (AIL) treatments are compared to a Group Based lending (GBL) model which uses the standard lending protocol used by SS (and indeed almost all of the microfinance organizations in India): groups of size 5, joint liability and initial savings requirement with one variation: repayment is due after 120 days and not a fortnight after loans disbursed. This essentially implies that unlike in the traditional model, the borrowers are able to invest in projects with a longer gestational period and

more importantly in agriculture, should they wish. Of the groups that were formed and survived until the cut-off date of October 15, 2010, 2 were randomly selected via public lottery. Members of the selected groups receive a total of Rs 10,000, which is divided (typically equally) among the group members. They are joint liability loans of 4-month duration, have similar dynamic lending criteria and have the same loan cycles as the agent intermediated loans.

Naturally the mix of borrowers and possibly outcomes in TRAIL and GRAIL are going to be quite different from those in the GBL treatments because of the fact the TRAIL and GRAIL borrowers come recommended and also they receive individual liability loans as opposed to the GBL borrowers who form the groups (voluntarily) and receive joint liability loans. Indeed one would also expect the selection/recommendation and outcomes to vary between the TRAIL and GRAIL treatments given that the agents are quite different. Table 2 presents differences in the characteristics of the TRAIL and GRAIL agents. The biggest difference is in terms of the primary occupation of the agent: in TRAIL the primary occupation of nearly 96% of the agents is trade/business, while it is so for only 16.67% of the agents in GRAIL. In GRAIL most agents are cultivators. Additionally TRAIL agents are less likely to be Muslims or belong to lower castes (scheduled caste, scheduled tribe or other backward caste).

3 Data and Descriptive Statistics

We conduct an extensive household level survey of 50 households in each of the 72 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 7 surveys over the period 2010 - 2012 (matching the credit cycles). *Treatment* households are recommended households that receive loan (in TRAIL/GRAIL) 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 loan (in TRAIL/GRAIL) or members of groups that did not receive loans (in GBL). In each village we also surveyed 30 households as additional control. These are the *Control 2* households. Table 3 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 (TRAIL, GRAIL or GBL) and we refer to villages that receive the TRAIL/GRAIL/GBL treatment as TRAIL/GRAIL/GBL.

Villages were randomly allocated to the treatment. Table 4 shows that 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 three treatment groups: the pairwise differences, TRAIL − GRAIL, TRAIL − GBL and GRAIL − GBL,

are never statistically significant.

Table 5 presents the means (and standard deviations) of selected household characteristics in the TRAIL, GRAIL and GBL villages. We also present the t-tests for pairwise differences (TRAIL − GRAIL, TRAIL − GBL and GRAIL − GBL). There are significant differences across the three treatments - not surprising since the selection process is very different across the three treatments. There are fewer differences when we restrict ourselves to the non-recommended households (see Table 6), but even here treatment differences persist (non-recommended households are negatively selected). That the non-recommended households are different from the recommended households is made clear from the difference in means between recommended and non-recommended households presented in Table 7.

The majority of loans are from traders (see Figure 1) - 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 rate varies from almost 34% per annum for borrowing from the money lender to 10.5% per annum for borrowing from the bank. Also interesting is 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 on the assumptions that we make in the model (in Section 4). First Figure 2 presents the predicted value of interest rate in the informal market on landholding and shows that there a u-shaped relationship between interest rate in the informal market and landholding. Second, this u-shaped relationship requires that project returns are convex in the level of landholding. Table 8 presents evidence in support of this. Project returns (here defined as crop profit from potato cultivation) is indeed convex in the amount of landholding. This effect persists even when we control for the variety of potato cultivated (Model (2)).

4 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.[5] 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.[6] 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.[7]

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' participation 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

[5] 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.

[6] 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)

[7] 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.

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.

Condition 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.[8]

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 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.*

[8]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.

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 according as $R_i'(a)$ 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 8, the evidence does support this assumption. The model thus provides an explanation of the observed u-shape of the interest rate.

Since $R_i(a)$ is convex in a (see Table 8, the interest rate for safe types could exhibit a u-shape. This possibility is illustrated in Figure 3.

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).

4.1 Implications of Joint Liability Microfinance Loans

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.[9] 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. 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

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

[9] 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 $\mathcal{F}^{JL} = \{(r, c) : r(a) = c(a) \geq 0\}$.

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):

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

4.2 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. 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 $Kp_sr_T + \rho_I - p_sr_T = \rho_I - (1-K)p_sr_T$ by recommending the own-segment safe borrower. Analogously the gain from recommending an own-segment risky type is $\rho - (1-K)p_rr_T$. These are the saving of the lender's cost of capital ρ_I as the borrower switches to borrowing from the MFI, less the net expected repayment $(1-K)p_ir_T$ 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 attract 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.

4.3 Summary of Theoretical Predictions: TRAIL versus GBL

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, then the agent recommends more risky clients (from other segments).

This indicates a way of empirically testing whether TRAIL is effective: check whether average interest rate paid by the *Control 1* households (those who were recommended by the agent but did not receive credit under the scheme) is systematically lower compared to that faced by the *Control 2* households, who were not recommended by the agent.[10] Additionally check whether the agent exhibits a bias in favor of recommending clients on whom he has more information, either through prior interaction or through common caste and religion networks.

Assuming that this test for effectiveness is passed. Then we expect the following differences between TRAIL and GBL:

Targeting: TRAIL selection will be biased in favor of 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, which is true). 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).

[10]The correct comparison group within the set of *Control 2* households should be those households that do not borrow from families and friends and do not borrow at very low interest rates (the super-safe borrowers). TRAIL agents possibly have no incentive to recommend these super-safe borrowers.

Takeup: Controlling for landholding, takeup rates should be higher under TRAIL, since TRAIL clients incur a lower repayment burden and avoid the cost of attending meetings and achieving savings targets.

Repayment: TRAIL should achieve higher repayment rates than GBL.

4.4 Differences between GRAIL and TRAIL

Under GRAIL, the agent has some information regarding the type of the borrowers in her segment, but is unlikely to interact with them in the informal credit market. The definition of the segment in GRAIL is different in that it represents the agent's social network and not his business clientele. GRAIL agents are primarily cultivators so they would be likely to recommend other cultivators. Moreover, the GRAIL agent is likely to have lower quality information with respect to the risk types of borrowers compared with the TRAIL agent.

With regard to preferences, GRAIL agents are likely to share with TRAIL agents the objective of achieving a higher repayment rate, partly because they earn the corresponding commissions. Also they might perceive the success of the scheme as enhancing their social prestige within the village, and making the MFI more willing to expand the scheme which gives them an opportunity to extend their patronage to others in the village.

On the other hand, the GRAIL agents are unlikely to have a bias towards clients paying lower interest rates, if they themselves do not lend to the clients. They wouldn't worry as TRAIL agents do about losing clients.

GRAIL agents may also be politically motivated, and so seek to favor specific groups in the village who would be most likely to be induced to vote for the incumbent party in return for being recommended for the loan. One would expect this to bias them in favor of poorer farmers who would value the loans more. But if the poor are likely to be voting for the incumbent anyway, they may be inclined to target 'swing' voters who might be wealthier. It is therefore difficult to assess which landholdings they are likely to favor on these grounds.

In summary, we expect poorer targeting with respect to risk type in GRAIL compared with TRAIL, and correspondingly lower repayment rates. Predicting targeting by landholding is difficult. takeup rates in GRAIL should be similar to TRAIL (controlling for selection) since once the borrowers have been selected all the advantages of AIL over GBL loans for them come into play.

5 Results

Are the predictions regarding selection, takeup and repayment validated empirically? To do that we examine the evidence on selection/recommendation of clients and on takeup/continuation and repayment over the first year of this ongoing project. In the following discussion we focus primarily on differences between TRAIL and GBL, with analogous results for GRAIL noted in passing when the empirical results are reviewed. In our 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 of the type of the borrower and will use this information to recommend safe borrowers. The interest rate paid on informal loans is viewed as a measure of the innate riskiness of the household. If TRAIL is effective, then the agent will recommend own segment safe types. Whether this is indeed the case can be examined by comparing the interest rate on informal loans paid by *Control 1* households to those paid by (a restricted set of) *Control 2* households. If TRAIL is effective, then the interest rate paid by *Control 1* households should be lower than that paid by *Control 2* households. This is true irrespective of the level of landholding (see Panel A, Figure 5). This is further supported by the regression results presented in column 1 in Table 9, which shows that even after controlling for landholding, *Control 1* households pay a significantly lower interest rate on informal loans compared to the (restricted set of) *Control 2* households.

As a further test of TRAIL effectiveness we examine whether the agents exhibit a bias towards clients with whom he has had prior interactions and belong to the same caste/religion network. Evidence presented in column 1 of Table 10 indeed supports the argument that TRAIL agents are biased towards households on whom they are likely to have more information: they are more likely to recommend households who have previously purchased from them or borrowed from them. Additionally TRAIL agents are significantly less likely to recommend households from outside their religion and caste network: Hindu agents are significantly less likely to recommend non-Hindu households; high caste agents are less likely to recommend lower caste (SC) households, though this effect is not statistically significant. TRAIL agents (the large majority of whom report Business to be their primary occupation - see Table 2) exhibit a slight bias in favour of households where the primary occupation is labour.

Targeting by Landholding: Selection/Recommendation

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 conducted 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 three 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 selection will be biased in favor of 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). In contrast GBL selection will be biased in favor of landholdings exhibiting the highest average informal interest rate (i.e., the landless households). As we have argued, in the case of GRAIL however predicting targeting by landholding is difficult.

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 AIL (both TRAIL and GRAIL) and landholding, with the likelihood of being recommended highest in the intermediate landholding range. The peak of the recommendation plot is attained at a higher level of landholding in the case of GRAIL. 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 10. 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; the corresponding probability of being recommended by a GRAIL agent is the highest for households owning around 0.64 acres of land. In an alternate specification we included a landless household dummy (as opposed to continuous landholding and landholding squared). The landless dummy was not significant in the recommendation regressions for TRAIL and GRAIL, but landless households are significantly more likely to select themselves into groups under GBL.

There is also evidence of biases in favor of recommending borrowers from the same religion, caste and occupation groups in TRAIL and GRAIL. This has already been reported in the test for TRAIL effectiveness (above). Hindu TRAIL agents were significantly less likely to recommend a non-Hindu household. On the other hand GRAIL agents who are cultivators were significantly more likely to recommend households where the primary occupation of the household head is cultivation. In the case of TRAIL agents who are businessmen exhibited a slight bias in favor of 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. These effects were generally stronger in the case of TRAIL.

The patterns of group formation under GBL reveal an interesting pattern. Remember *Control 1* households in GBL villages are those who select themselves into groups but do not receive the SS loan. So the interest rate paid on informal loans by *Control 1* households is a measure of the riskiness of the group members. While theoretically it is possible for groups to comprise of both risky and safe types (and this, we argue contributes to a lower repayment rate in GBL), we see that *Control 1* households in TRAIL and GBL pay very similar interest rates on informal loans. This appears to suggest that there is assortative matching type in groups (as in Ghatak, 2000): risky households are excluded from groups; safe households self select into GBL and risky households borrow from the informal market at higher interest rates. See Panel B in Figure 5 and further support from the regression results presented in column 2 in Table 9.

Takeup

Controlling for landholding, takeup rates should be higher under TRAIL, since TRAIL clients incur a lower repayment burden and avoid the cost of attending meetings and achieving savings targets. On the other hand there is unlikely to be any difference between TRAIL and GRAIL in terms of takeup rates. Figure 7 presents the takeup rate in Cycle 1 and the likelihood of continuation in subsequent cycles (this of course depends on repayment in the previous cycle and the willingness to re-borrow). The takeup rate in cycle 1 is lower under GBL compared to TRAIL (82% compared to 87% in TRAIL) though the difference is not statistically significant ($p - value = 0.12$). While across the different cycles the likelihood of continuation is higher in TRAIL compared to GBL, the difference between the two actually becomes smaller. It also worth noting that the takeup rate in both GBL and TRAIL remain quite stable across the first four cycles.

Table 11 presents the marginal effects from probit regressions for loan takeup in Cycle 1. While takeup rate is higher in TRAIL compared to GBL, the difference is not statistically significant. The takeup rate is significantly lower in Hugli (driven by TRAIL/GRAIL).

This last result is interesting as it corroborates the anecdotal evidence obtained from field visits that suggest 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. Table 12 presents the marginal effects from the probit regressions for continuing to borrow in Cycles 2 (column 2), 3 (column 3) and 4 (column 4), conditional on eligibility. For comparison purposes we also include the results from takeup in cycle 1. Both the takeup and continuation probabilities are lower in Hugli compared to West Medinipur and this difference becomes stronger over cycles. The likelihood of takeup is 12, 15, 17 and 18 percentage points lower in Cycle 1, 2, 3 and 4 respectively. The takeup rate is always higher in TRAIL compared to GBL but the difference is never statistically significant. Takeup/continuation rates in GRAIL are very similar to those in GBL. Landholding has no effect on takeup/continuation rate in any cycle.

Repayment Patterns

The theoretical model predicts that if TRAIL is effective:

1. TRAIL should achieve higher repayment rates compared to GBL.
2. TRAIL should achieve higher repayment rates compared to GRAIL.

Figure 8 and Table 13 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%, though all loans were been fully repaid at the end of Cycles 1 and 2. The average repayment rate after one year is around 94% across all treatments, though there is a fair amount of variation: ranging from 87% in GBL to 99% in TRAIL, with GRAIL in between (96%). The marginal effects from the probit regression on repayment in Cycle 3 essentially tells the same story. Repayment rates in TRAIL are significantly higher compared to both GRAIL and GBL, The evidence is thus consistent with the theoretical prediction. Treatment differences become statistically significant at the end of the first year. Again landholding has no effect on repayment rate.

6 Discussion

The primary aim of this paper can be summarized as follows: Is it possible to design a more 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 intermediated loan (AIL) system in a field experiment, with group-based lending (GBL) as a control. We compare targeting (selection), takeup, repayment rates and impacts on borrowers. We build a theoretical model that addresses some of these issues relating to incentives 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 those segments as a result of past experience from interacting with them and allow the borrowers to be heterogenous in terms of landholding (an observable). This enables us to examine targeting patterns across different landholding levels under AIL 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; repayment rates are higher in TRAIL as are takeup rates, though the differences are not statistically significant in this case. Additionally we find that the agent intermediated lending models (both TRAIL and GRAIL) are *working well* at least in terms of the conventional MFI metrics of takeup and repayment rates. If anything they are doing better than GBL. Comparing TRAIL and GBL in terms of targeting is hard, because GBL is more pro-poor (more likely to select landless households) but TRAIL and GBL both appear to be able to target safe borrowers.

One implication of this assortative matching on types in GBL is that it is not the presence of risky households in the groups that contributes to lower repayment rates in GBL (Table 13). We therefore need to look at alternative explanations to explain the lower repayment rates in GBL. Possibly the explanations lie in how the TRAIL and GBL households use credit, which is an issue of some importance since the GBL households appear to be poorer and more disadvantaged compared to the TRAIL households. Alternatively the excessive monitoring by peers and the inflexibility of MFIs can be contributing to lower repayment rates in GBL. At this stage we do not have an answer to this question. Interestingly GRAIL agents tend to select clients with even higher landholdings than TRAIL, and as expected achieves intermediate repayment and takeup rates.

The process of targeting differed substantially between different treatments. GBL is the most pro-poor, with landless households most likely to form groups and avail of credit. Under AIL, 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. While the information set of GRAIL agents are likely to be more diffused, they also do not appear to use their information as effectively

for targeting purposes. 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 AIL could be offered at the same time, with poorest (landless, minority caste and religion) households self-selecting into GBL contracts, while small and marginal landowners are more likely to be recommended under AIL.

At this stage it seems premature to comment on broader welfare implications of these different approaches or the policy implications. Impacts of the three different treatments on cultivation, profits, household incomes and assets need to be assessed, which will form the topic of our next 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 $\alpha \in (0,1)$,[11] 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.

[11] 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.

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

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

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)[12] 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 $R_s(a) - \frac{a}{p_s} > \frac{\rho_I}{\overline{p}}$.

[12] 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.

On the other hand, in the non-generic case where $R_s(a) - \frac{a}{p_s} = \frac{\rho_I}{\overline{p}}$, there 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.[13] 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 $b^*(a) = p_r R_r(a) - p_r r_T - a < 0$ 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

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

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

[13] 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 $\overline{u}_s(a) = a$.

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.

■

Table 1: Credit Arm of the Intervention

Cycle	Date of Disbursal	Loan Amount* (Rs)	Duration	Interest Amount (Rs)	Amount to be Repaid (Rs)
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
To continue ...					

* : Conditional on Full Repayment of Earlier Loan

Table 2: Agent Characteristics

	TRAIL	GRAIL
Number	24	24
Average Age	39.71	41.29
Agent Hindu (percent)	91.67	87.5
Agent General Caste (percent)	91.67	83.33
Agent Occupation (percent)		
Cultivator	4.17	66.67
Business	95.83	16.67
Service	0	8.33
Other	0	8.33

Table 3: Sample Sizes in Each Village

TRAIL and GRAIL:	Number of Recommended Households	30
TREATMENT	Households Recommended and Receiving Credit	10
CONTROL1	Households Recommended and Not Receiving Credit	10
CONTROL2	Households Not Recommended	30
GBL:		
TREATMENT	Group survived until lottery and eligible for credit (Sample at group level: 2 groups)	10
CONTROL1	Group survived until lottery but not selected through lottery (Sample at group level: 2 groups)	10
CONTROL2	Random sample of households who did not form group	30

Table 4: Randomization

	TRAIL		GRAIL		GBL		Difference	Difference	Difference
	Mean	SD	Mean	SD	Mean	SD	TRAIL - GRAIL	TRAIL - GBL	GRAIL - GBL
Number of Households	276.04	201.59	252.21	238.36	346.42	374.90	23.83	-70.38	-94.21
Number of Potato Cultivators	164.63	130.30	160.75	168.39	208.29	237.94	3.88	-43.67	-47.54
Total Landless	15.96	18.98	27.96	75.63	12.83	17.00	-12.00	3.13	15.13
Total $0 - 1.25$	113.88	103.22	99.67	78.00	149.96	213.76	14.21	-36.08	-50.29
Total $1.25 - 2.50$	25.58	16.27	24.63	25.20	31.54	21.92	0.96	-5.96	-6.92
Total $2.50 - 5.00$	10.88	7.39	12.83	17.11	11.58	8.65	-1.96	-0.71	1.25
Total $5.00 - 12.50$	1.38	1.79	1.17	1.95	2.38	3.27	0.21	-1.00	-1.21
Total Above 12.50	0.00	0.00	0.04	0.20	0.00	0.00	-0.04	0.00	0.04

Total refers to total number of potato cultivators

Table 5: Descriptive Statistics and Treatment Differences. Household Characteristics

	TRAIL		GRAIL		GBL		Difference	Difference	Difference
	Mean	SD	Mean	SD	Mean	SD	TRAIL - GRAIL	TRAIL - GBL	GRAIL - GBL
Male Head	0.96	0.19	0.95	0.21	0.93	0.25	0.01	0.03 ***	0.02 **
Non Hindu	0.19	0.40	0.15	0.36	0.15	0.35	0.04 ***	0.05 ***	0.01
SC	0.26	0.44	0.23	0.42	0.31	0.46	0.04 **	-0.04 **	-0.08 ***
ST	0.05	0.22	0.05	0.22	0.05	0.21	0.00	0.01	0.01
OBC	0.05	0.22	0.06	0.23	0.07	0.25	-0.01	-0.02	-0.01
Household Size	4.89	2.27	4.95	2.38	5.02	2.34	-0.06	-0.13	-0.07
Age of Household Head	48.07	12.45	48.13	11.98	48.30	13.08	-0.06	-0.23	-0.16
Married Head	0.92	0.28	0.92	0.28	0.91	0.29	0.00	0.01	0.01
Head: More than Primary School	0.49	0.50	0.46	0.50	0.46	0.50	0.03	0.03	0.00
Head: Cultivator	0.49	0.50	0.50	0.50	0.45	0.50	-0.01	0.04 **	0.05 **
Head: Labourer	0.31	0.46	0.29	0.45	0.32	0.47	0.02	-0.01	-0.03
Head: Resident	0.99	0.12	0.98	0.13	0.98	0.15	0.00	0.01	0.01
Landholding	0.75	0.92	0.73	0.95	0.76	1.05	0.02	-0.01	-0.03
Landless	0.18	0.38	0.18	0.38	0.20	0.40	0.00	-0.02	-0.02
Purchased on Credit	0.37	0.48	0.30	0.46	0.38	0.48	0.07 ***	-0.01	-0.08 ***
Bought from Agent	0.36	0.48	0.06	0.23	.	.	0.30 ***		
Borrowed from Agent	0.19	0.39	0.06	0.24	.	.	0.13 ***		
Worked for Agent	0.10	0.30	0.09	0.29	.	.	0.01		
Received GP Benefits	0.59	0.49	0.63	0.48	0.64	0.48	-0.04 *	-0.05 ***	-0.02

$^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$

Table 6: Descriptive Statistics and Treatment Differences in Non-Recommended Households. Household Characteristics

	TRAIL		GRAIL		GBL		Difference	Difference	Difference
	Mean	SD	Mean	SD	Mean	SD	TRAIL - GRAIL	TRAIL - GBL	GRAIL - GBL
Male Head	0.94	0.23	0.94	0.23	0.94	0.24	0.00	0.00	0.00
Non Hindu	0.22	0.41	0.16	0.37	0.16	0.37	0.06 ***	0.05 ***	0.00
SC	0.26	0.44	0.22	0.42	0.28	0.45	0.03	-0.02	-0.05 **
ST	0.05	0.22	0.05	0.22	0.04	0.19	0.00		0.03
OBC	0.05	0.21	0.07	0.25	0.06	0.23	-0.02 *		0.08
Household Size	5.00	2.50	5.03	2.61	5.15	2.58	-0.03	-0.15	-0.12
Age of Household Head	49.93	13.02	49.21	12.69	51.49	12.93	0.72	-1.56 **	-2.29 ***
Married Head	0.90	0.30	0.90	0.31	0.89	0.32	0.00	0.01	0.01
Head: More than Primary School	0.47	0.50	0.47	0.50	0.48	0.50	0.00	-0.01	-0.02
Head: Cultivator	0.50	0.50	0.45	0.50	0.49	0.50	0.04	0.00	-0.04
Head: Labourer	0.26	0.44	0.29	0.45	0.25	0.44	-0.03	0.01	0.04
Head: Resident	0.98	0.12	0.98	0.15	0.98	0.13	0.01	0.00	0.00
Landholding	0.90	1.07	0.84	1.14	0.96	1.24	0.06	-0.06	-0.12 *
Landless	0.18	0.38	0.19	0.39	0.16	0.36	-0.01	0.02	0.03
Purchased on Credit	0.34	0.48	0.26	0.44	0.36	0.48	0.08 ***	-0.02	-0.10 ***
Bought from Agent	0.32	0.47	0.04	0.21	.	.	0.27 ***		
Borrowed from Agent	0.15	0.36	0.04	0.20	.	.	0.11 ***		
Worked for Agent	0.09	0.28	0.08	0.27	.	.	0.01		
Received GP Benefits	0.55	0.50	0.61	0.49	0.61	0.49	-0.06 **	-0.06 **	0.00

$^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$

Table 7: Differences between Recommended and Non-Recommended Households. By Treatment

	Non Recommended (NR)		Recommended (R)		Difference
	Mean	SD	Mean	SD	R - NR
TRAIL					
Male Head	0.94	0.23	0.99	0.11	0.04 ***
Non Hindu	0.22	0.41	0.16	0.37	-0.06 **
SC	0.26	0.44	0.27	0.44	0.01
ST	0.05	0.22	0.05	0.22	0.00
OBC	0.05	0.21	0.06	0.23	0.01
Household Size	5.00	2.50	4.73	1.87	-0.28 **
Age of Household Head	49.93	13.02	45.28	10.97	-4.65 ***
Married Head	0.90	0.30	0.94	0.23	0.05 ***
Head: More than Primary School	0.47	0.50	0.51	0.50	0.04
Head: Cultivator	0.50	0.50	0.49	0.50	-0.01
Head: Labourer	0.26	0.44	0.37	0.48	0.11 ***
Head: Resident	0.98	0.12	0.99	0.12	0.00
Landholding	0.90	1.07	0.52	0.54	-0.38 ***
Landless	0.18	0.38	0.19	0.39	0.01
Purchased on Credit	0.34	0.48	0.40	0.49	0.06 ***
Bought from Agent	0.32	0.47	0.41	0.49	0.10 **
Borrowed from Agent	0.15	0.36	0.25	0.44	0.10 ***
Worked for Agent	0.09	0.28	0.13	0.33	0.04 **
Received GP Benefits	0.55	0.50	0.65	0.48	0.11 ***
GRAIL					
Male Head	0.94	0.23	0.96	0.19	0.02 *
Non Hindu	0.16	0.37	0.15	0.35	-0.01
SC	0.22	0.42	0.24	0.42	0.01
ST	0.05	0.22	0.05	0.23	0.00

Continued ...

Table 7 Continued.

	Non Recommended (NR)		Recommended (R)		Difference
	Mean	SD	Mean	SD	R - NR
OBC	0.07	0.25	0.04	0.20	-0.02 *
Household Size	5.03	2.61	4.83	1.98	-0.21
Age of Household Head	49.20	12.69	46.54	10.64	-2.66 ***
Married Head	0.90	0.31	0.94	0.23	0.05 ***
Head: More than Primary School	0.47	0.50	0.45	0.50	-0.01
Head: Cultivator	0.46	0.50	0.57	0.50	0.11 ***
Head: Labourer	0.29	0.45	0.29	0.45	0.00
Head: Resident	0.98	0.15	0.99	0.09	0.01 *
Landholding	0.84	1.14	0.55	0.51	-0.29 ***
Landless	0.19	0.39	0.16	0.37	-0.03
Purchased on Credit	0.26	0.44	0.35	0.48	0.08 ***
Bought from Agent	0.04	0.21	0.07	0.26	0.03 ***
Borrowed from Agent	0.04	0.20	0.10	0.29	0.05 ***
Worked for Agent	0.08	0.27	0.11	0.31	0.03 *
Received GP Benefits	0.61	0.49	0.66	0.47	0.05 *
GBL					
Male Head	0.94	0.24	0.92	0.28	-0.03 *
Non Hindu	0.16	0.37	0.12	0.33	-0.04 **
SC	0.28	0.45	0.35	0.48	0.08 ***
ST	0.04	0.19	0.06	0.23	0.02 *
OBC	0.06	0.23	0.08	0.27	0.02
Household Size	5.16	2.58	4.80	1.87	-0.36 ***
Age of Household Head	51.52	12.95	43.22	11.61	-8.30 ***
Married Head	0.89	0.32	0.94	0.24	0.05 ***
Head: More than Primary School	0.48	0.50	0.43	0.50	-0.06 *
Head: Cultivator	0.49	0.50	0.39	0.49	-0.10 ***
Head: Labourer	0.25	0.44	0.42	0.49	0.17 ***

Continued ...

Table 7 Continued.

	Non Recommended (NR)		Recommended (R)		Difference
	Mean	SD	Mean	SD	R - NR
Head: Resident	0.98	0.13	0.97	0.17	-0.01
Landholding	0.96	1.24	0.43	0.48	-0.53 ***
Landless	0.16	0.36	0.27	0.45	0.12 ***
Purchased on Credit	0.36	0.48	0.40	0.49	0.04
Received GP Benefits	0.61	0.49	0.70	0.46	0.09 ***

$^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$

Table 8: Crop Profit (Potato)

	(1)	(2)
Landholding	4,400.838**	4,102.377**
	(1,965.295)	(1,997.313)
Landholding Squared	4,655.443***	4,815.714***
	(1,684.349)	(1,699.500)
Jyoti		951.012
		(1,158.940)
Pokhraj		-4,700.906***
		(1,338.829)
Chandramukhi		1,099.339
		(1,534.366)
Constant	7,104.621***	6,864.762***
	(440.869)	(1,216.564)
Observations	2,352	2,352
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

Table 9: Informal Interest Rate

	TRAIL	GBL
	(1)	(2)
Control 1	-5.307***	-5.205***
	(1.667)	(1.578)
Landholding	-2.425	-3.881**
	(1.568)	(1.852)
Constant	33.359***	36.521***
	(1.573)	(1.558)
Observations	411	364

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 10: Selection: Recommendation/Group Formation

	TRAIL	GRAIL	GBL
Buy from Agent	0.069	0.084	
	(0.055)	(0.054)	
Borrow from Agent	0.194***	0.163	
	(0.037)	(0.097)	
Work for Agent	0.029	0.067	
	(0.055)	(0.044)	
Landholding	0.222	0.173	-0.187
	(0.134)	(0.195)	(0.168)
Landholding squared	-0.232**	-0.139	0.025
	(0.093)	(0.128)	(0.100)
Non hindu	-0.021	0.221	-0.178
	(0.318)	(0.176)	(0.195)
Non Hindu × Agent Hindu	-0.184	-0.375*	
	(0.319)	(0.190)	
SC	0.276***	-0.019	0.023
	(0.063)	(0.049)	(0.081)
SC × Agent Hindu	-0.362***	-0.021	
	(0.074)	(0.061)	
ST	-0.354***	-0.189***	0.046
	(0.117)	(0.045)	(0.153)
ST × Agent Hindu	0.306	0.203	
	(0.188)	(0.126)	
OBC	-0.005	0.010	0.135
	(0.078)	(0.037)	(0.134)
OBC × Agent Hindu		-0.122	
		(0.137)	
Purchased on credit	0.070**	0.112*	0.043
	(0.030)	(0.055)	(0.050)
Received GP benefits	0.031	0.024	-0.008
	(0.030)	(0.038)	(0.033)
Constant	0.250	0.280**	0.898***
	(0.155)	(0.120)	(0.136)
Total Effect			
Non Hindu Household, Hindu Agent	10.91***	4.85**	
SC Household, High Caste Agent	2.40**	0.58	
ST Household, High Caste Agent	0.10	0.01	
OBC Household, High Caste Agent		0.78	
Head Cultivator, Agent Business	0.44	3.29*	
Head Cultivator, Agent Cultivator		15.74***	
Head Labour, Agent Business	4.32**	0.02	
Head Labour, Agent Cultivator		6.38**	

Continued ...

Table 10 (Continued)

	TRAIL	GRAIL	GBL
Sample Size	1,031	1,050	1,038
Number of Villages	24	24	24
Village Fixed Effects	Yes	Yes	Yes

Linear Probability Estimates
Standard errors clustered at village level 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 11: Takeup Cycle1

	All	TRAIL/GRAIL	GBL
Landholding	0.052	0.011	0.175
	(0.068)	(0.075)	(0.118)
Landholding Squared	-0.039	-0.032	-0.086
	(0.025)	(0.024)	(0.053)
TRAIL	0.067	0.063	
	(0.069)	(0.048)	
GRAIL	-0.005		
	(0.075)		
Hugli	-0.117**	-0.168**	-0.044
	(0.059)	(0.072)	(0.138)
TRAIL = GRAIL	1.85		
Number of Households	718	480	238

Marginal Effects from Probit Regression
Standard errors in clustered at the village level in parentheses
$^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$
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 12: Takeup/Continuation: Cycles 1 - 4

	Cycle 1	Cycle 2	Cycle 3	Cycle 4
	Cycle 1	Cycle 2	Cycle 3	Cycle 4
Landholding	0.052	0.048	0.046	0.015
	(0.068)	(0.067)	(0.075)	(0.078)
Landholding squared	-0.039	-0.035	-0.039	-0.025
	(0.025)	(0.025)	(0.027)	(0.026)
TRAIL	0.067	0.037	0.093	0.112
	(0.069)	(0.078)	(0.083)	(0.080)
GRAIL	-0.005	-0.048	0.001	-0.013
	(0.075)	(0.085)	(0.090)	(0.085)
Hugli	-0.117**	-0.149**	-0.175***	-0.164**
	(0.059)	(0.061)	(0.067)	(0.069)
TRAIL = GRAIL	1.85	2.30	2.41	4.10***
Number of Households	718	718	715	681

Marginal Effects from Probit Regression
Standard errors in clustered at the village level in parentheses
$^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$
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 13: Repayment Cycle 3

	Cycle 3
Landholding	0.031
	(0.039)
Landholding Squared	-0.015
	(0.010)
TRAIL	0.073**
	(0.033)
GRAIL	0.021
	(0.020)
Hugli	-0.028
	(0.038)
TRAIL = GRAIL	4.10***
Average Repayment in GBL	0.87
Number of Households	557

Repayment Rate is 100% in all treatments in Cycle 1
Marginal Effects from Probit Regression
$^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$
Standard errors in clustered at the village level in parentheses
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

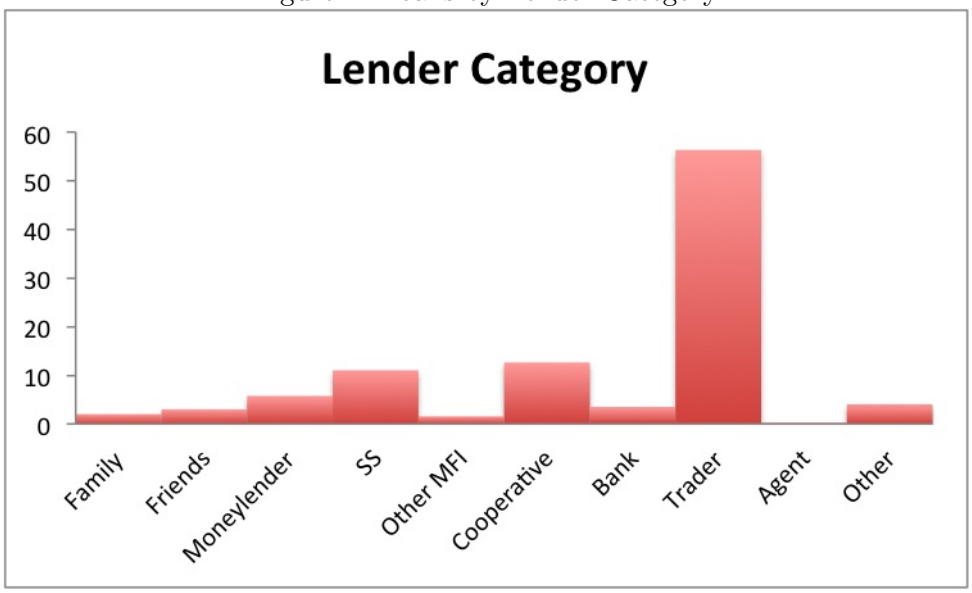


Figure 2: Informal Interest Rate and Landholding

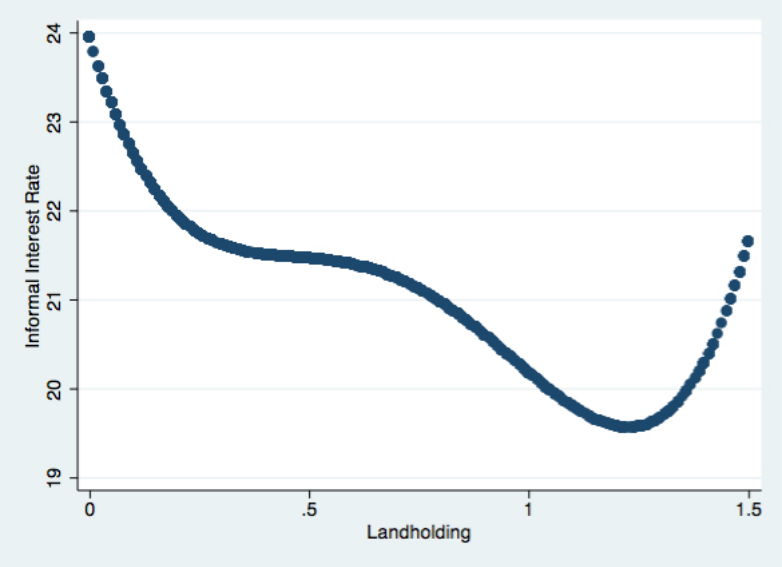


Figure 3: Interest Rate, Landholding and Production Function

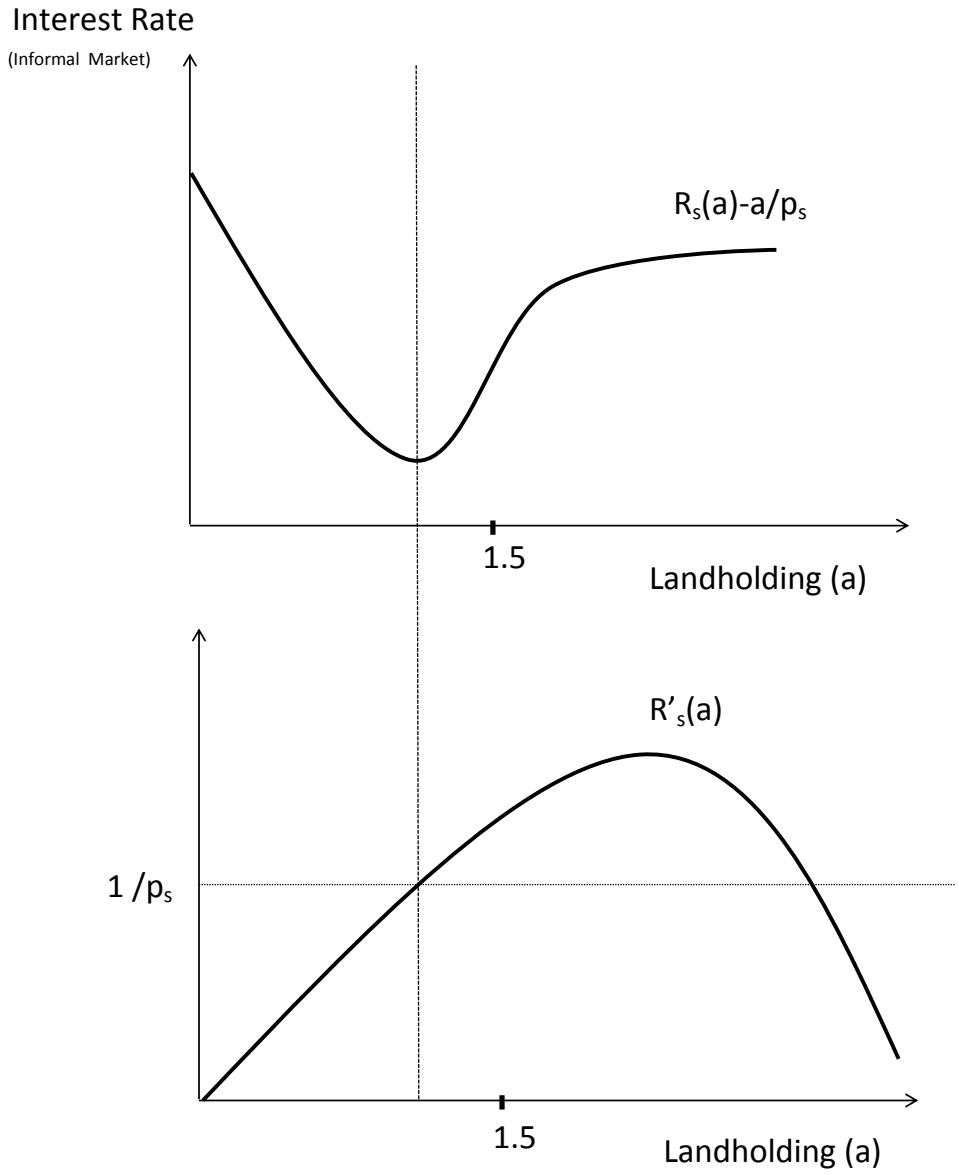


Figure 4: Individual Expected Surplus and Social Cost of Project

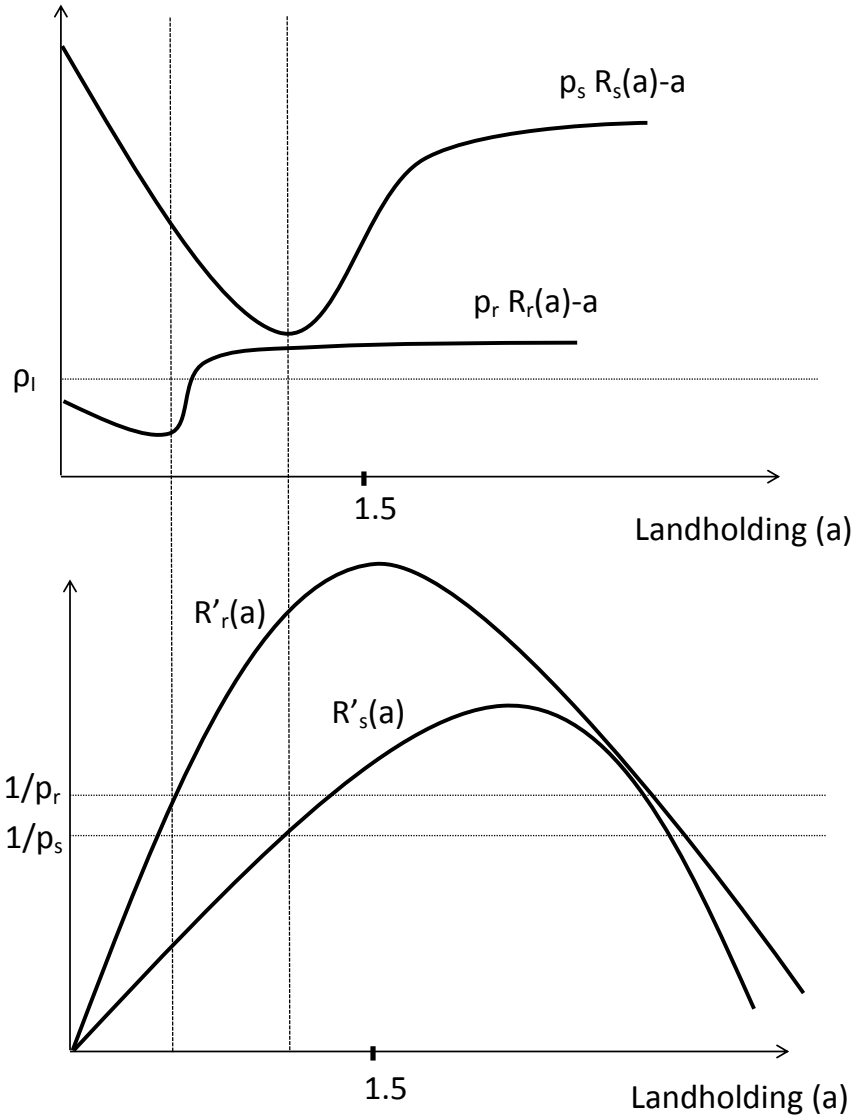


Figure 5: Informal Interest Market

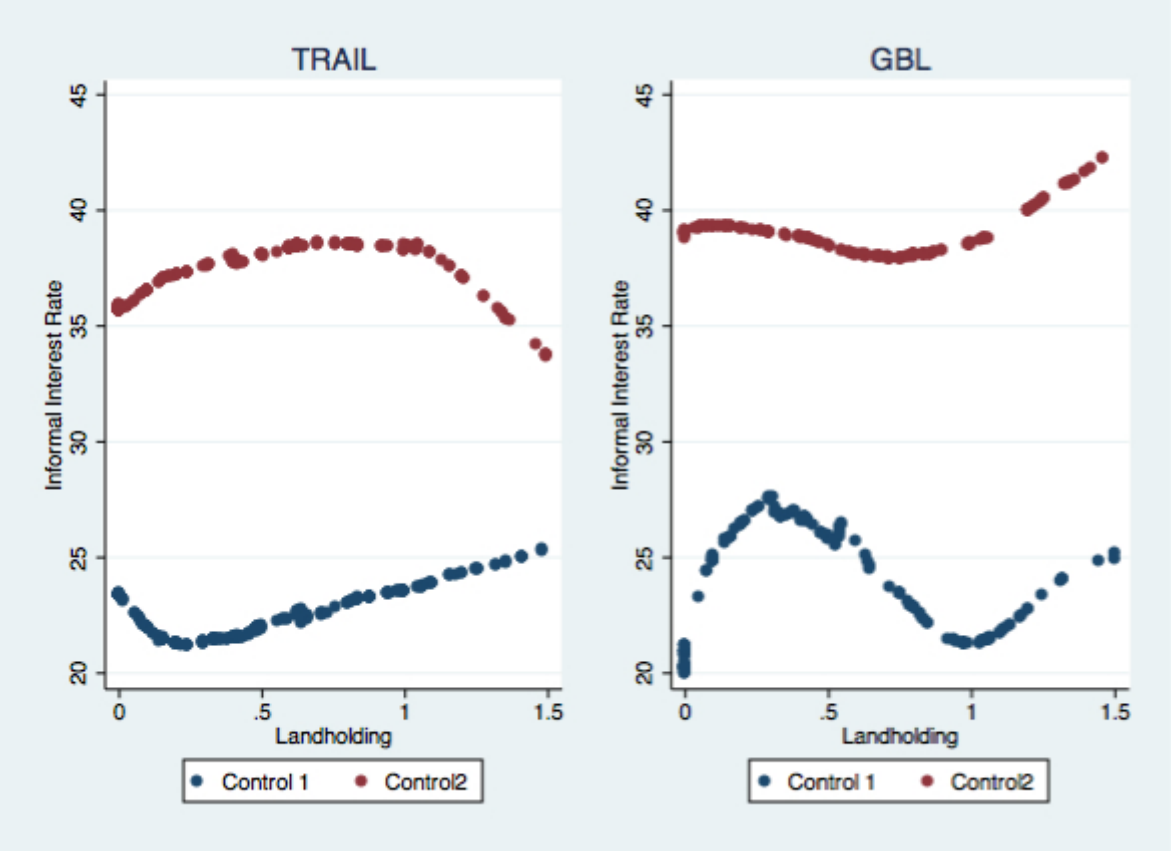


Figure 6: Selection: Recommendation/Group Formation

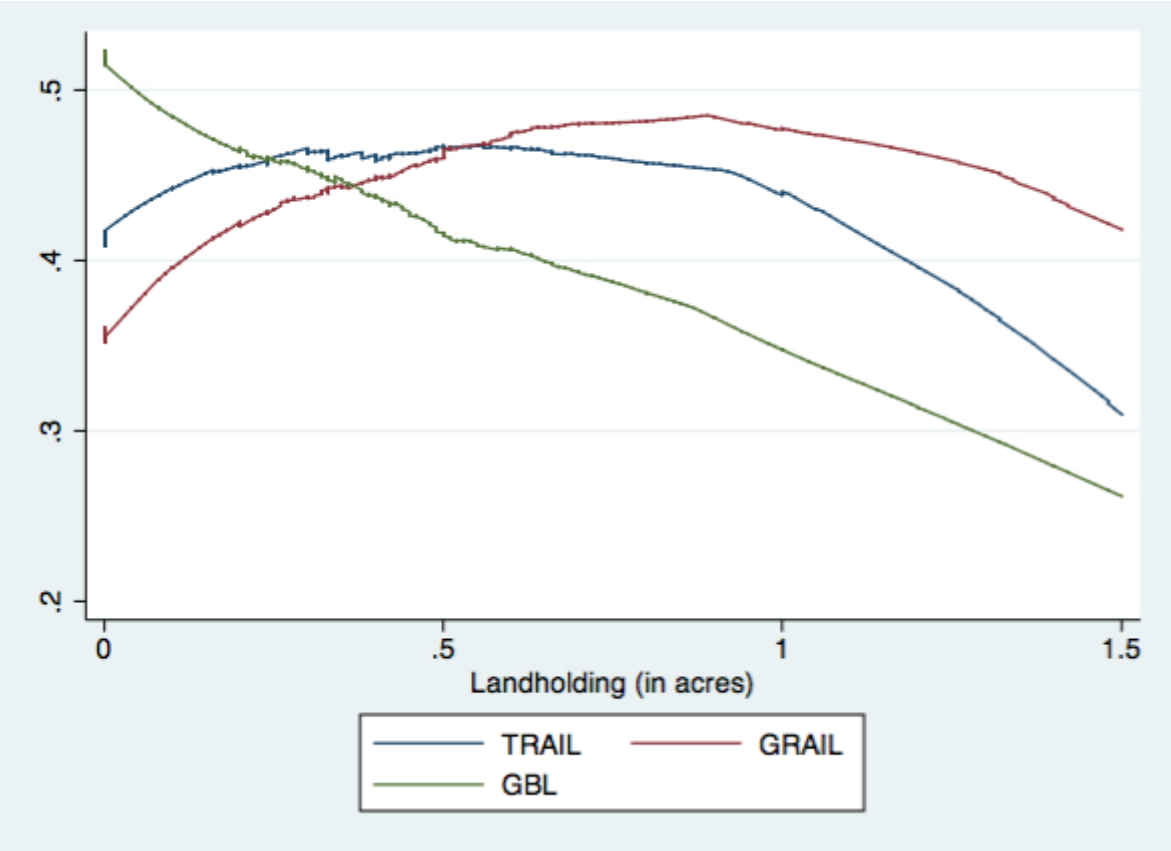
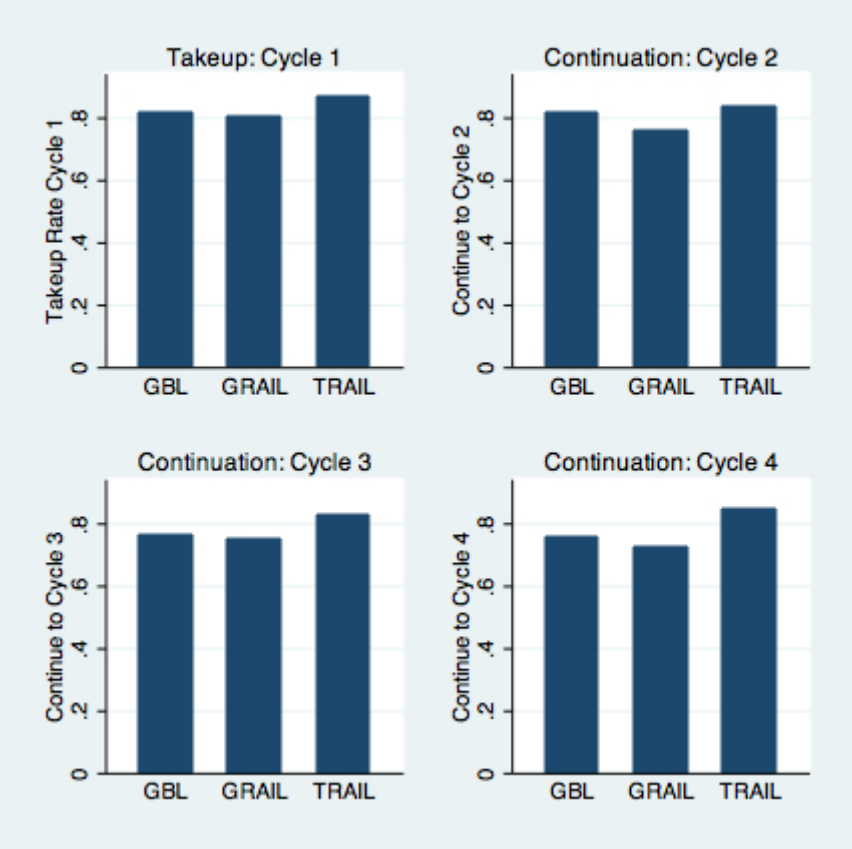
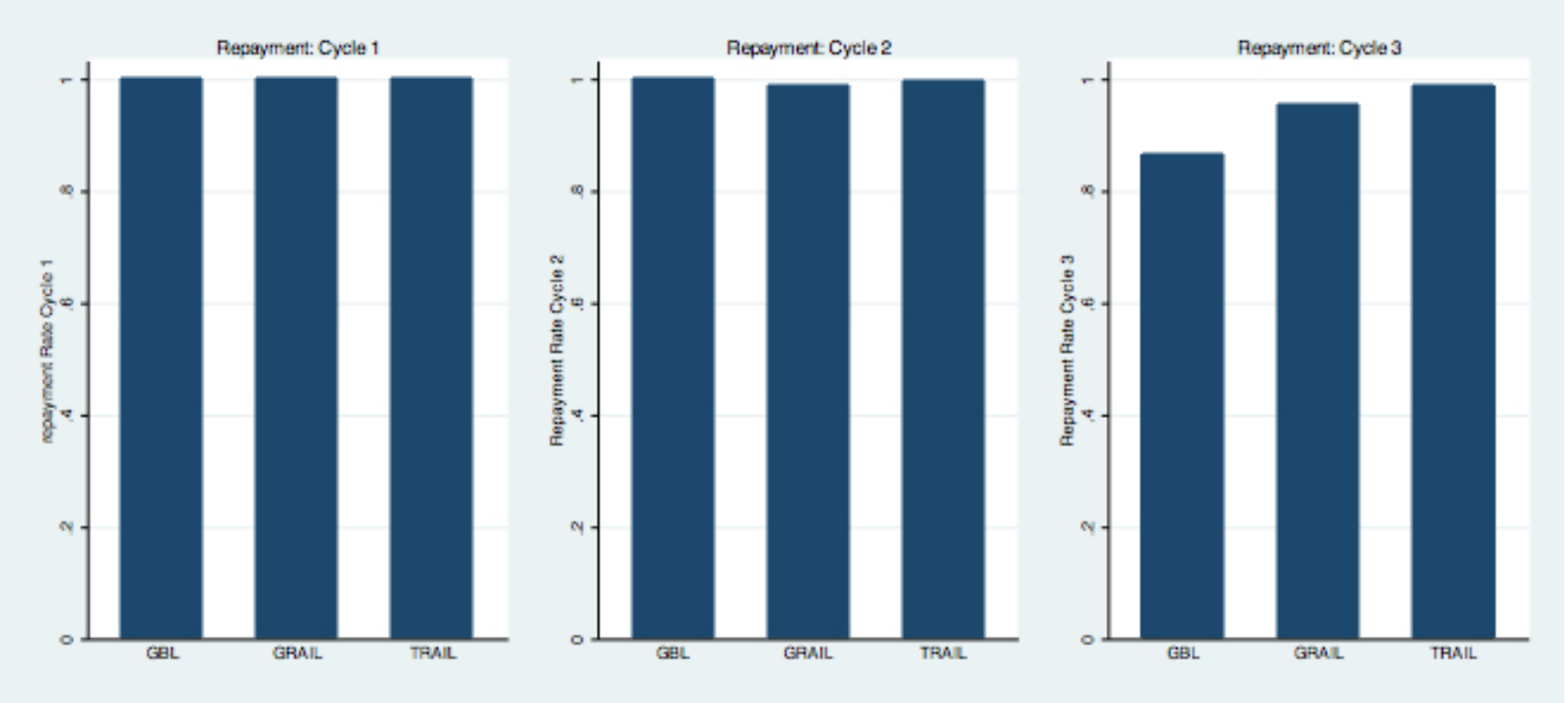


Figure 7: Takeup and Continuation over Cycles



Takeup conditional on being eligible

Figure 8: Repayment over Cycles



Repayment conditional on being eligible and continuation

References

Attanasio, O., B. Augsburg, R. D. Haas, E. Fitzsimons, and H. Harmgart (2011): "Group Lending or Individual Lending? Evidence from a Randomised Field Experiment in Mongolia," Mimeo, IFS.

Augsburg, B., R. D. Haas, H. Harmgart, and C. Meghir (2011): "Microfinance at the margin: Experimental evidence from Bosnia," Mimeo, IFS.

Banerjee, A., E. Duflo, R. Glennerster, and C. Kinnan (2011): "The miracle of microfinance? Evidence from a randomized evaluation," Mimeo, MIT, JPAL.

Banerjee, A. V., and E. Duflo (2011): *Poor Economics: A Radical Rethinking of the Way to Fight Global Poverty*. Public Affairs.

Banerjee, A. V., M. Ghatak, and P. Gertler (2003): "Empowerment and efficiency: tenancy reform in West Bengal," *Journal of Political Economy*, 110(2), 239 – 280.

Buttenheim, A. (2006): "Microfinance programs and contraceptive use: Evidence from Indonesia," WorkingPaper CCPR-020-06, California Center for Population Research.

Celik, G. (2009): "Mechanism Design with Collusive Supervision," *Journal of Economic Theory*, 144(1), 69 – 95.

Crépon, B., F. Devoto, E. Duflo, and W. Parienté (2011): "Impact of microcredit in rural areas of Morocco: Evidence from a Randomized Evaluation," Mimeo, MIT.

Desai, J., K. Johnson, and A. Tarozzi (2011): "On the Impact of Microcredit: Evidence from a Randomized Intervention Rural Ethiopia," Mimeo, Duke University.

Desai, J., and A. Tarozzi (2011): "Microcredit, family planning programs and contraceptive behavior: Evidence from a field experiment in Ethiopia," *Demography*, 48(2), 749–782.

Faure-Grimaud, A., J. J. Laffont, and D. Martimort (2003): "Collusion, Delegation and Supervision with Soft Information," *Review of Economic Studies*, 70, 253 – 275.

Feigenberg, M., E. Field, and R. Pande (2010): "Building Social Capital Through MicroFinance," Discussion Paper w16018, NBER Working Paper.

Field, E., and R. Pande (2008): "Repayment frequency and default in micro-finance: Evidence from India," *Journal of the European Economic Association*, 6(2-3), 501 – 509.

Floro, M. S., and D. Ray (1997): "Vertical Links Between Formal and Informal Financial Institutions," *Review of Development Economics*, 1(1), 34 – 56.

Fuentes, G. (1996): "The Use of Village Agents in Rural Credit Delivery," *Journal of Development Studies*, 33(2), 188 – 209.

Gangopadhyay, S., M. Ghatak, and R. Lensink (2005): "On Joint Liability Lending and the Peer Selection Effect," *Economic Journal*.

Gertler, P., D. I. Levine, and E. Moretti (2009): "Do microfinance programs help families insure consumption against illness?," *Health Economics*, 18, 257 – 273.

Ghatak, M. (2000): "Screening by the company you keep: joint liability lending and the peer selection effect," *Economic Journal*, 110(465), 601 – 631.

Giné, X., and D. Karlan (2010): "Group versus individual liability: Long-term evidence from Philippine microcredit lending groups," Discussion paper, Yale University.

Holvoet, N. (2004): "Impact of microfinance programs on children's education: Do the gender of the borrower and the delivery model matter?," *Journal of Microfinance*, 6(2), 27–49.

Islam, A., and P. Maitra (2012): "Health Shocks and Consumption Smoothing in Rural Households: Does Microcredit have a Role to Play," *Journal of Development Economics*, Forthcoming.

Kaboski, J. P., and R. M. Townsend (2011): "A structural evaluation of a large-scale quasi-experimental microfinance initiative," *Econometrica*, 79(5), 1357–1401.

Karlan, D., and S. Mullainathan (2010): "Rigidity in Microfinancing: Can One Size Fit All?," Discussion paper, QFinance.

Karlan, D., and J. Zinman (2011): "Expanding Microenterprise Credit Access: Using Randomized Supply Decisions to Estimate the Impacts in Manila," *Review of Financial Studies*, Forthcoming.

Laffont, J. J., and D. Martimort (1998): "Collusion and delegation," *RAND Journal of Economics*, 29, 280 – 305.

——— (2000): "Mechanism design with collusion and correlation," *Econometrica*, 68, 309 – 342.

Maloney, C., and A. B. Ahmad (1988): *Rural Savings and Credit in Bangladesh*. University Press Ltd., Dhaka Bangladesh.

Melumad, N. D., D. Mookherjee, and S. Reichelstein (1995): "Hierarchical Decentralization of Incentive Contracts," *RAND Journal of Economics*, 26, 654 – 672.

Mookherjee, D., and M. Tsumagari (2004): "The Organization of Supplier Networks: Effects of Delegation and Intermediation," *Econometrica*, 72(4), 1179 – 1219.

Motta, A. (2011): "Collision and Selective Supervision," Discussion paper, UNSW, Australia.

Onchan, T. (1992): "Informal Rural Finance in Thailand," in *Informal Finance in Low-Income Countries*, ed. by D. W. Adams, and D. Fitchett. Westview Press, Boulder, CO.

Pitt, M. M., and S. R. Khandker (1998): "The Impact of Group-Based Credit Programs on Poor Households in Bangladesh: Does the Gender of Participants Matter?," *Journal of Political Economy*, 106(5), 958 – 996.

Schuler, S. R., S. M. Hashemi, and A. P. Riley (1997): "The influence of women's changing roles and status in Bangladesh's fertility transition: Evidence from a study of credit programs and contraceptive use," *World Development*, 25(4), 563–575.

Srinivasan, N. (2008): *Microfinance India. State of the Sector Report*. SAGE.

Stiglitz, J., and A. Weiss (1981): "Credit Rationing in Markets with Imperfect Information," *American Economic Review*, 71(3), 393 – 410.

Wells, R. J. G. (1978): "An Input Credit Programme for Small Farmers in West Malaysia," *Journal of Administration Overseas*, 17, 4 – 16.