Financing Smallholder Agriculture: An Experiment with Agent-Intermediated Microloans in India *

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

July 2014

Abstract

We experimentally evaluate two micro-lending schemes to finance high-value smallholder agriculture. Loans featured durations that matched crop cycles, low interest rates, dynamic repayment incentives and index insurance. In the TRAIL design, the lender incentivized a local trader to recommend borrowers for individual-liability loans. In GBL, it offered joint-liability loans to self-formed groups, who attended high-frequency meetings and met savings targets. TRAIL loans increased potato cultivation and farm incomes by 17–21%, but GBL loans had insignificant effects, because TRAIL borrowers were more productive and lower-risk. TRAIL loans had higher repayment and take-up rates, and lower administrative costs than GBL loans.

Key words: Agricultural Finance, Agent Based Lending, Group Lending, Selection, Repayment

JEL Codes: D82, O16

*Funding was provided by the Australian Agency for International Development, the International Growth Centre, United States Agency for International Development and the Hong Kong Research Grants Council. We are grateful to Shree Sanchari for implementing the lending schemes. Clarence Lee, Daijing Lv, Foez Mojumder, Moumita Poddar and Nina Yeung provided exceptional research assistance and Elizabeth Kwok provided excellent administrative support. Boston University Masters students Torry Ah-Tye, Ou Bai, Juan Blanco, Chantel Pfeiffer and Stefan Winata conducted useful analysis and provided insights from a field study of relations between agents and borrowers in the study. We thank Xavier Gine, Albert Park, Russell Toth, Bruce Wydick and a large number of seminar and conference participants for helpful comments on previous and related versions. Internal review board clearance was received from Monash University, Boston University and the Hong Kong University of Science and Technology. The authors are responsible for all errors.

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

[‡] Sandip Mitra, Sampling and Official Statistics Unit, Indian Statistical Institute, 203 B.T. Road, Kolkata 700108, India. Sandip@isical.ac.in.

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

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

[‖] Sujata Visaria, Department of Economics, Lee Shau Kee Business Building, Hong Kong University of Science and Technology, Clear Water Bay, Hong Kong. svisaria@ust.hk.

1 Introduction

A major challenge in development policy is finding ways to finance the agricultural needs of poor farmers. Institutional finance is typically available only to those with enough assets to post as collateral, and as a result the majority of the rural population in developing countries is excluded from the formal financial sector. In turn this restricts growth in agricultural production and prevents poor farming households from diversifying into high value cash crops (Feder, 1985, Armendáriz and Morduch, 2005).

Microcredit has filled this chasm to some extent, but because loans must be repaid in frequent installments, and there is low tolerance for risk, micro-loans have not financed the productive needs of poor borrowers successfully. Some recent experimental evaluations of microcredit suggest that rather than increasing entrepreneurship or borrower incomes, its principal role has been to allow consumption smoothing and the purchase of consumer durables (Morduch, 1998, Banerjee, Duflo, Glennerster, and Kinnan, 2011, Banerjee, 2013).[1]

This paper investigates a new mechanism (called Trader Agent Intermediated Lending, or TRAIL) for selecting farmers with low landholdings to receive unsecured individual-liability loans to finance agricultural working capital. In contrast to standard microcredit, loan durations match crop cycles, and repayment amounts are index-insured against yield and price risk in the major cash crop. The interest rate is set below the average interest rates on loans from informal lenders. Local intermediaries embedded in the local community, who have extensive experience and knowledge about the creditworthiness of local farmers are appointed as *agents* and are asked to recommend borrowers to the lender. They are incentivized through commissions that depend on the loan repayments of the borrowers. Borrowers are induced to repay by conditioning their future credit access on current loan repayments.

Through a field experiment conducted in 48 villages in two districts of West Bengal, India during 2010-12, we assess the performance of the TRAIL scheme. We focus on potato-growing districts, since potatoes are the leading cash crop in West Bengal. Shree Sanchari, a Kolkata-based microfinance institution offered TRAIL loans at an annual interest rate of 18% (compared to 26% average rates charged by informal lenders), with a duration of 4 months. Successful repayment would render a borrower eligible for another TRAIL loan in a future lending cycle equal to 133% of the current loan repaid. The lender paid agents 75% of the interest received from their recommended borrowers as commission.

One randomly-selected trader from the village was appointed to be the agent. Loans were offered to a randomly-selected subset of the borrowers he recommended to the lender. To evaluate the impact of these loans on borrower outcomes, we compare the outcomes of the treated borrowers with outcomes of those who were recommended but were unlucky in the

[1] There has been a long controversy over the impact of microcredit on borrower incomes in Bangladesh. For a recent contribution to this debate, see Khandker and Samad (2013).

lottery and so did not receive the loans. This allows us to estimate the average treatment effect of the TRAIL loans, uncontaminated by endogenous selection.

We compare the impacts of the TRAIL scheme with those of a Group Based Lending (GBL) scheme, where selection and enforcement were induced through a mechanism similar to that used in traditional microcredit. Borrowers self-selected into groups that met with an official of the MFI twice every month and fulfilled savings targets, before becoming eligible to receive joint-liability loans. All other features of the loans such as interest rate, duration, index insurance and the eligibility for future credit access were the same in two schemes. We develop a theoretical model to analyze the patterns of borrower selection in both alternatives, as well as their impacts on cultivation, output and agricultural incomes. The predictions of the model are tested with data from loan records as well as detailed household surveys collected every four months over a period of two years, from a sample of households in the study villages.

Our theoretical model is one of segmented credit markets within each village, where borrowers are classified into two categories: *connected* and *floating*. Connected borrowers are in turn partitioned into different networks: each network consists of lenders and borrowers who behave in a cooperative fashion to maximize the aggregate payoffs of network members, and share useful production and marketing information that raises farm productivity. This cooperative behavior could be the result of close social and economic relationships, or altruism within networks. Every lender belongs to some network. Floating borrowers do not belong to any network, and do not have access to network benefits. The credit relationships across networks or between lenders and floating borrowers is characterized by non-cooperative behavior, because of the lack of altruism and close social links. Partly for this reason, and partly due to higher default risk caused by their lower productivity, floating borrowers pay higher interest rates in the informal market.

The predictions of this model are similar to related models of segmented credit markets based on non-cooperative behavior and informational or enforcement frictions (as explained in the online Appendix). A lender appointed as a TRAIL agent is motivated to recommend borrowers from his own network. This is due both to cooperation within networks, and the fact that the agent's commission depends on borrower repayment. In contrast, in the GBL scheme, floating borrowers are not excluded: all borrowers whose opportunity cost of the time spent attending group meetings, and cost of meeting savings requirements are small enough, will form groups and apply for loans. Thus GBL groups may consist of connected or floating borrowers, or both. Since floating borrowers do not have network benefits, the pool of GBL borrowers is likely to have lower average productivity and repayment rates than the pool of TRAIL borrowers.

Since connected borrowers are more productive, the same drop in interest rates causes TRAIL borrowers to expand production and borrowing by more, and achieve higher income increases than GBL borrowers. This effect is reinforced by the cooperation between the TRAIL borrowers and the agent, since a larger scale of borrowing generates higher agent commissions, which are internalized by borrowers. In contrast, the joint liability feature in

GBL raises the effective cost of credit, and peer pressure from group members discourages borrowers from expanding the scale of borrowing and taking risk. Hence the TRAIL scheme is predicted to lead to higher total borrowing, greater production of high value cash crops and higher farm incomes than the GBL scheme.[2]

The experiment was carried out in two districts in the potato-growing belt of the state of West Bengal in India. Potatoes generate substantially higher value added and farm income per acre than the major alternatives: paddy and sesame. However they also involve higher working capital requirements to pay for expensive inputs. The loans were timed to match the production and marketing cycles of potatoes, and index insurance was provided against fluctuations in potato yield and prices in the localized area. Hence our expectation is that access to cheaper credit would induce farmers to expand production of potatoes in particular.

In line with the predictions of the model, we find evidence that the TRAIL scheme induced a large and statistically significant increase in levels of borrowing, acreage devoted to potatoes, and farm incomes. The effects of the GBL scheme were substantially smaller, and mostly statistically insignificant. The evidence also supports the main channels suggested by the theory. TRAIL agents were significantly more likely to recommend own-network borrowers, viz., persons who had borrowed from them in the past, belonged to the same caste network, and who were charged below-average interest rates on the informal market. In contrast, GBL applicants paid above-average interest rates on informal loans. The rate of return on potato cultivation and total farm income for TRAIL borrowers was estimated to be between 70 and 115%. In contrast we do not find that increased expenditure on cultivation resulted in an increase in output for GBL borrowers.

The TRAIL scheme also exhibited superior performance in terms of loan repayments and take-up. The average repayment rate at the end of two years was 98% for TRAIL loans and 91% for GBL loans. The higher loan take-up rates and larger effects on farm incomes suggest that TRAIL borrowers benefitted more from the scheme than GBL borrowers did.[3] Moreover, we find no evidence that the TRAIL agent extracted the benefits of TRAIL borrowers by manipulating prices or quantities. Nor is there evidence that the agent helped TRAIL borrowers by lowering their interest rates, lowering input prices or raising output prices. Finally, since the TRAIL scheme did not require group meetings, the lender's administrative costs of implementing the TRAIL scheme were significantly lower than for the GBL scheme.

These results indicate that the TRAIL scheme successfully harnessed local network rela-

[2]Models of segmented credit markets based on non-cooperative behavior predict similar selection patterns, because of the incentives of the TRAIL agent induced by repayment-based commissions. To the extent that TRAIL borrowers are more productive than GBL borrowers, the same drop in the cost of credit expands their scale of cultivation and farm incomes by more. This expansion is accentuated when the TRAIL borrowers and agent cooperate.

[3]However, because the GBL estimates are imprecise, some of these differences are not statistically significant.

tionships between loan agents and borrowers to create a "win-win" situation where both borrowers and agents benefitted, while generating high loan take-up, high repayment rates and lower administrative costs. In contrast, the GBL scheme attracted borrowers of more dispersed and lower average quality, and the impacts of GBL loans were smaller on average and more dispersed. Consistent with the hypothesis that the differential effects are driven by productivity differences among the borrowers in the two schemes, we find that GBL borrowers also expanded area under potato cultivation, but their output did not increase significantly. However we cannot rule out the competing explanation that the individual liability TRAIL loans gave borrowers a stronger incentive to exert effort and increase output.

Our paper contributes to the policy debate on ways to promote financial inclusion of the rural poor in the developing world. Various countries have attempted to expand financial services in rural areas by employing local agents, but with limited success.[4] Research suggests that these programs often fail because agents can collude and extract rents from the customers (Floro and Ray, 1997). Instead, we demonstrate that it is possible to design an agent-intermediated lending scheme in a manner that limits the possibility of collusion.[5] In the TRAIL scheme, agents can only recommend households that own less than a predetermined threshold of land. All loan transactions take place between the lender and the borrower and the agent has no control over funds. Only a random subset of households recommended are selected to receive the loan, which also limits the benefit to borrowers of making side-payments to the agent in return for a recommendation. These restrictions limit the avenues through which the agent could extract surplus from the recommended borrowers. We also do not find any evidence of extraction in our experimental sample.[6]

The paper is organized as follows. Section 2 explains the experimental design and data, followed by Section 3 which presents the theoretical model. Section 4 contains the main empirical results, followed by robustness checks and sensitivity analysis in Section 5 and a discussion of financial sustainability of the two schemes in Section 6. Section 7 concludes.

[4]Agents have been employed to intermediate financial services in Thailand (Onchan, 1992), Philippines (Floro and Ray, 1997), Bangladesh (Maloney and Ahmad, 1988), Malaysia (Wells, 1978) and Indonesia (Fuentes, 1996).

[5]A large literature in contract theory discusses the role of middlemen and managers in contexts with asymmetric information. See Melumad, Mookherjee, and Reichelstein (1995), Laffont and Martimort (1998, 2000), Faure-Grimaud, Laffont, and Martimort (2003), Mookherjee and Tsumagari (2004), Celik (2009), Motta (2011). It has been shown that the problems associated with a delegation of discretionary power to an informed third party can be limited by constructing appropriate incentive schemes and constraining the extent of discretion that middlemen are allowed.

[6]India's central bank has recently been promoting a lending approach where "banking facilitators" are recruited from within communities to select and monitor borrowers on behalf of formal banks (Srinivasan, 2008). In practice, these loans are usually given to joint liability groups (also known as self-help groups). The TRAIL scheme is an alternative where the banking facilitator would recommend borrowers for individual liability loans. To our knowledge this is the first rigorous evaluation of such a scheme.

2 Experimental Design and Data

We collaborated with Shree Sanchari, a microfinance institution based in Kolkata, to conduct a field experiment in two districts Hugli and West Medinipur in the state of West Bengal, India. These two districts grow some of the largest quantities of potatoes in West Bengal. The state itself produces about a third of all potatoes grown in India. In October 2010 Shree Sanchari introduced the TRAIL scheme in 24 randomly selected villages, and the GBL scheme in a separate set of 24 villages. To minimize spillovers, the experimental design ensured that each TRAIL village was at least 8 kilometers away from a GBL village. Prior to this project, Shree Sanchari had not operated in any of these villages.[7]

In both schemes, Shree Sanchari offered borrowers multiple cycles of loans of 4-month durations at an annual interest rate of 18%. The first cycle loans were capped at Rupees 2000 (equivalent to approximately $US40 at the prevailing exchange rate), and were disbursed in October-November 2010, to coincide with the potato-planting season. Repayment was due in a single lump sum after 4 months. Upon full repayment, the borrower became eligible for a new loan which was 33 percent larger than the first, for another 4-month duration and at the same interest rate. In this way in each subsequent cycle successful borrowers became eligible for a 33 percent increase in loan size, with all other loan terms remaining unchanged. Those who repaid less than 50 percent of the repayment due were not allowed to borrow again. Those who repaid less than the full but more than 50 percent of the repayment amount were eligible to borrow 133 percent of the principal repaid. To facilitate credit access for post-harvest storage, borrowers were allowed to repay the loan in the form of potato "bonds" rather than cash, in which case the amount repaid was calculated at the prevailing price of potato bonds.[8] Both schemes had an in-built index insurance scheme – the required repayment would be revised downwards if revenue per acre for potatoes fell 25 percent below a three year average in the village, as assessed through a separate village survey. While Shree Sanchari told borrowers that these were agricultural loans, and the terms of the loans implicitly encouraged borrowers to use them for agriculture, borrowers were not required to report to Shree Sanchari the intended or actual use of the loan.[9]

[7]In another 24 villages, Shree Sanchari implemented an alternative version of the agent intermediated lending scheme called GRAIL, where the agent was recommended by the village council or *Gram Panchayat*. Borrower selection and impacts of the GRAIL scheme will be analysed in future research. Sixty-eight of the total of 72 villages were also part of a sample drawn for a previous project conducted by a subset of the current authors (see Mitra, Mookherjee, Torero, and Visaria, 2013).

[8]When potatoes are placed in cold storage, the storage facility issues receipts, also known as "bonds". These are traded by farmers and traders.

[9]However in our household surveys we did ask respondents to tell us the actual purpose of each loan they reported having taken.

2.1 The Trader-Agent-Intermediated Lending (TRAIL) Scheme

In the TRAIL villages, officials from Shree Sanchari consulted with prominent persons in the village to draw up a list of traders and business people who had at least 50 clients in the village, and had been in business in the village for at least three years. One person from the list was randomly chosen and offered the opportunity to become an agent.[10] The agent was asked to recommend 30 village residents who owned no more than 1.5 acres of agricultural land, as potential borrowers. Our project officer and an official from Shree Sanchari conducted a lottery in the presence of village leaders to select 10 out of these 30 individuals who were then offered the loan. Loan officers visited these randomly chosen individuals in their homes to explain the loan terms and disburse the loan if they accepted the offer.

At the beginning of cycle 1, for each loan given to borrowers whom he recommended, the agent was required to deposit Rs 50 with Shree Sanchari. At the end of each loan cycle he received as commission 75% of the interest received on these loans. The deposit was refunded to the agent at the end of two years, in proportion to the loan repayment rates of his recommended borrowers. Agents were told their contract would be terminated at the end of any cycle in which 50% of their recommended borrowers failed to repay. Agents were also promised an in-kind reward of an expenses-paid holiday at a local sea-side resort if they survived in the program for two years.

2.2 The Group-based Lending (GBL) Scheme

In the GBL villages, Shree Sanchari initiated operations in February/March 2010 by inviting residents to form 5-member groups, and then organizing bi-monthly meetings for all groups in the presence of Shree Sanchari loan officers, where they made regular savings deposits of Rupees 50 per member per month. Of the groups that survived until October 15, 2010, two were randomly selected into the scheme through a public lottery. Each group member received a loan of Rupees 2,000 in Cycle 1, for a total of Rupees 10,000 for the entire group, with a four-month duration, payable in a single lump sum. All group members shared liability for the entire Rupees 10,000: if less than the full amount due was repaid in any cycle, all members were disqualified from future loans; if the loans were fully repaid the group was eligible for a new loan which was 33% larger than the previous loan. Bi-monthly group meetings continued throughout, in keeping with standard protocol that is used by Shree Sanchari. To cover their administrative costs Shree Sanchari retained 75% of the interest received.

[10]The experimental protocol stated that if the person approached rejected the offer, the position would be offered to another randomly chosen person from the list. Shree Sanchari officials would go down the list in this manner until the position was filled. In practice, the first person offered the position accepted it in every village.

2.3 Data and Descriptive Statistics

Starting in December 2010, we collected household survey data from 50 households in each village at four-month intervals. This included information about household demographics, assets, landholding, cultivation, land use, agricultural input use, sale and storage of agricultural output, credit received and given, incomes, and economic relationships within the village. The household sample was composed of three sub-groups. In each village sample we included all 10 Treatment households: households that both were recommended for loans/formed groups (in TRAIL/GBL villages, respectively) and also were randomly selected to receive loans. We also included 10 Control 1 households: chosen randomly from those that were recommended/formed groups (in TRAIL/GBL respectively) but were *not* selected to receive loans. Finally, we included 30 households that were not recommended/did not form groups. These were chosen by first, purposively selecting households to ensure that all 24 sample households from the Mitra, Mookherjee, Torero, and Visaria (2013) study were included, and next, filling any remaining additional sample slots through a random draw of non-recommended/non-selected households from the village.[11]

Table 1 provides descriptive statistics. Panel A shows there were no significant differences in the village-level characteristics of TRAIL and GBL villages. Household characteristics are described in Panel B. These statistics are computed for the restricted sample of 24 households per village that were included in the original sample drawn for the Mitra, Mookherjee, Torero, and Visaria (2013) study.[12] For most characteristics, there are only minor differences across households assigned to the two treatment arms. However households in GBL villages were more likely to be Hindu, had slightly larger household sizes, were more likely to have received government transfers and were more likely to have purchased agricultural inputs on credit during Cycle 1. However, as the F-statistic shows, we cannot reject the joint hypothesis that these characteristics are similar on average across the two treatment groups.

Table 2 describes credit market transactions that took place during September – December 2010 in all sample households that owned less than 1.5 acres of land. Since this was the planting season for potatoes, which is the crop with the highest working capital requirements in this region (as shown in Table 3, below), these data provide a picture of the main sources of agricultural credit, and characteristics of the loans. The sample households self-reported all borrowing, regardless of source or loan purpose. We present here data on

[11]The 24 households in the Mitra, Mookherjee, Torero, and Visaria (2013) study were a stratified (by land-size) random sample of all households that had cultivated potatoes in the year 2007.

[12]We do this for the following reason. It is unlikely that our full sample of 50 households per village would be balanced across treatment groups, as both Treatment and Control 1 households were systematically selected into the sample by virtue of being recommended by the agent (TRAIL villages)/joining a group (GBL villages). In contrast, Control 2 households were selected by virtue of not being recommended, and form an unknown proportion of the population of households that the agent would not have wanted to recommend. Thus it is unclear how to re-weight these two groups to arrive at a representative sample of village households. Restricting attention to the stratified random sample drawn before the lending schemes were introduced side-steps this problem.

all borrowing and borrowing for agricultural purposes.[13] Note first that nearly 70 percent of sample households borrowed in this 4-month period. Informal lenders (traders and moneylenders) provided two-third of all agricultural credit and thus were the single most important lender category. Credit cooperatives provided about a quarter of the agricultural credit, but they loaned mainly to households with relatively larger landholdings.

The average interest rate on loans from informal lenders is 26%, substantially above the rate that Shree Sanchari charged on the program loans. The average duration of informal loans is 4 months, presumably reflecting the fact that agricultural cycles in this area are four months long. Only 1% of informal loans are secured by collateral. Cooperatives and government banks charge substantially lower interest rates and have longer average durations, but are much more likely to be collateralized, again pointing to the fact that they are less likely to be available to households with low levels of assets.[14]

Table 3 describes the mean characteristics of the major categories of crops grown by sample farmers in 2011 and 2012, the two years of data used in our analysis. Paddy is grown twice or thrice a year, and in both years, farmers planted on average 0.70 acres of land with paddy. Potatoes and sesame are both winter crops planted only once a year, and the average farmer planted each on similar quantities of land: potatoes on 0.48 acres and sesame on 0.43 acres. A large range of vegetables such as cauliflower, cabbage, gourd, chillies and lentils are grown year-round on small patches, accounting for an acreage of 0.20 over the year. As the table shows, potato cultivation involves large investment during cultivation: the annual cultivation cost for potatoes was just about Rs 10,000 in both years. However the revenues and value added earned from potato cultivation were also considerably higher than those earned from sesame, paddy or vegetables. These figures make it clear that potatoes have high working capital needs, and are also the major source of high farm income in these villages. We also see that crop prices can vary considerably from year to year. Price fluctuations are an important source of the risk involved in agriculture. Potato prices especially can be very variable: the average of the village-level median farmgate price of the two most widely-grown varieties of potatoes across our sample villages was Rs 2.36 in 2008, Rs 3.85 in 2011 and Rs 5.36 in 2012. Clearly, the prevailing prices for potatoes affect the profitability of potato cultivation.

[13]Importantly, the data also include information on trade credit from input suppliers. Since we collected detailed data on input purchases, we are able to cross-check that all inputs purchased on credit are counted as loans.

[14]In statistics not presented here, we find that informal lenders become a progressively more important source of agricultural credit as household landholding decreases from 1.5 acres to zero. Landless households received 87% of their agricultural credit from informal lenders, and only 6% from cooperatives. Presumably this is because cooperatives require that the borrower posts collateral: nearly three quarters of their loans were collateralized.

3 Theoretical Model

As explained in Section 1, we use a model of segmented informal credit markets, which abstracts from standard adverse selection or moral hazard, and instead assumes cooperative behavior within borrower-lender networks, and non-cooperative behavior among players from different networks. Our model is motivated by the dense social and economic agent-borrower relationships described in a field study of a sub-sample of these villages by Ah-Tye, Bai, Blanco, Pheiffer, and Winata (2013). Agent and borrowers interact in credit, and insurance markets, and agents also provide borrowers with advice on production, input-sourcing and marketing matters. This cooperative behavior may be the result of repeated interaction among non-cooperative agents (*a la* the Folk Theorem), or may be due to altruism within networks. Similar results can be obtained using more standard non-cooperative formulations of credit markets involving adverse selection and moral hazard, as in Ghatak (2000) and Besley and Coate (1995). Details of such formulations are provided in online Appendix A-1.

Our model is silent on how the payoffs earned by the network are distributed among its members. Payoff vectors where the lion's share from the benefits of cooperation accrue to a few members (e.g., lenders rather than borrowers) are also possible in the model. In practice however, the TRAIL scheme was designed to limit such "extraction" by agents: agents were responsible for recommending borrowers at the beginning of the scheme, but not for loan disbursal or collection of repayment, recommendations could not be modified after they had been made, households with more than 1.5 acres of cultivable land were ineligible to be recommended, and only a random sub-set of recommended borrowers were selected to receive loans. All of these features would limit the extent to which borrowers and agents could enter side-contracts that might siphon off the benefits accruing to borrowers. In the empirical analysis we also test for, but do not find, evidence of extraction by the agent through manipulation of credit, input or output contracts.

3.1 Informal Credit Market, pre-MFI

The village is partitioned into a number of networks, and a set of *floating* borrowers. Each network has some lenders and *connected* borrowers who are knit together into a group with close economic and social ties. Each network behaves in a cooperative fashion, in the sense that decisions are made by network members to maximize the aggregate payoff of all within-network members. Floating borrowers operate in isolation and behave non-cooperatively, to maximize their own payoffs. Members of two different networks play non-cooperatively when they participate in some transaction. Hence lenders from different networks compete in offering credit to the floaters, *a la* Bertrand in the informal market.

Network members help each other with production and business matters, whereas floaters do not receive any help. Foster and Rosenzweig (1996), Bandiera and Rasul (2006), Conley and Udry (2010) have provided evidence that farmers learn from others in the same social network. As a result connected borrowers' projects succeed with a higher probability (p_c) than the floaters' projects do (p_f). In particular, we assume that $p_f(2-p_f) < p_c$.[15]

All lenders face a cost of capital ρ_I, and are unconstrained in terms of lending capacity. The connected and floating borrowers have production functions $f_C(l)$ and $f_F(l)$ respectively. It is assumed that the help received from the network makes connected borrowers more productive, i.e. $f'_C(l) \geq f'_F(l), \forall l$. The production functions are strictly increasing, strictly concave, twice-differentiable function of loan size l satisfying Inada conditions.

Loans are needed to purchase a variable input whose price is normalized to 1. We abstract from moral hazard in loan repayments, and assume that loans are always repaid when the borrower's project succeeds. This is true for both floating and connected borrowers.[16] Borrowers have limited liability: when the project fails, they do not repay.

Since all networks have identical costs of capital and there are no capacity constraints, there is no gain from borrowing or lending across networks.[17] Each connected borrower obtains a loan from within his own network, and the network makes a cooperative choice of the loan size of each own-network borrower. Hence a connected borrower selects a loan size $l_I^c = \text{argmax}_{l\geq 0}\{p_c f_C(l) - \rho_I l\} \equiv p_c \Pi_C(\frac{\rho_I}{p_c})$ where $\Pi_C(r)$ denotes the maximized value of $f_C(l) - rl$, and r is the *effective cost of credit (ECC)*.

Lenders from different networks compete with one another to lend to floating borrowers *a la* Bertrand. Thus floaters obtain credit at the competitive rate $\frac{\rho_I}{p_f}$ at which lenders break even on average. A floating borrower selects a loan size $l_I^f = \text{argmax}_{l\geq 0}\{p_f f_F(l) - \rho_I l\} \equiv p_f \Pi_F(\frac{\rho_I}{p_f})$. Since the effective cost of credit for floating borrowers is higher, they select smaller loan sizes: $l_I^f < l_I^c$.

3.2 Agent-Intermediated Lending: TRAIL

Now consider the introduction of the TRAIL scheme into this credit market. A single network lender is chosen randomly to be the agent for the scheme. He recommends a set of borrowers, of whom a randomly chosen subset is offered TRAIL loans at the interest rate r_T. The agent stands to receive a fixed fraction $K \in (0,1)$ of the interest payment made by the borrower. We assume $r_T < \rho_I$.

[15] This assumption affects only the comparison between repayment rates in the TRAIL and GBL schemes. If it were not true, repayment rates would always be higher in GBL.

[16] The results extend when floating borrowers are allowed to default strategically, provided this default rate d is smaller than the TRAIL commission rate K.

[17] If p_c is always constant regardless of whether the loan is given by a own-network lender or an other-network lender, then lenders are indifferent between lending within our outside their network, and so we assume they lend within the network. If instead p_c is lower when the lender belongs to another network, then clearly the lender prefers to lend within his network.

Suppose initially there is no collusion, in the sense that the borrowers cannot/do not bribe the agent in exchange for recommending them. Whom will a network lender recommend for a TRAIL loan? If he selects an own-network borrower, this borrower will select the loan size that maximizes the network's aggregate profit: $l_T^c = \text{argmax}_{l \geq 0}\{p_c f_C(l) - (1-K)p_c r_T l\} \equiv p_c \Pi_C((1-K)r_T)$. Clearly, the ECC has decreased from $\frac{\rho_I}{p_c}$ in the pre-intervention regime to $(1-K)r_T < \rho_I$ under the TRAIL scheme, and so $l_T^c > l_I^c$. If a floating borrower is recommended and offered the loan, he will non-cooperatively select the loan size that maximizes his own payoff: $l_T^f = \text{argmax}_{l \geq 0}\{p_f f_F(l) - p_f r_T l\} \equiv p_f \Pi_F(r_T)$. The ECC is r_T, so the loan size is higher than in the informal market, but smaller than for a connected borrower in TRAIL. The network lender will earn an expected commission of $K p_f r_T l_T^f$. The gain from recommending a floating borrower is $K p_f r_T l_T^f$, and from recommending a borrower from another network is $K p_c r_T l_T^f$.[18] Recommending a borrower from a different network therefore dominates recommending a floating borrower because the help that the borrower receives from his network ensures that he repays with a higher probability, which in turn implies a higher expected commission for the agent.

Now examine the agent's incentive to recommend an own-network borrower, rather than a connected borrower from another network. The former option dominates since

$$p_c[\Pi_C((1-K)r_T) - \Pi_C(\frac{\rho_I}{p_c})] \geq K p_c r_T l_T^f + p_c[\Pi_C(r_T) - \Pi_C(\frac{\rho_I}{p_c})] \geq K p_c r_T l_T^f$$

Here the first inequality follows from $\Pi_C((1-K)r_T) \geq K r_T l_T^f + \Pi_C(r_T)$ (as the agent internalizes the increased profits from a lower ECC for a within-network borrower), and the second inequality follows from $r_T < \rho_I < \frac{\rho_I}{p_c}$ (the network borrower in turn internalizes the commissions earned by the agent).

Now suppose borrowers could bribe the agent in return for being recommended. Given that the agent is already cooperating fully with own-network borrowers, only the returns from recommending out-of-network borrowers is affected. If the agent has absolute bargaining power, he can extract at most all the increased profits that other-network borrowers would earn. In that case, he would earn the same benefit from selecting an other-network borrower as from an own-network borrower.[19] If the agent's bargaining power is any lower he would clearly prefer to select the own-network borrower.

With regard to floating borrowers, the most a network lender can extract is all their profit gains, thus earning a net benefit of $K p_f r_T l_T^f + p_f[\Pi_F(r_T) - \Pi_F(\frac{\rho_I}{p_f})]$. Consider the function $Q(p) \equiv K p r_T l^*(r_T) + p[\Pi_F(r_T) - \Pi_F(\frac{\rho_I}{p})]$ where $l^*(r_T)$ denotes the maximizer of $f_F(l) - r_T l$. Notice that by the Envelope Theorem $\frac{\partial \Pi_F}{\partial p}(\frac{\rho_I}{p}) = \frac{\rho_I}{p^2} l^*(\frac{\rho_I}{p})$. Moreover, $\Pi_F(r_T) - \Pi_F(\frac{\rho_I}{p}) \geq$

[18] By assumption, a borrower from another network will not internalize the profits earned by the agent. Hence such a borrower will select the same loan size l_T^f as a floating borrower. Note we are assuming here that a borrower from a different network will be just as productive as a borrower from the same network. If instead he is less productive, the agent's preference tilts further in favor of an own-network borrower.

[19] The agent could make a take-it-or-leave-it offer to an other-network borrower, stipulating the size of the loan as well as the bribe. Thus the agent would receive the entire benefit that accrued to this borrower and thus earn the same payoff as he would get from recommending an own-network borrower.

$[\frac{\rho_I}{p} - r_T]l^*(\frac{\rho_I}{p})$. Hence

$$
\begin{aligned}
Q'(p) &= Kr_T l^*(r_T) + [\Pi_F(r_T) - \Pi_F(\frac{\rho_I}{p})] - \frac{\rho_I}{p} l^*(\frac{\rho_I}{p}) \\
&\geq Kr_T l^*(r_T) + [\frac{\rho_I}{p} - r_T]l^*(\frac{\rho_I}{p}) - \frac{\rho_I}{p} l^*(\frac{\rho_I}{p}) = Kr_T l^*(r_T) - r_T l^*(\frac{\rho_I}{p})
\end{aligned}
$$

which is positive as long as $K > k^* \equiv [l^*(\frac{\rho_I}{p_c})/l^*(r_T)]$. This implies collusion with a connected borrower dominates collusion with a floating borrower, as long as the commission rate is large enough. We thus obtain

Proposition 1 *If collusion is not allowed, it is optimal for the TRAIL agent to recommend an own-network borrower. Even when collusion is possible, he will still prefer to recommend an own-network borrower, as long as the commission rate K is high enough.*

3.3 Group-based Lending: GBL

To analyze the GBL scheme, we simplify by assuming that groups are of size two as in Besley and Coate (1995). The group is jointly liable to repay the two loans. We abstract from the possibility that the limited liability constraint binds for some landholding sizes. This ensures that even if only one member's project succeeds, both loans can and will be repaid. Borrowers have to attend group meetings and make regular savings to qualify for a group loan. This imposes an additional cost γ_i for a borrower of type $i \in \{c, f\}$.

If two connected borrowers from the same network form a group, both loans will be repaid with probability $p_c(2 - p_c)$, and neither loan will be repaid with the remaining probability $1 - p_c(2 - p_c)$. If two floating borrowers form a group, both loans will be repaid with probability $p_f(2-p_f)$ and neither will be repaid with the remaining probability $1-p_f(2-p_f)$. Our assumption that $p_f(2-p_f) < p_c$ implies (F, F) groups repay at a lower rate than TRAIL borrowers do, whereas (C, C) groups repay at a higher rate.[20]

Compared with individual liability loans, a joint liability loan involves a 'tax' corresponding to the additional repayment burden associated with loans of other group members, should their projects fail. A connected borrower group thus involves an ECC of $r_T + (1 - p_c)r_T = (2-p_c)r_T$ rather than r_T. Hence a (C, C) group will select a loan l_G^C to maximize $p_c[f_C(l) - (2 - p_c)r_T l]$ and attain a per member profit of $p_c\Pi_C((2 - p_c)r_T)$. *The joint liability tax in GBL therefore implies a smaller expansion of borrowing and cultivation scale for connected borrowers, compared with TRAIL.* As for floating borrowers, an (F, F) group will select a loan l_G^f to maximize $p_f f_F(l) - p_f(2 - p_f)r_T l$ and attain a per member profit of $p_f\Pi_F((2 -$

[20]This last result captures the fact that, for a given probability of success and interest rate, GBL repayment rates still dominate those of an individual liability loan because group members have the incentive to repay on behalf of those who are unsuccessful.

$p_f)r_T)$. Since $(2-p_f) > (2-p_c) > 1$, the loan size and scale of cultivation of GBL borrowers will be uniformly smaller than that of TRAIL borrowers.

We do not address the question whether this model will give rise to positive assortative matching, as this depends on the distribution of bargaining power within groups. More importantly, it does not affect comparisons between TRAIL and GBL. Consider the consequences of a mixed group (C, F). With side-payments within the group, (l_c, l_f) would be selected to maximize $p_c f_C(l_c) + p_f f_F(l_f) - [1-(1-p_c)(1-p_f)]r_T(l_c + l_f)$. The ECC for the loan of the connected member of a group would be $[1 + \frac{p_f}{p_c} - p_f]r_T > r_T$, and for a floating member would be $[1 + \frac{p_c}{p_f} - p_c]r_T > r_T$. Hence the average loan size in a mixed (C, F) group would also be smaller than for a TRAIL borrower.

It is unclear whether an (F, F) group or a (C, C) group would benefit more from a GBL loan. For the (F, F) group the decrease in the ECC is from $(2 - p_f)r_T - \frac{\rho_I}{p_f}$ which is larger than the decrease $(2 - p_c)r_T - \frac{\rho_I}{p_c}$ for the (C, C) group, since $\frac{\rho_I}{p} - (2 - p)r_T$ is decreasing in p. However, the profit function is a decreasing convex function of the ECC, so profits rise at a slower rate for the (F, F) group. Therefore we cannot order the gains for the two groups without making additional assumptions.

In what follows, we shall represent GBL borrowers as including both (C, C) and (F, F) groups. This is because both kinds of groups would have an incentive to form and apply for a GBL, as long as the costs of group meetings and savings requirements are small enough that there is still a net advantage of a lower interest burden for both groups. Importantly, *there is no mechanism in GBL to screen out one kind of group in preference to the other.* To simplify the exposition we ignore (C, F) groups hereafter, while noting the qualitative conclusions would be unaltered if they were also present.

The key differences in the selection patterns and cultivation outcomes between the GBL and TRAIL schemes are the following. First, TRAIL has an in-built screening mechanism such that the agent has a preference for selecting connected borrowers from his own network. In contrast GBL borrowers are likely to include both connected and floating borrowers. Therefore, TRAIL agents will select safer, more productive borrowers (who pay lower interest rates on the informal market, and have a higher productivity). Second, the joint liability tax inherent in GBL implies that the effective cost of credit is lower for TRAIL borrowers, so they will borrow and cultivate high-value crops more. These results would obtain even in the presence of non-cooperative behavior within networks. With cooperative behavior resulting from close network ties, the agent and connected borrowers internalize mutual benefits in TRAIL, which generate further increases in borrowing and cultivation scales. These features combine to yield the prediction that TRAIL borrowers will increase borrowing, scale of cultivation of high value cash crops, and farm income by more than GBL borrowers.

The theory does not have a clear prediction for whether repayment rates will be higher in the TRAIL or GBL schemes. On the one hand TRAIL agents tend to select connected borrowers with a higher probability of project success. On the other hand, for any given type of borrower, GBL loans are repaid at higher repayment rates because group members have the incentive to repay on behalf of those who are unsuccessful. Finally, we expect lower take-up of loans in the TRAIL scheme because of the joint liability tax and the burden of attending group meetings and achieving mandated savings targets.

Table 4 summarizes these comparisons of the TRAIL and GBL selection patterns and impacts. These predictions will be tested in the data below.

4 Empirical Analysis

This study examines two different lending schemes, or mechanisms for delivering credit to rural households. The schemes differ in how households were selected to become borrowers. Therefore, when estimating and comparing the effects of the loans on borrowers in the two schemes, we account for the fact that households selected in the two schemes may have very different characteristics, not all of which may be observable to us. To do this, we rely on the fact that only a randomly chosen subset of the selected households (households recommended by the agent/that formed groups in TRAIL/GBL villages) were offered the loans. Therefore any differences between households that were recommended but were not offered loans (Control 1 households) and those that were both recommended and offered loans (Treatment households) must be caused by the loans. We call this the "treatment effect". Similarly, we can estimate the "selection effect": the difference between Control 1 households and Control 2 households (those that were not recommended/did not form groups in TRAIL/GBL villages).

In our regression specification below,

$$\begin{aligned} y_{iv} = \beta_0 + \beta_1 \text{TRAIL}_v + \beta_2(\text{TRAIL}_v \times \text{Control } 1_{iv}) + \beta_3(\text{TRAIL}_v \times \text{Treatment}_{iv}) \\ + \beta_4(\text{GBL}_v \times \text{Control } 1_{iv}) + \beta_5(\text{GBL}_v \times \text{Treatment}_{iv}) + \gamma\, \mathbf{X}_{iv} + \varepsilon_{iv} \end{aligned} \tag{1}$$

y_{iv} denotes the outcome variable of interest for household i in village v, β_2 is the selection effect in the TRAIL scheme, β_4 is the selection effect in the GBL scheme, $\beta_3 - \beta_2$ is the treatment effect in the TRAIL scheme and $\beta_5 - \beta_4$ is the treatment effect in the GBL scheme.[21] $\mathbf{X}_{iv}$ includes a set of additional controls including the land owned by the household, a year dummy to control for secular changes over time, and a dummy variable for whether the village received a separate intervention informing residents of the prevailing market prices for potatoes.[22] Standard errors are clustered at the village level to account for spatial correlation in outcomes.

[21] All treatment effects presented in the tables below are intent-to-treat estimates because they compare the outcomes for households *assigned* to Treatment and Control 1 groups, regardless of actual take-up.

[22] This information intervention was undertaken for a separate project examining the effect of delivering information about potato prices to farmers and is similar to the "public information" treatment described in Mitra, Mookherjee, Torero, and Visaria (2013). Villages were assigned to the information treatment randomly and orthogonally to the credit intervention that is the focus of the present paper.

4.1 Treatment Effects on Borrowing, Cultivation and Farm Incomes

Table 5 presents estimates of treatment and selection effects of the main outcomes of interest: borrowing (Panel A), cultivation and farm income from the major cash crop (Panel B) and income from other crops (Panel C). These estimates are computed from regressions according to the specification in equation (1). The complete regression results are available in online Appendix A-1.

4.1.1 Effects on Borrowing

Row 1 in Table 5 presents effects of the TRAIL and GBL schemes on how much households borrow for agricultural purposes. The TRAIL selection effect is estimated to be Rupees 417 but is not statistically significant, suggesting that households recommended by the agent did not borrow a significantly different amount from those not recommended, absent the program (column 6). However the TRAIL treatment caused overall borrowing to increase substantially, by Rs. 7126 (column 4), which represents almost a 100 percent increase over the Rs. 7280 mean borrowing by Control 1 borrowers (column 7). Households that formed groups in the GBL villages also borrowed a similar amount on average to those who did not form groups (column 5) but the program loans caused their borrowing to increase significantly by Rs. 6464 (column 3), which is an 88 percent increase over the mean.

To check if the program loans crowded out loans from other sources, Row 3 in Panel A examines if total borrowing for agricultural purposes through non-program loans decreased as a result of treatment. The treatment effects are small in magnitude and non-significant for both TRAIL and GBL borrowers. This indicates that the program loans given by Shree Sanchari were a net addition to the agricultural borrowing of the treated groups, consistent with the idea that sample households face credit constraints in agriculture.

Row 2 shows effects on the unit cost of borrowing. Note first that consistent with our theoretical prediction that GBL groups include a larger fraction of floating borrowers who pay higher interest rates in the informal market, we find that the selection effect in the GBL scheme is significantly positive: households that formed groups paid on average 4 percentage points higher annually for agricultural credit than those who did not form groups. In contrast the TRAIL selection effect is small and non-significant. Next, we find that for both TRAIL and GBL schemes, the treatment caused the average annual interest rate on agricultural loans to decrease significantly.[23] For TRAIL borrowers the cost of credit decreased by 3 percentage points (a 12.5 percent reduction over the Control 1 mean), and

[23] We computed this interest rate using household reports of the principal of each loan, the repayment amount due, and the repayment schedule. Trade credit was also counted as a loan and recorded as such, and included in the total borrowing and used to compute the cost of borrowing. Since we asked detailed questions about input purchases in each cycle, we were able to cross-check that inputs purchased on credit were always accounted for.

for GBL borrowers it decreased by 7 percentage points (a 29 percent reduction).

Row 4 shows the treatment had no spill-over effects on the cost of borrowing from non-program sources. This is consistent with the idea that being recommended/forming a group and then receiving a program loan did not change the local information about these households' inherent repayment probabilities, or substantially change these probabilities.

4.1.2 Effects on Cultivation and Farm Incomes

Since the treatment caused total borrowing for agricultural purposes to increase, one would expect it to have created real effects through increased agricultural activity. Since the loans were designed specifically to make it possible to finance the cultivation of the major cash crop, potatoes, we present first the estimated effects on potato cultivation.[24]

Row 5 of Table 5 shows that households recommended by the TRAIL agent were likelier (by 9.5 percentage points, which is 14 percent of the Control 1 mean of 68%) than average to cultivate potatoes. Receiving the program loans did not change this probability significantly, but it did change the acreage devoted to potatoes by potato cultivators (by 0.09 acres, 20 percent of the Control 1 mean, Row 6). About half of this increase in acreage was achieved by leasing in more land (Row 7). TRAIL treatment households also spent more on inputs (Row 8) and produced higher output (treatment effect is 18% of Control 1 mean, Row 9). The net effect is an 18% increase in revenue of 18% (Row 10), and an 18% increase in value-added (Row 11). Value-added is computed by subtracting from revenues only the costs of purchased or rented inputs.[25] Importantly, self-provided inputs are not accounted for, the most important of which is typically family labor. Row 12 shows a small and statistically insignificant increase in family labor hours devoted to potato cultivation. We impute a cost of family labor at the average market wage rate for hired labor in the village (which is an upper bound to the shadow cost of family labor) to obtain an estimate of imputed net profits from potato cultivation (Row 13). The TRAIL treatment effect on imputed net profit is Rs 1676, which is 21% of the control 1 mean. For GBL households, the point estimates suggest that households that formed GBL groups cultivated smaller quantities of potatoes, spent less on inputs and earned lower revenue and value-added (Column 5). However, although the program loans increased these (Column 3) the treatment effects are estimated imprecisely, presumably due to the high variance in the productivity of these households. As a result the average effect is not significant.

Panel C of Table 5 shows program effects on incomes earned from other main crops (paddy, sesame and vegetables). TRAIL loans caused farmers to increase acreage devoted to these

[24]See Panel A in Table A-3 in online Appendix A-1 for the full set of results.

[25]For all inputs purchased, we asked the respondent to report both the payment made immediately upon purchase and the amount of trade credit received. The total cost of the input is calculated as the sum of the two. For share-cropped land the household reports to us the share of the harvest that is paid to the landlord. We use this in combination with the harvest quantity and the price at which the harvest was sold to compute the monetary value of this rental payment.

crops as well, but although positive, the increases in harvest, revenue or value-added were not significantly different from zero. For GBL borrowers also there was no significant increase in value-added from any of the other crops.

Finally in Row 20 we present the treatment and selection effects on total farm income of the households, aggregating across all crops. Given the large share of potatoes in total cultivation, the positive TRAIL treatment effect on value-added from potatoes leads to a large, positive and statistically significant TRAIL treatment effect on overall farm profits, of the order of 25% over the Control 1 mean. In contrast, GBL loans had a negligible and statistically insignificant treatment effect on total farm income.

4.2 Testing Theoretical Assumptions and Predictions

Having estimated the large positive effects of the TRAIL scheme on borrowers' agricultural value-added and incomes, we now examine the mechanisms behind these effects.

4.2.1 Comparing Productivity of Selected TRAIL and GBL Borrowers

First, we test the prediction that households recommended by TRAIL agents were more productive than households that formed groups in GBL villages. Assuming that revenue is a Cobb-Douglas function of the cost of production, we estimate the regression

$$\begin{aligned}\log(\text{Revenue}_{iv}) = \alpha_0 + \alpha_1 \text{TRAIL}_v + \alpha_2(\text{GBL}_v \times \log \text{Cost}_{iv}) + \alpha_3 \ (\text{TRAIL}_v \times \log \text{Cost}_{iv}) \\ +\alpha_4(\text{GBL}_v \times \text{Recommended}_{iv}) + \alpha_5(\text{TRAIL}_v \times \text{Recommended}_{iv}) + \gamma \ \mathbf{X}_{iv} + \varepsilon_{iv}\end{aligned} \tag{2}$$

for household i in village v. This is run for each separate crop, as well as after aggregating across all 4 major crop categories.[26] Cost refers to cost of cultivation. Given our finding above that program loans caused households to expand cultivation of all crops, we use assignment to treatment as an instrument for the cost of cultivation. The underlying identification assumption is that treatment status does not affect productivity. This is because productivity depends on network relationships, which are available whether or not the household receives a loan. Under this identification assumption, we obtain consistent estimates of the elasticities α_2 of revenue with respect to cost for GBL households, and α_3 for TRAIL households, which are presented in Panel A of Table 6. This enables us to estimate the rate of return on the additional cultivation costs incurred as a result of receiving program loans. Specifically, we can estimate $\text{RoR}_{\text{GBL}} = (\alpha_2 \times \frac{Revenue}{Cost}) - 1$, and $\text{RoR}_{\text{TRAIL}} = (\alpha_3 \times \frac{Revenue}{Cost}) - 1$. As seen here, a 1 percent increase in the cost of potato cultivation for TRAIL borrowers caused their revenue from potatoes to increase by a statistically significant 0.8 percent, which translates into a rate of return of 72%. In

[26]The vector of control variables includes the land owned by the household, a year dummy and a dummy variable for the information intervention, as described in Section 4.

contrast, an increase in the cost of cultivation for GBL borrowers did not increase revenue significantly. Since potatoes are a major source of agricultural income in this region, the large impact of TRAIL loans on potato output also translates into a large effect on total farm income: we estimate a rate of return of 103 percent on TRAIL loans.

An alternative, less parametric procedure of estimating rates of return is shown in Panel B of Table 6. We calculate directly the ratio of the treatment effect on value-added, to the treatment effect on cultivation cost in TRAIL and GBL respectively. These are reported in Panel B, with standard errors computed by bootstrapping using 600 replications. The rate of return achieved by the TRAIL treatment group in potato was 105%, and for total farm income was 115%, both statistically significant at the 1% level. The rates of return achieved by the GBL treatment group were a substantially smaller 9% and negative 1% in Panel B, neither of which are statistically significant.

4.2.2 Selection Patterns in TRAIL and GBL

We showed above that TRAIL borrowers were more productive than GBL borrowers. In our theoretical model this occurs because TRAIL agents recommend households that belong to their own network, who benefit from network benefits, rather than floating borrowers who do not receive any network benefits. In Table 7 we test if TRAIL agents showed a preference for recommending households that belonged to their own network. We run a linear probability regression of the form

$$\text{Recommended}_{iv} = \alpha_0 + \sum_{k=1}^{3} \beta_k (\text{Interacted with agent in market } k)_{iv} + \gamma\, \mathbf{X}_{1iv} + \varepsilon_{iv} \quad (3)$$

on the sample of households owning at most 1.5 acres of cultivable land in TRAIL villages. On the left hand side we have an indicator variable for whether household i in TRAIL village v was recommended for a TRAIL loan by the agent, and on the right hand side, three variables indicating whether the household had interacted with the agent in the three years prior to this study – by buying inputs from, borrowing from, or working for the agent. We control for a range of other household demographics and assets, including land owned. In line with our prediction, we see in Column 1 that households that had borrowed from the agent in the past, were 14 percentage points (or 6 times) more likely to be recommended than households that had not interacted with him. In Column 2 we include indicators for the household's religion and caste, and also interact them with the agent's religion and caste. Clearly, agents were more likely to recommend households that belonged to the same religion or caste as themselves. However, note that there remains a strong significant effect of prior borrowing, suggesting that a prior credit relationship and possibly information acquired about the household through this relationship, are independently important in the agent's decision of whom to recommend.

Consider now the interest rate that the households paid on informal loans taken prior to this lending scheme, as a measure of their inherent default risk. We use this measure to test the hypothesis that TRAIL agent recommended farmers with below-average default risk, whereas the GBL scheme attracted households with above-average default risk. We expect that (*i*) among the group of sample households that had interacted with the agent previously, those that he recommended had paid a relatively low interest rate; (*ii*) the average default risk of GBL group-members was higher than that of the general population; and (*iii*) the average default risk of GBL group-members was higher than TRAIL recommended households.

To test hypothesis (*i*) we run the regression

$$\begin{aligned} r_{iv} = \beta_0 + \beta_1 \text{Recommended}_{iv} + \beta_2 \text{Interacted with agent}_{iv} \\ + \beta_3 (\text{Recommended}_{iv} \times \text{Interacted with agent}_{iv}) + \gamma\ \mathbf{X}_{2iv} + \varepsilon_{iv} \end{aligned} \quad (4)$$

where r_{iv} is the average interest rate the household paid on informal loans reported in Cycle 1. The sample is restricted to households in TRAIL villages that owned at most 1.5 acres of land. The variable Interacted with agent is a summary indicator variable for whether the agent and the household had interacted in the input, credit or labour markets in the three years prior to the study. In Columns 1 and 2 of Table 8, we find that within the group of households whom he had interacted with in the past, those that the agent recommended were likely to have been charged interest rates that were on average 7 percentage points (or about 30 percent) lower than the interest rates paid by those within this group that were not recommended.[27,28]

This is in stark contrast to the borrower selection pattern in GBL villages seen in Columns 3 and 4, where we test hypothesis (*ii*). Households that formed GBL groups had paid over 5% points (or 27 percent) higher interest rates on the informal market than those who did not form a group. The GBL scheme thus attracted borrowers who were perceived by local lenders to be higher default risks than the rest of the village population.[29]

Finally, to test hypothesis (*iii*), we run the regression

$$r_{iv} = \beta_0 + \beta_1 \text{TRAIL}_{iv} + \gamma\ \mathbf{X}_{2iv} + \varepsilon_{iv} \quad (5)$$

[27]Columns 1 and 2 correspond to an OLS and a Heckman-selection-corrected regression of the informal interest rate respectively, where the correction is for selection of those who chose to borrow. The first round selection equation uses as an instrument a dummy variable for whether the household head reported cultivation as his primary occupation. Since agricultural production loans are much larger than consumption loans, this is a good predictor that the household reported at least one loan. The identifying assumption is that conditional on taking a loan, and all the included regressors such as landholding and caste, the occupation of the household head *per se* does not affect the interest rate.

[28]The coefficient on the Recommended dummy in Columns 1 and 2 has a positive but non-significant coefficient. This could be because the agent has less information about households that he has not interacted with in the past, and so he recommends from this group using criteria that do not correlate with default risk.

[29]Here we run the following regression

$$r_{iv} = \beta_0 + \beta_1 \text{Recommended}_{iv} + \gamma\ \mathbf{X}_{2iv} + \varepsilon_{iv}$$

on the sample of households that owned at most 1.5 acres of land in GBL villages.

on the pooled sample of TRAIL recommended and GBL group-forming households (Treatment and Control 1) that owned at most 1.5 acres of land. In the corresponding regression results in Columns 5 and 6, we see that the TRAIL agent recommended borrowers who had paid 6.4% points (or 24 percent) lower interest rates in the informal market than those who formed GBL groups. This is consistent with our model's prediction that the GBL scheme attracts a larger proportion of floating borrowers.

4.2.3 Repayment and Take-up Patterns in TRAIL and GBL

The preceding results suggest the TRAIL agent selected borrowers who were more productive and had a lower risk of default. However, borrowers in the GBL scheme have the benefit of joint liability: even when their own projects fail, their group members have an incentive to repay the loan on their behalf. This positive effect on loan repayment could overwhelm the negative effect of being less productive, and so there is no clear theoretical prediction for which of the two schemes would generate higher repayment rates.

Panel A of Figure 1 shows the evolution of repayment rates in TRAIL and GBL across the six loan cycles, along with the corresponding 90% confidence intervals. Repayment rates were high in both schemes: at the end of 6 cycles, the average repayment rate was 98 percent in the TRAIL scheme, and 91 percent in the GBL scheme.[30]

The take-up rate of loans in our two schemes could also be a useful metric of the extent to which these loans affected borrower welfare *ex ante*. A low take-up rate would indicate that households did not expect to receive large benefits from the loans. In Panel C we present the take-up rate, which is the proportion of those eligible to borrow at the outset of Cycle 1 who took the loan in any subsequent cycle. In Panel B of Figure 1 we present the continuation rate, which is the proportion of those eligible to borrow in the cycle in question that actually took the loan. The continuation rate is jointly determined by past take-up, default (which would disqualify the household from participating in a subsequent cycle) and current take-up. Both panels show that borrower participation was consistently higher in the TRAIL scheme in all cycles. The differences are statistically significant in all cycles starting with Cycle 3.

[30]In column 1 of Table A-6 in online Appendix A-1, we show a regression of the repayment rate on Cycle 6 loans on the TRAIL treatment dummy, landholding and its square. The coefficient estimate on the TRAIL dummy is 0.09 and statistically significant at the 1% level. However, a borrower is only eligible for a loan in any cycle if he/she successfully repaid previous loans, and so repayment rates in Cycle 2 onwards are subject to selective attrition. This problem is avoided in an alternate measure: whether a household that was assigned to the treatment group in Cycle 1 continues to be eligible for future loans at the end of Cycle 6. (Households that are eligible in a cycle but choose not to borrow in that cycle continue to be eligible in the subsequent cycle.) In the regression result presented in column 2 of the table, we find that TRAIL treatment households are 6 percentage points (or 8 percent) more likely than GBL treatment households to be eligible for a future loan at the end of Cycle 6. This difference is statistically significant at the 10% level.

5 Robustness Checks and Sensitivity Analysis

In this section, we examine a number of ancillary issues that affect our assessment of the success of the TRAIL scheme in enhancing borrowers' welfare. These involve (*i*) possible compensatory effects on non-farm incomes; (*ii*) sensitivity of farm income effects to price and wage fluctuations; (*iii*) sensitivity of the standard errors to the choice of the cluster (*iv*) the possibility that borrower benefits may have been siphoned off by the TRAIL agent through higher input, lower output prices or higher interest rate on loans; and (*v*) distributive impacts.

5.1 Effect on Non-Farm Incomes

Did the increase in TRAIL borrower farm incomes come at the expense of non-farm incomes? Conversely, could the GBL loans have had positive treatment effects on non-farm incomes instead of agricultural incomes? Table 9 suggests otherwise. We see positive but imprecisely-estimated effects of the TRAIL loans on rental income, income from sales of animal products, labor income, reported business profits, current value of business and total household income from non-agricultural sources. The treatment effects of GBL loans are smaller and also estimated imprecisely. The point estimate of the GBL treatment effect on aggregate non-farm income is negative, while that for TRAIL is positive, though both are statistically indistinguishable from zero.[31]

5.2 Sensitivity to Potato Price Fluctuations

The production of cash crops usually involves high risk, part of which arises from price fluctuations. Potato prices exhibit substantial volatility across years, as well as over time within the year, as explained in detail in Mitra, Mookherjee, Torero, and Visaria (2013). In our sample villages the median farmgate price for the two most widely-grown varieties of potatoes was on average Rs 2.34 in 2008, Rs 3.85 in 2011 and Rs 5.36 in 2012. In Table 10 we show how estimated treatment and selection effects for potato value-added would have been affected had farmers faced different potato prices than they actually did. In particular, we impute the farmers' revenue from potato sales using the average of the village-level median prices from a different year but the actual quantity sold and actual cost of cultivation. Row 1 is identical to Row 11 in Table 5, and shows estimated effects on value-added given actual prices at which farmers sold. Row 2 is computed as if all farmers sold potatoes at Rs. 3.85 which was the average price in 2011, Row 3 is computed as if they sold them at Rs. 5.36, and so on. As is to be expected, there is a rank-ordering of the size of the estimated treatment effects that matches the ordering of the prices used: the TRAIL treatment effects would have been largest if farmers had sold their produce

[31] The full set of results are presented in Table A-5 in online Appendix A-1.

in both years of the study at the high 2012 price. They would have been insignificant if they had sold it at the low price of 2008. The GBL treatment effects would have always been negative and insignificant.[32] These variable treatment effects are not surprising: the scheme successfully financed agriculture, therefore it is to be expected that agricultural price fluctuations would drive profitability from year to year. This may also explain why, in the absence of this scheme, TRAIL borrowers did not take advantage of the large gap between the estimated rates of return (70%) and the cost of borrowing (around 26%) in order to borrow and cultivate even more potatoes than they already did. The rate of return that farmers anticipate at the time of planting or cultivation in any given year is probably considerably below what we calculated in the years of the experiment.

This uncertainty in the treatment effect on value-added highlights the need for any credit scheme aimed at agricultural finance to also provide insurance against aggregate risk. As stated earlier, although it was not triggered in our study period, both the TRAIL and GBL schemes included index insurance, so that the repayment obligation would have been reduced if the local revenue per acre had fallen by 25% or more relative to a 3-year historical average, thus limiting the losses to the borrower households. This feature may have positively affected the take-up of the program loans, relative to other loans that may already be available in the formal and informal market.

5.3 Sensitivity to Choice of Cluster

Standard errors in all our regressions discussed so far are clustered at the village level, to account for spatial correlation in outcomes. However, it could be argued that the relevant unit at which outcomes are correlated is the specific network that the household is part of. Although we did not map actual networks in our sample villages, we can follow the theoretical model and identify in our sample an alternative clustering variable. Since the model predicts that TRAIL agents would recommend borrowers from within their own network, we can assume that in TRAIL villages, all recommended borrowers (Treatment and Control 1) belong to the agent's network and are placed in a common cluster. In GBL villages we assume that all 5 members of each self-formed GBL group belong to a common network and so are placed in clusters corresponding to their group. All Control 2 households are assumed to belong to singleton clusters. When standard errors are estimated using these alternative cluster definitions, the results on the program effects on potato cultivation, output, value-added and profits are very similar to those presented in the Table 5.[33]

[32] The full set of results are presented in Table A-7 in online Appendix A-1.

[33] These results are presented in Table A-8 in online Appendix A-1.

5.4 Extraction by Agent in Other Spheres of Interaction

We argued above that the TRAIL agent recommended borrowers from his own network and that network ties caused him to internalize the benefits to the borrowers. A natural question that arises then is whether he extracted these benefits from the borrowers, thus reducing the net benefit to the borrowers themselves. This extraction could occur in the form of a bribe in return for being recommended, or a side-payment, say after the harvest season. Alternatively, this extraction could have take place indirectly through manipulation of other transactions among the lender and own-network borrowers. The TRAIL agent could have increased the quantity that the borrower must sell to him at a discounted price, or adjusted downward the price he paid for the output. Alternatively, the agent could have sold inputs at higher prices to the borrower. Finally, the agent might have charged higher interest rates on loans.

Naturally, it is difficult to collect data on bribery or side-payments between borrowers and agents. However, we do have detailed data on input purchase and output sale of sample households, collected every four months, which we can use to test if the agent extracted rents from TRAIL borrowers through these channels.[34]

In Table 11 we analyse input, output and credit transactions reported by sample households in TRAIL villages. Column 4 shows the mean incidence of such transactions for the Control 1 households. The first two rows of Panel A show that over the 6 cycles, only approximately 9% of input transactions by Control 1 households were with the agent, accounting for 8% of input values purchased. The top rows of Panel B show that 21% of output transactions of control 1 households were with the agent, representing 15% of the transaction value, and the top two rows of Panel C show that 17% of Control 1 households borrowed from the agent, accounting for only 5% of the total borrowing by households. It does not appear that the agent had a monopoly or near-monopoly on these transactions in the village.[35]

Columns 1 and 2 present the treatment and selection effects. Looking first across Panels A and B, Column 2 shows that recommended households were slightly more likely to buy and sell from the agent. However, the effects are statistically non-significant for the most part, with the exceptions that recommended households paid significantly lower rents on power-tillers to the agent, and sold a significantly higher fraction of their output to the agent. Hence it does not appear to be consistently true that agents charged higher prices to recommended households as payment for recommending them. We also do not find in Column 1 that recommended households that actually were randomly selected to receive loans, transacted larger quantities with or paid higher prices to/received lower prices from the agent. The treatment effect is significant only for the rental rate on power tillers and in fact shows that Treatment households could rent power tillers even more cheaply from the agent than Control 1 households. If anything, the benefits of the TRAIL loan obtained

[34]Students in Boston University's Masters of Global Development Studies program did fieldwork and very helpful analysis addressing this question (Ah-Tye, Bai, Blanco, Pheiffer, and Winata, 2013).

[35]See Tables A-9 – A-11 for the full set of results.

by the borrower were supplemented by cheaper inputs purchased from the agent, the very opposite of the hypothesis that the benefits were being siphoned off by the agent.

In Panel C we consider the borrowing from the agent during the 6 cycles, and the interest rate charged. Recall from Table 7 that the agent was more likely to recommend households that had borrowed from him in the 3 years prior to the program. Column 2 shows that recommended borrowers continue to be more likely to borrow from the agent, and also receive a larger share of their total borrowing from the agent. However, presumably because they now receive the program loans, treatment households become *less* likely to borrow from the agent during the 6 cycles. Interest rates charged by the agent also do not change.

Overall, we do not find evidence that the agent extracted side-payments from the borrowers by engaging in greater volume of transactions, or charging higher prices/paying lower prices to the borrowers. It appears likely that the TRAIL treatment households retained control over the program benefits that accrued to them.

5.5 Heterogeneity in Selection and Distributive Impacts

We have thus far discussed the estimated effects of the TRAIL and GBL schemes on the average borrower. In Maitra, Mitra, Mookherjee, Motta, and Visaria (2014b), we study the heterogeneity of treatment and selection effects, which are relevant to evaluating distributive impacts of the different schemes. First, compared to the households that the TRAIL agent recommended, households that formed groups in the GBL villages were less likely to own land, and more likely to belong to socio-economically weak sections of society. In particular, TRAIL agents were likely to recommend farmers who owned between 0.5 and 1 acres of land, whereas GBL groups were more likely to be formed by households that owned less than 0.25 acres of land. Also, possibly due to historical caste-based occupational patterns, most TRAIL agents did not belong to a scheduled caste. They were less likely to recommend scheduled caste borrowers, perhaps because they had not lent money to them in the past and therefore were not informed about their default risk. Hence while the TRAIL scheme had superior effects on cultivation, output and income, the GBL scheme was more likely to expand credit access for the socio-economically weaker sections of the village population. Note again, however, that the GBL scheme did not generate significant positive impacts on output or income for borrowers.

Second, the TRAIL loans had different treatment effects on the allocation of time by male and female members of the household. Females tended to reduce labor hours in employment outside the household and correspondingly spend more time on non-agricultural self-employment, but their total hours worked on the family farm or in the aggregate did not change significantly. In contrast, male members significantly increased hours of work on the family farm, and to some extent on other self-employment, without cutting back on hours spent on employment outside the household. We find no effects of the schemes on the demand and supply of child labour in the borrower households.

Finally, the effects of the schemes differed by the land-size category of borrowers. The treatment effects in both schemes were significantly stronger for households that owned 0.5 – 1 acres of land. It is possible that local intermediaries interact more intensively with households in this category, because they have greater marketable surplus to sell to traders, or are in greater need of agricultural credit.

6 Financial Sustainability

Lending institutions usually evaluate loan programs in terms of their repayment rates, clientele size and administrative costs. We have shown that both repayment rates and loan take-up rates were higher for the TRAIL than the GBL scheme. In addition, it cost the MFI less to implement the TRAIL scheme than the GBL scheme. The per-month cost of operating the GBL scheme in a village was Rupees 1463, whereas the cost of running the TRAIL scheme was only Rupees 68 per village: a difference of almost Rupees 1400 per village. About 80 percent of this difference is explained by lower salary costs and transport expenses for loan officers, which followed from the absence of meetings in the TRAIL design. The MFI also paid for the services of an office assistant for the GBL villages, and made phone calls and additional visits to the village to negotiate with the borrowing groups, which it did not do in the TRAIL villages.

Thus our results show that the TRAIL scheme delivered superior results on borrower impacts, repayment and take-up rates, at a lower cost than the traditional group-based lending scheme. Nevertheless, at the 12 percent per annum that Shree Sanchari would have paid for loanable funds from formal financial institutions in India, it would not have broken even on the TRAIL scheme.[36] However, cheaper financing options would allow this scheme to become financially sustainable. If our results generalize to other settings, the TRAIL scheme would become viable at an even higher cost of funds than the GBL scheme would.

7 Conclusion

The problem of identifying creditworthy borrowers and ensuring repayment in the absence of collateral have made agricultural finance in developing countries notoriously cost-ineffective. While microcredit has famously solved these problems by leveraging local information and enforcement, it is not usually used as a source of agricultural finance. In this study, we have demonstrated that it is possible to build on the key principles of microcredit

[36] For example, in Cycle 1, if all loans were repaid in full, the total loan interest generated from 10 loans would be Rupees 1200. Shree Sanchari would retain 25 percent of this after paying agent commissions. Since a cycle lasts 4 months this would generate a revenue of Rupees 75 per month per village, which would cover the administrative cost of Rs 68 mentioned above, but not the cost of funds of Rs. 200 per month per village in Cycle 1.

and design a lending mechanism that targets productive farmers who earn high rates of return and repay the loans with high probability.

The trader-agent intermediated lending (TRAIL) scheme involved individual liability loans at below-market-average interest rates, durations that matched crop cycles of the most important cash crop in the region, and insured against local yield and price shocks. The scheme was particularly successful at inducing selected beneficiaries to increase the cultivation and output of potatoes. This did not come at the cost of reduction in income from any other source that we measured. We explained this result in terms of the underlying selection patterns: TRAIL agents recommended households from among their own networks that they knew were low-risk borrowers and had high productivity. The GBL scheme employed the traditional group-based micro-finance approach to borrower selection, and did not generate comparable positive effects on farm output. We argue this is because both high and low productivity households participated in the GBL scheme. However possibly due to joint liability incentive to repay on behalf of defaulting group-members, the GBL loans also had high repayment rates, although marginally lower than for TRAIL loans. Loan take-up rates were higher in the TRAIL scheme, indicating higher *ex ante* effects on borrower welfare. We also found no evidence that TRAIL agents siphoned off the benefits of recommended or treated borrowers.

It is clear that TRAIL borrowers increased their output of the cash crop as a result of the expanded credit access. The high crop prices prevailing during the years of the experiment ensured that this translated into large positive effects on value added and income. The effects would have been much smaller had prices been lower, as they were as recently as 2008. This is consistent with the well-known fact that agricultural prices fluctuate considerably from year to year, and therefore agriculture is a high-risk enterprise. This underscores the need for agricultural financing schemes to also include an insurance component. It is likely that the crop insurance that both our schemes provided contributed positively to their high take-up rates.

Nevertheless, the fact that the TRAIL scheme lowered borrowing costs, and induced borrowers to expand the cultivation scale of potatoes, suggest that there were positive *ex ante* welfare improvements. The absence of mandatory group meetings, savings requirements, or the burden of joint liability also likely lowered the costs of participating in the scheme.

For the lender, administrative costs were considerably lower in the TRAIL scheme than the GBL scheme. The bulk of the cost savings came from lower outlays on loan officers' salaries and transport, since the TRAIL design did not require bi-monthly meetings with borrowers. However, the lender paid 75% of the loan interest received on TRAIL loans to the agents, whereas it retained the entire interest received on GBL loans. In some developing countries, government policy ensures that institutions that offer microcredit and agricultural financial services have access to funds at lower than the market interest rate.[37] In such environments, the lender could break even or earn profits from the TRAIL

[37]Notably, in Bangladesh, MFIs receive loanable funds from a government-sponsored agency at roughly

scheme. Coupled with the large effects on agricultural production and farm incomes, this approach could help to fulfill the promise of microfinance.

half the interest rate that commercial banks charge.

References

Ah-Tye, T., O. Bai, J. Blanco, C. Pheiffer, and S. Winata (2013): "The Effect of Social and Economic Ties on Loan Repayment in Agent-Intermediated Lending in West Bengal, India," Master's thesis, Boston University.

Armendáriz, B., and J. Morduch (2005): The Economics of Microfinance. MIT Press, Cambridge, MA.

Bandiera, O., and I. Rasul (2006): "Social Networks and Technology Adoption in Northern Mozambique," Economic Journal, 116(514), 869 – 902.

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. (2013): "Microcredit Under the Microscope: What Have We Learned in the Past Two Decades, and What Do We Need to Know?," Annual Review of Economics, 5, 487 – 519.

Besley, T., and S. Coate (1995): "Group lending, repayment incentives and social collateral," Journal of Development Economics, 46(1), 1 – 18.

Casini, P. (2010): "Competitive Microcredit Markets: Differentiation and ex-ante Incentives for Multiple Borrowing," Licos discussion papers 26610, LICOS - Centre for Institutions and Economic Performance, K.U.Leuven.

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

Conley, T. G., and C. R. Udry (2010): "Learning about a New Technology: Pineapple in Ghana," American Economic Review, 100(1), 35 – 69.

Demont, T. (2012): "The Impact of Microfinance on the Informal Credit Market: An Adverse Selection Model," Discussion paper, Namur.

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

Feder, G. (1985): "The relation between farm size and farm productivity : The role of family labor, supervision and credit constraints," Journal of Development Economics, 18(2-3), 297 – 313.

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

Foster, A., and M. R. Rosenzweig (1996): "Technical Change and Human-Capital Returns and Investments: Evidence from the Green Revolution," American Economic Review, 86(4), 931 – 953.

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

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

Guha, B., and P. R. Chowdhury (2012): "Borrower Targeting under Micro-finance Competition with Motivated MFIs," Discussion paper, Singapore Management University, School of Economics.

Jain, S. (1999): "Symbiosis vs crowding-out: The interaction of formal and informal credit markets in developing countries," Journal of Development Economics, 59(2), 419 – 444.

Jain, S., and G. Mansuri (2003): "A little at a time: the use of regularly scheduled repayments in microfinance programs," Journal of Development Economics, 72(1), 253 – 279.

Khandker, S., and H. Samad (2013): "Dynamic Effects of Microcredit in Bangladesh," Policy research working paper 6821, World Bank.

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.

Maitra, P., S. Mitra, D. Mookherjee, A. Motta, and S. Visaria (2014a): "Agent Intermediated Lending: A New Approach to Microfinance," Discussion paper, Mimeo, Boston University.

——— (2014b): "Distributive Impacts of Loans to Finance Smallholder Agriculture," Discussion paper, Mimeo, Boston University.

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

McIntosh, C., and B. Wydick (2005): "Competition and Microfinance," Journal of Development Economics, 78, 271 – 298.

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

Mitra, S., D. Mookherjee, M. Torero, and S. Visaria (2013): "Asymmetric Information and Middleman Margins: An Experiment with West Bengal Potato Farmers," Discussion paper, Mimeo, Hong kong University of Science and Technology.

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

Morduch, J. (1998): "Does Microfinance Really Help the Poor? New Evidence from Flagship Programs in Bangladesh," Discussion paper, New York University: New York.

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

Navajas, S., J. Conning, and C. Gonzalez-Vega (2003): "Lending technologies, competition and consolidation in the market for microfinance in Bolivia," Journal of International Development, 15(6), 747 – 770.

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.

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

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

Table 1: Randomization

	TRAIL		GBL		Difference
	Mean	SE	Mean	SE	TRAIL - GBL
Panel A: Village Level Differences					
Number of households	297.59	48.06	388.50	80.36	-90.91
Percent households electrified	0.60	0.06	0.59	0.05	0.01
Has primary school	0.77	0.09	0.79	0.08	-0.02
Has primary health centre	0.27	0.10	0.21	0.08	0.06
Has bank branch	0.14	0.07	0.17	0.08	-0.03
Has pucca road	0.27	0.10	0.42	0.10	-0.14
Panel B: Household Level Differences					
Male Head	0.95	0.01	0.94	0.01	0.01
Non Hindu	0.21	0.02	0.16	0.02	0.06**
Scheduled Caste (SC)	0.23	0.02	0.25	0.02	-0.02
Scheduled Tribe (ST)	0.05	0.01	0.04	0.01	0.01
Other Backward Caste (OBC)	0.06	0.01	0.06	0.01	-0.01
Household Size	5.13	0.12	5.32	0.11	-0.19
Age of Household Head	49.94	0.58	51.56	0.53	-1.61**
Household Head: Married	0.91	0.01	0.90	0.01	0.01
Household Head: Completed Primary School	0.50	0.02	0.49	0.02	0.00
Household Head: Occupation Cultivator	0.56	0.02	0.55	0.02	0.01
Household Head: Occupation Labor	0.22	0.02	0.22	0.02	-0.01
Household Head: Resident	0.99	0.01	0.99	0.01	0.00
Landholding (acres)	1.00	0.05	1.05	0.06	-0.05
Landless	.07	0.01	0.08	0.01	-0.01
Purchased inputs on credit	0.38	0.02	0.43	0.02	-0.05*
Received government benefits	0.54	0.02	0.62	0.02	-0.08***
Total Borrowing^{+}	6579.42	524.32	6417.26	489.24	162.52
Duration (Days)$^{+}$	124.88	1.57	122.47	1.27	2.40
Interest Rate (Per annum)$^{+}$	20.48	0.87	20.89	0.77	-0.40
Number of Loans^{+}	2.17	0.06	2.24	0.06	-0.06
Collateralized^{+}	0.02	0.00	0.01	0.00	0.01*
Joint Significance of Household Variables‡					27.07

Notes:
$^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$. ‡: $\chi^2(16)$. Panel A uses village census data collected in 2007-2008; Panel B uses the 2007-2008 sample, but data from the 2010 Cycle 1 survey. $^{+}$: Restricted to loans from informal sources for agriculture.

Table 2: Credit Market Characteristics

	All Loans (1)		Agricultural Loans (2)	
Does the household Borrow?	0.69		0.59	
Total Borrowing[†]	6221.78	(10140.18)	4952.85	(8607.67)
Proportion of Loans by Source[‡]				
Informal Lenders	0.65		0.66	
Family and Friends	0.05		0.03	
Cooperatives	0.23		0.24	
Government Banks	0.05		0.05	
Interest Rate (Annualized) by Source				
Informal Lenders	26.57	(24.14)	26.36	(24.51)
Family and Friends	20.53	(15.09)	19.84	(16.32)
Cooperatives	15.41	(3.07)	15.62	(3.15)
Government Banks	11.91	(4.30)	11.83	(4.65)
Duration (Days) by Source				
Informal Lenders	123.63	(27.54)	122.52	(20.29)
Family and Friends	168.92	(103.61)	174.13	(101.31)
Cooperatives	323.53	(91.19)	320.19	(93.97)
Government Banks	299.67	(108.95)	300.35	(108.74)
Proportion of Loans Collateralized by Source				
Informal Lenders	0.01		0.01	
Family and Friends	0.02		0.07	
Cooperatives	0.73		0.77	
Government Banks	0.77		0.83	

Notes:
The sample consists of sample households in TRAIL and GBL villages with less than 1.5 acres of land. All loan characteristics are summarized for loans taken by the household in Cycle 1. Program loans are not included. When computing interest rate summary statistics we do not consider loans for which the borrower reports that the principal amount equals the repayment amount.
†: Total borrowing = 0 for households that do not borrow.
‡: Proportion of loans in terms of value of loans at the household level. Proportion computed for households that borrow. Standard Deviations in parenthesis.

Table 3: Selected Crop Characteristics

	2011 Sesame (1)	2011 Paddy (2)	2011 Potatoes (3)	2012 Sesame (4)	2012 Paddy (5)	2012 Potatoes (6)
Acreage (acres)	0.44	0.70	0.48	0.46	0.70	0.48
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
Harvested quantity (Kg)	141.69	1153.46	5207.62	144.74	1187.24	5052.68
	(3.27)	(20.03)	(90.98)	(4.04)	(29.25)	(125.94)
Cost of cultivation (Rupees)	717.51	4495.50	10474.21	741.58	4939.15	10627.31
	(17.42)	(81.38)	(197.19)	(24.22)	(126.63)	(281.48)
Family labor (Hours)	26.57	41.23	58.92	29.02	44.56	61.62
	(0.39)	(0.61)	(0.86)	(0.60)	(0.93)	(1.18)
Price Received by Farmers (Rupees)	27.23	9.45	4.61	31.54	9.38	5.51
	(0.22)	(0.04)	(0.03)	(0.15)	(0.05)	(0.04)
Revenue (Rupees)	3005.74	7385.61	21208.61	3627.83	8080.20	24901.82
	(69.69)	(145.93)	(412.20)	(111.11)	(237.77)	(687.96)
Value-added (Rupees)	2286.77	2999.18	10615.09	2885.21	3149.42	14243.61
	(61.75)	(104.76)	(268.57)	(98.90)	(168.13)	(455.34)
Value-added Per Acre	5192.29	4310.88	22144.13	6320.40	4515.78	29584.66

Notes:
The sample consists of sample households in TRAIL and GBL villages with less than 1.5 acres of land. Standard Errors in parenthesis.

Table 4: Summary of Theoretical Predictions

Treatment		*Composition* C=connected F=floaters	*Observed Interest rate*	*Repayment Rate*	*Effective Cost of Credit*
TRAIL	Treatment	C	r_T	p_c	$(1-K)r_T$
	Control 1	C	$\frac{\rho_I}{p_c}$	p_c	$\frac{\rho_I}{p_c}$
	Control 2	C, F	$\frac{\rho_I}{p_c}, \frac{\rho_I}{p_f}$	p_c, p_f	$\frac{\rho_I}{p_c}, \frac{\rho_I}{p_f}$
GBL	Treatment	CC, FF	r_T	$p_c(2-p_c), p_f(2-p_f)$	$(2-p_c)r_T, (2-p_f)r_T$
	Control 1	CC, FF	$\frac{\rho_I}{p_c}, \frac{\rho_I}{p_f}$	p_c, p_f	$\frac{\rho_I}{p_c}, \frac{\rho_I}{p_f}$
	Control 2	C, F	$\frac{\rho_I}{p_c}, \frac{\rho_I}{p_f}$	p_c, p_f	$\frac{\rho_I}{p_c}, \frac{\rho_I}{p_f}$

Table 5: Program Impacts. Treatment and Selection Effects.

		Unit	Treatment TRAIL	Treatment GBL	Selection TRAIL	Selection GBL	Sample Size	Mean Control 1
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Effects on Total Borrowing and Cost of Borrowing								
1	Total Borrowing (All Loans)	Rs	7126.23***	6464.46***	-417.02	-919.86	2758	7279.76
2	Cost of Borrowing (All Loans)	Percent (Annualized)	-0.03**	-0.07***	-0.01	0.04**	2428	0.24
3	Total Borrowing (Non-program Loans)	Rs	-495.74	254.72	-372.19	-930.27	2601	7279.76
4	Cost of Borrowing (Non-program Loans)	Percent (Annualized)	0.01	-0.01	-0.01	0.04***	2159	0.24
Panel B: Effects on Potato Production								
5	Cultivate		0.0545	0.0492	0.0949***	0.0614	4163	0.677
6	Acreage	Acres	0.0896***	0.0402	0.0010	-0.0421	2718	0.432
7	Leased-in acres	Acres	0.0467**	0.0222	-0.00265	0.00447	2718	0.111
8	Cost of production	Rs	1774**	1308	372.8	-1111	2718	9538
9	Output	Kg	888.0***	278	145.4	-417.9	2718	4760
10	Revenue	Rs	3429***	1637	942	-2534	2718	19137
11	Value added	Rs	1687**	271.8	555.6	-1371	2718	9498
12	Family labour hours	Hours	6.03	4.906	-0.2	4.951	2718	57.86
13	Imputed profit	Rs	1676**	457	203.2*	-1665	2718	8076
Panel C: Comparing Acreage and Value-Added in Different Crops								
Sesame								
14	Acreage	Acres	0.0424*	0.0111	0.0192	-0.0052	2037	0.414
15	Value added	Rs	180	-158.3	-115.7	73.41	2037	2126
Paddy								
16	Acreage	Acres	0.0324**	0.0516	-0.0402	-0.00237	3054	0.641
17	Value added	Rs	271.6	573.6	-469.9	-759.6*	3047	2506
Vegetables								
18	Acreage	Acres	0.159**	-0.0197	-0.0161	-0.0145	402	0.196
19	Value-Added	Rs	1255	-1955	1329	-957.5	402	8325
Panel D: Effects on Household Income								
20	Total Farm Income	Rs	2621***	53.24	11466***	10066***	4163	10328

Notes: Standard errors, clustered at the village level are in parentheses. $^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$. Sample restricted to households with at most 1.5 acres. All regressions include TRAIL dummy, TRAIL dummy interacted with Treatment household, TRAIL dummy interacted with Control 1 household, GBL dummy interacted with Treatment household and GBL dummy interacted with Control 1 household, land owned by the household, a Year 2 dummy and a dummy for Information Village. The full set of results corresponding to presented in Table A-2 (corresponding to Panel A), Table A-3 (corresponding to Panels B and C) and Table A-1 (corresponding to Panel D) in online Appendix A-1.

Table 6: Rates of Return

	Potatoes	Total Farm Income
	(1)	(2)
Panel A: IV estimates based on Cobb-Douglas production function		
TRAIL (α_3)	0.83***	0.92***
	(0.16)	(0.16)
GBL (α_2)	0.67	0.63
	(0.47)	(0.56)
Implied RoRs at mean cost/revenue ratio		
TRAIL	0.72	1.03
GBL	0.37	0.38
Panel B: Bootstrapped estimates		
TRAIL	1.05***	1.15***
	(0.06)	(0.02)
GBL	0.09	-0.1
	(0.37)	(0.29)

Notes:
In Panel A, ROR defined as the elasticity of revenue on cost (from a regression of log revenue on log cost using assignment to treatment as the instrument) multiplied by ratio of revenue to cost. In Panel B, ROR defined as the ratio of the treatment effect on value added and the treatment effect on cost. Standard errors are bootstrapped with 600 replications. $^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$. Sample restricted to Treatment and Control 1 households with at most 1.5 acres of land.

Table 7: Selection: TRAIL

(Dependent Variable: Household was recommended into the scheme)

	(1)	(2)
Bought from agent	0.023	0.016
	(0.044)	(0.047)
Borrow from agent	0.139***	0.142***
	(0.037)	(0.035)
Work for agent	0.003	-0.005
	(0.049)	(0.055)
Non Hindu		0.030
		(0.143)
Non Hindu × Agent Hindu		-0.098
		(0.132)
SC		0.544***
		(0.031)
SC × Agent High Caste		-0.610***
		(0.036)
ST		-0.198*
		(0.108)
ST × Agent High Caste		0.218
		(0.166)
Constant	0.023	0.037
	(0.079)	(0.098)
Sample Size	1,031	1,031
Number of Villages	24	24

Notes:
Linear Probability Estimates. Dependent variable is household was recommended/selected into the scheme. Standard errors, clustered at the village level, are in parentheses. $^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$. Sample restricted to households with at most 1.5 acres. All regressions control for age, gender, educational attainment, primary occupation of the household head, household size, dummies for whether the household purchased on credit or received government transfers and landholding.

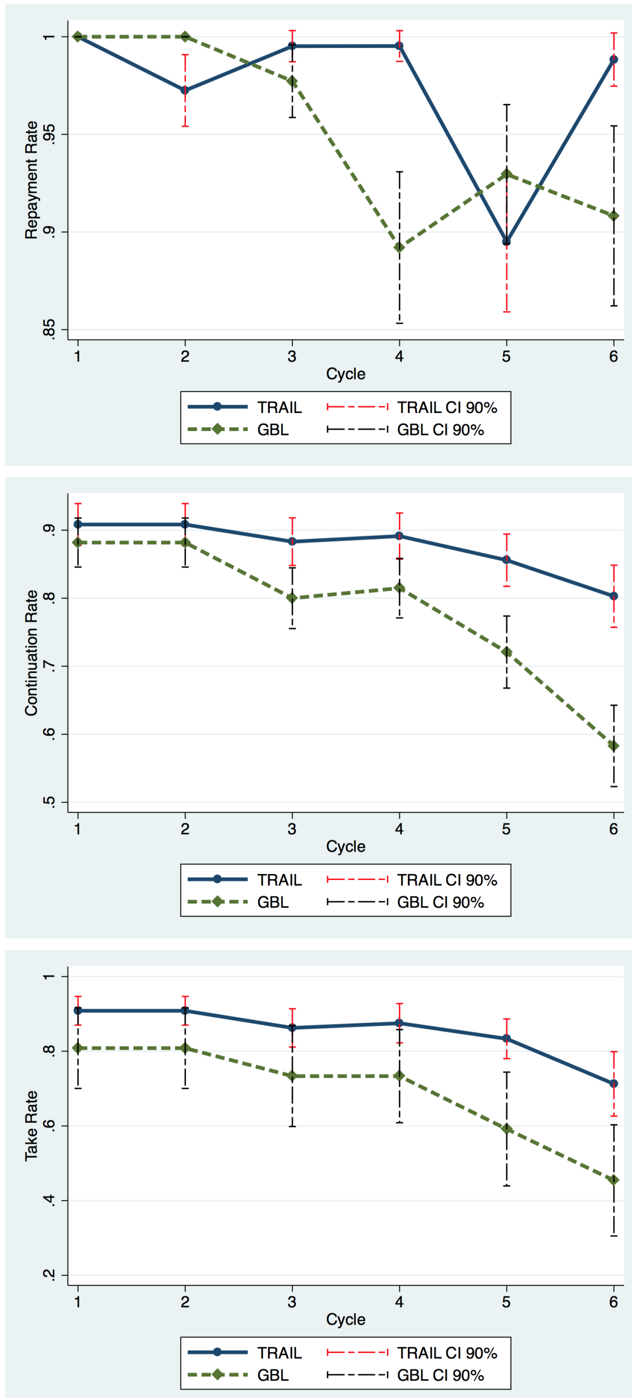
Table 8: Interest Rate Comparisons

(Dependent Variable: average interest rate paid on informal loans)

	TRAIL		GBL		TRAIL v GBL	
	OLS	Heckman	OLS	Heckman	OLS	Heckman
	(1)	(2)	(3)	(4)	(5)	(6)
Recommend	0.022	0.022	0.053*	0.052*		
	(0.016)	(0.017)	(0.027)	(0.029)		
Own-clientele	0.050	0.049*				
	(0.033)	(0.027)				
Own-clientele × Recommend	-0.071**	-0.071**				
	(0.026)	(0.035)				
TRAIL					-0.064	-0.064**
					(0.046)	(0.027)
High caste	-0.058***	-0.059***	0.134*	0.134***	0.053	0.053*
	(0.016)	(0.016)	(0.071)	(0.031)	(0.044)	(0.028)
Landholding	0.091	0.090	-0.103	-0.071	-0.047	-0.023
	(0.070)	(0.078)	(0.170)	(0.142)	(0.182)	(0.129)
Landholding Squared	-0.063	-0.062	0.065	0.050	0.053	0.042
	(0.044)	(0.052)	(0.129)	(0.093)	(0.136)	(0.086)
Constant	0.238***	0.240***	0.196***	0.151	0.271***	0.235**
	(0.013)	(0.068)	(0.027)	(0.118)	(0.046)	(0.112)
Inverse Mill's Ratio (λ)		-0.002		0.038		0.032
		(0.055)		(0.095)		(0.098)
Sample Size	438	1,032	417	1,038	412	911

Notes:
The dependent variable is the average interest rate the household pays on loans taken from traders or moneylenders, for non-emergency and non-consumption purposes, in Cycle 1. The sample in columns 1 and 2 consists of all sample households in TRAIL villages. The sample in columns 3 and 4 consists of all sample households in GBL villages. The sample in columns 5 and 6 consists of all Recommended (Treatment and Control 1) households in TRAIL and GBL villages. Columns 2, 4 and 6 report the results of the second step of a Heckman two-step regression, where the first stage selection regression estimates the likelihood that the households takes a non-emergency and non-consumption loan from a trader or moneylender in Cycle 1. Explanatory variables included in the first stage are Landholding, Landholding squared and an indicator variable for cultivator household. Standard errors are in parenthesis. In columns 1, 3 and 5, standard errors are clustered at the village level. $^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$. Sample restricted to households with at most 1.5 acres.

Figure 1: Loan Performance: Repayment, Continuation and Take-up Rates



Panel A: Repayment conditional on being eligible and continuation

Panel B: Takeup/Continuation conditional on eligibility

Panel C: Maximum number eligible in each village is 10

Table 9: Treatment Effect on Non-Farm Income.

		Treatment		Selection		Sample	Mean
		TRAIL	GBL	TRAIL	GBL	Size	Control 1
1	Rental Income (Rupees)	153.6	784.4	-182.1	-427.9	4162	1508
2	Income from Animal Products (Rupees)	166.8	49.18	62.66	-279.1	4162	771
3	labour income (year; Rupees)	393	-5642	-12729**	-4941	4162	37465
4	Wage employment (last 2 weeks; Hours)	0.615	-4.496	-6.855*	1.749	4162	40.24
5	Self-employment (last 2 weeks; Hours)	6.884	4.294	0.215	5.914*	4162	121.8
6	Reported profits (Rupees)	2343	2918	100.9	-1917	4162	5802
7	Current value business (Rupees)	4917	6692	952.1	353.8	4162	10465
8	Total Non-Farm Income (Rupees)	3056	-1890	-12748	-7565	4162	45546

Notes:
Standard errors, clustered at the village level are in parentheses. $^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$. Sample restricted to households with at most 1.5 acres. All regressions include TRAIL dummy, TRAIL dummy interacted with Treatment household, TRAIL dummy interacted with Control 1 household, GBL dummy interacted with Treatment household and GBL dummy interacted with Control 1 household, land owned by the household, a Year 2 dummy and a dummy for Information Village. Full set of results presented in Table A-5 in Online Appendix A-1

Table 10: Sensitivity of Treatment Effects for Potato Value Added to Price Changes.

Dependent Variable: Value added (Actual/Imputed)

		Treatment		Selection		Sample	Mean
		TRAIL	GBL	TRAIL	GBL	Size	Control 1
1	Actual	1687**	271.8	555.6	-1371	2718	9498
2	2011 prices	1833***	-541.4	-63.12	-258.2	2516	8687
3	2012 prices	3370***	-299.7	-42.65	-764.3	2516	15859
4	2008 prices	304.0	-782.0	-83.48	245.5	2516	1550

Notes:
Standard errors, clustered at the village level are in parentheses. $^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$. Sample restricted to households with at most 1.5 acres. All regressions include TRAIL dummy, TRAIL dummy interacted with Treatment household, TRAIL dummy interacted with Control 1 household, GBL dummy interacted with Treatment household and GBL dummy interacted with Control 1 household, land owned by the household, a Year 2 dummy and a dummy for Information Village. Full set of results presented in Table A-7 in Online Appendix A-1.

Table 11: Treatment and Selection Effects for Transactions with TRAIL Agent

	Treatment Effect (1)	Selection Effect (2)	Sample Size (3)	Mean Control 1 (4)
Panel A: Input Purchase				
Buy any Input from agent†	-0.00338	0.00780	12,448	0.0875
Share of agricultural input purchased from agent	-0.00359	0.0187	10,196	0.0760
Input Price (Rs/unit)				
Inorganic fertilizer	-0.322	0.170	1,672	13.78
Organic fertilizer	29.39	-4.024	370	16.12
Outside seeds	2.174	-2.863	1,654	22.36
Pesticide	-31.08	-25.32	2,691	533.5
Powertiller	-32.33***	-33.23**	1,403	195.2
Water/irrigation	148.3	-148.3	1,230	72.30
Panel B: Output Sold				
Sold output to agent†	0.00559	0.00560	2,990	0.209
Share of output sold to agent	0.0152	0.0465*	2,765	0.151
Output Price (Rs/kg)				
Potato	0.098	0.00955	1,386	4.507
Paddy	0.0289	-0.149	498	9.282
Sesame	-7.817	8.429	881	28.42
Panel C: Borrowing				
Borrowed from agent†	-0.082*	0.060*	1398	0.173
Share of total borrowing from agent	-0.036**	0.016*	1398	0.049
Interest rate (APR)	-0.003	0.007	4320	0.145

Notes:
Standard errors, clustered at the village level are in parentheses. $^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$. Sample restricted to sample households in the TRAIL villages. Borrowing (in Panel C) restricted to agricultural purposes. All regressions include TRAIL dummy interacted with Treatment household, TRAIL dummy interacted with Control 1 household, land owned by the household, a Year 2 dummy and a dummy for Information Village. †: Purchased inputs from , sold output to or borrowed from agent in the last 2 years. Full set of results presented in Table A-9 (corresponding to Panel A), Table A-10 (corresponding to Panel B) and Table A-11 (corresponding to Panel C) in Online Appendix A-1.

For Online Publication

A-1 Alternative Theoretical Models

In this appendix we explain how similar predictions would be generated with alternative models of the informal credit market based on noncooperative behavior and adverse selection or moral hazard.

The following assumptions are common to all the models:

- The informal credit market is segmented. In each segment there is one lender who is in a privileged position to deal with borrowers in that segment. Lenders in different segments engage in price competition with one another. All lenders face a common cost of capital ρ_I and have no capacity constraints.
- Borrowers are shielded by limited liability, have no collateral, and require capital to start a productive project.
- We allow for side-contracts between informal lenders and borrowers, which are unobservable to the MFI.
- All parties are risk neutral.
- The TRAIL and GBL loans charge interest rate $r_T < \rho_I$.

- *Adverse Selection Model*: This model is based on Ghatak (2000). Borrowers know the riskiness of their own and each other's projects. A safe project succeeds with probability $p_s \in (0, 1)$, whereas a risky project succeeds with a strictly lower probability, p_r. All borrowers belong to some segment. The model abstracts from repayment incentives and assumes borrowers repay whenever they have the means to do so. With certain parametric assumptions, the model generates an Akerlof-style 'lemons' equilibrium, where low-risk borrowers do not have access to any loans at all, an outcome that causes investment to be lower than the social optimum. Ghatak (2000) showed how this under-investment can be eliminated through a group-based lending scheme with joint liability. In Ghatak (2000) informal lenders are just as uninformed as the MFI about the borrowers' risk type.[38] Instead, we assume that informal lenders are informed about the risk type of certain borrowers in the market. In particular, we assume that each lender lends on a regular basis to borrowers in her segment, and has learnt their risk types through past experience. This information about borrower risk type is unavailable to lenders in other segments. This gives lenders monopoly power over safe borrowers within their segments. All segments have the same ratio θ of risky to safe types of borrowers.

[38] The theoretical literature on microcredit has usually assumed that the MFIs and the informal lenders are either equally uninformed (Navajas, Conning, and Gonzalez-Vega, 2003, McIntosh and Wydick, 2005, Casini, 2010, Guha and Chowdhury, 2012, Demont, 2012), or they share the same information (Jain, 1999, Jain and Mansuri, 2003).

As in Ghatak (2000), this model assumes all projects involve a fixed scale of cultivation and a given need for working capital, so loan sizes do not vary.[39] Hence this model is useful in illustrating selection patterns that can arise with TRAIL and GBL, rather than impacts on loan size and scales of cultivation. The moral hazard model to be developed below has the advantage of incorporating these latter aspects as well. Let the required loan size to be normalized to 1, while the outside option of the borrower is denoted by a. If the project succeeds, a borrower of type $i \in \{r, s\}$ obtains a payoff R_i and 0 otherwise.

The informal market before the MFI enters is as follows. A strategy for each lender is represented by a set of interest rates offered to own-segment borrowers distinguished by their risk types, and to borrowers in other segments: $\{r_s, r_r, r\}$, respectively denoting interest rate offered to own-segment safe borrowers, own-segment risky borrowers, and other-segment borrowers. Lenders simultaneously announce their interest rates. Following Ghatak (2000), we impose the assumptions below to ensure that an equilibrium exists in the informal market:

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

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

$$p_s R_s > \rho_I + a \tag{A-3}$$

Equation (A-1) ensures that any interest rate that satisfies the safe borrowers' participation constraint also satisfies the risky borrowers' participation constraint, so that there is no interest rate that attracts only safe borrowers. Equation (A-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 (A-3) states that the safe project is socially productive.

- *Moral Hazard Model*: in this version of the model we assume that borrowers' projects are always successful but borrowers can nonetheless default on their loans intentionally. In each segment there is at least one lender who has social and economic ties with the borrowers belonging to that segment. Harnessing this social capital, he can induce borrowers in his own segment to repay with probability p_c. However, he is unable to enforce the same repayment rate with external borrowers, who repay with probability $p_f < p_c$.[40] We assume that default risks are independent of the loan contract, for the sake of simplicity.[41]

  As in the model in the main text, we assume that there is a set of floater-borrowers that do not belong to any segment, and $p_f(2 - p_f) < p_c$. We also make similar assumptions

[39]With variable loan sizes, it is well known that the simple result of market breakdown for safe types with adverse selection may no longer occur, as lenders can screen borrower types via nonlinear interest rates that vary with loan size. Safe types can get small enough loans at low interest rates that do not attract risky types. The resulting extension of the adverse selection model becomes more complicated.

[40]This can be rationalized in the following way: suppose that the benefit from defaulting is a random variable that takes three possible values $\theta \in \{\theta_L, \theta_M, \theta_H\}$ with probabilities $\{p_f, p_c - p_f, 1 - p_c\}$ respectively. Also assume that the informal lender can commit to deny future loans in case of default, which entails a cost $\Delta \equiv \theta_L$ to the borrower. The lender can impose an additional penalty $s \equiv \theta_M$ on own-segment borrowers that default, but not on any other borrowers.

[41]This requires benefits of default and subsequent sanctions be large enough relative to the loan repayments involved.

concerning the production function. A borrower with a TFP denoted by g has a production function $gf(l)$ where f is a strictly increasing, strictly concave, twice differentiable function of loan size l satisfying Inada conditions. The TFP of connected borrowers (who belong to some segment) and floating borrowers (who do not belong to any segment) are denoted by g_c and g_f, where $g_c \geq g_f$ (for reasons similar to those discussed in the text: connected borrowers have access to technical and marketing information within their networks, unlike floaters). Each borrower's outside option equals a. Use $l_i(r)$ to denote the Walrasian loan demand of type $i = c, f$ borrower at interest rate r, i.e., which maximizes $g_i f(l) - rl$.

Lenders compete with one another in the credit market, and can make different contract offers to different borrowers. Besides their advantage with respect to enforcement of repayments *ex post*, a lender has a slight locational advantage over other lenders with regard to transactions with own-segment borrowers: whenever the latter are indifferent between borrowing from different lenders they end up borrowing from their own-segment lender.

The timing of the game is as follows: at stage 1, the informal lenders announce contract offers. At stage 2, each borrower accepts at most one offer. At stage 3, the borrowers learn θ and decide whether to repay or not. Conditional on default, sanctions are imposed.

Predictions

The Informal Credit Market

We present the main results for the two alternative models, and explain the underlying reasoning informally; formal proofs are available upon request.

Proposition 2 *(Adverse Selection Model) There is a unique equilibrium outcome in the informal market, in which safe types borrow from their own-segment lender at interest rate* $r_s \equiv R_s - \frac{a}{p_s}$*, while risky types borrow (from any lender) at interest rate* $r_r \equiv \frac{\rho_I}{p_r}$*.*

Here the informal lender uses his privileged information to identify the safe clients in his own segment, and charges them an interest rate that extracts all their surplus. Other lenders cannot compete for these safe clients because they cannot identify them. The only way to attract them would be to offer all the borrowers in the segment a common loan contract, but this would attract the risky clients as well. Hence, asymmetric information shields the informal lender from competition over safe borrowers in his segment. However, all informal lenders compete over risky borrowers, and so they all earn zero expected profits from lending to them. From equation (A-2) it follows that the equilibrium interest rate charged to risky borrowers, r_r, is higher than the equilibrium interest rate charged to safe borrowers.

Denote the payoff that a borrower of type (i) earns from his informal loans as $\overline{u}_i$. Proposition 2 implies that $\overline{u}_s = a$, whereas $\overline{u}_r = p_r R_r - \rho_I > a$. Similarly denote the profit that the informal lender makes from lending to a borrower of type i as Π_i. In equilibrium, lenders make positive profits on the loans they make to their own-segment safe borrowers: $\Pi_s = p_s R_s - \rho_I - a$, but they break even on loans to risky borrowers: $\Pi_r = 0$.

Proposition 3 *(Moral Hazard Model) There is a unique equilibrium outcome in the informal market, in which connected types borrow loan amount $l_c(\rho_I)$ from their own-segment lender at interest rate ρ_I/p_c, while floaters borrow (from any lender) loan amount $l_f(\rho_I)$ at interest rate ρ_I/p_f.*

In the moral hazard model, Bertrand competition across lenders implies they earn zero expected profit. Each borrower is charged an interest rate which takes into account their respective default risks. A borrower is offered an interest rate of $\frac{\rho_I}{p_c}$ by his own-segment lender, and an interest rate of $\frac{\rho_I}{p_f}$ by every other lender. Since the loan is repaid with probability p_c to the former, and p_f to any other lender, this implies the expected loan repayment is ρ_I per rupee borrowed by any type of borrower, irrespective whether or not the lender is from the same segment. In turn this implies all lenders compete with one another on an equal footing for all borrowers, implying that they must all earn zero expected profit. However observed interest rates vary across connected and floating borrowers (with the latter paying higher rates), and loan sizes also vary with the floaters borrowing less owing to a lower TFP. Despite the segmented nature of the market, this is actually a Walrasian equilibrium.

TRAIL Selection

Now suppose the TRAIL scheme is started in the village, with one of the segment lenders being selected to be the agent. Who will the agent select? To start with, we presume the agent cannot be bribed by borrowers to induce him to recommend them.

In the adverse selection model, the agent earns positive profit from safe borrowers in their own segment, which they would stand to lose if these borrowers switch to the TRAIL loan. They earn zero profit from all other borrowers, so on the basis of profits foregone they would prefer not to recommend own-segment safe borrowers. On the other hand, these borrowers are more likely to repay the loan which generates the commission for the agent, so this consideration pre-disposes the agent to recommend their own-segment safe borrowers. If the commission rate is large enough:

$$K \geq \frac{p_s R_s - \rho_I - a}{r_T(p_s - \overline{p})} \equiv \overline{K} \tag{A-4}$$

the latter consideration dominates. If there is sufficient adverse selection in the sense that $p_s - \bar{p} > \frac{p_s R_s - \rho_I - a}{r_T}$, the threshold $\overline{K}$ is smaller than one, so there exist commission rates less than 100% for which safe borrowers will be recommended.

The moral hazard model is different insofar as there are no profits foregone on the informal market as a result of borrowers switching to TRAIL loans. The only consideration is the commission that the agent expects to earn. Suppose that the agent's discount factor is $\delta \in (0, 1)$. An own-segment borrower offered a TRAIL loan will repay with probability p_c, and so will select loan size $l_c(p_c r_T)$. Since the agent loses his commission whenever the borrower defaults, he sanctions the borrower the same way as when default occurs on an informal loan. Then the expected present value of recommending an own-segment borrower satisfies the Bellman equation $V_c = p_c[K r_T l_c(p_c r_T) + \delta V_c]$, implying $V_c = \frac{K p_c r_T l_c(p_c r_T)}{1 - \delta p_c}$. A connected borrower in a different segment offered a TRAIL loan will repay with probability p_f, and so will select loan size $l_c(p_f r_T)$.

The expected present value of recommending an other-segment borrower satisfies the Bellman equation $V_c^o = p_f[Kr_T l_c(p_f r_T) + \delta V_c^o]$, implying $V_c^o = \frac{Kp_f r_T l_c(p_f r_T)}{1-\delta p_f}$. Finally, a floating borrower will repay with probability p_f, and so will select loan size $l_f(p_f r_T)$. The expected present value of recommending such a borrower satisfies the Bellman equation $V_f = p_f[Kr_T l_f(p_f r_T) + \delta V_f]$, implying $V_f = \frac{Kp_f r_T l_f(p_f r_T)}{1-\delta p_f}$. It follows that recommending a different segment borrower dominates recommending a floating borrower (since the former selects a larger loan size, generating a higher commission for the agent, while the default risk is the same). And the agent prefers to recommend an own-segment borrower rather than a connected borrower from a different segment if

$$\frac{pr_T l_c(pr_T)}{1-\delta p} \quad \text{is increasing in } p \text{ at } p = p_f \tag{A-5}$$

This requires either the loan demand function l_c to be inelastic; otherwise the discount factor δ needs to be large enough. If the loan demand has constant elasticity ϵ, (A-5) requires $\delta p_f > 1 - \frac{1}{\epsilon}$. The trade-off arises since other-segment borrowers select a larger loan size (translating into a larger commission in the absence of default), but also default more often.

In summary,

Proposition 4 *Assume borrowers cannot bribe the agent. In the adverse selection model the AIL agent recommends an own-segment safe borrower if and only if the commission rate satisfies* $K \geq \overline{K}$, *and a randomly chosen other-segment borrower otherwise. In the moral hazard model, the agent never recommends a floating borrower, and recommends an own-segment borrower rather than a connected borrower from a different segment if (A-5) holds.*

Now consider what happens when the TRAIL agent can be bribed. Assume that the agent has all the bargaining power in the bribe negotiations, so extracts all the surplus of borrowers from the TRAIL loan. Similar results apply when the agent gets a fixed fraction of the borrower surplus.

Proposition 5 *Suppose the agent can extract all the borrowers' surplus upfront by charging a bribe in exchange for a recommendation for the TRAIL loan. In the adverse selection model it is never optimal for the lender to recommend an own-segment safe borrower, and it is always optimal to recommend a borrower from a different segment. In the moral hazard model, it is never optimal to recommend a floating borrower, and it is optimal to recommend an own-segment borrower if the discount rate* δ *is large enough.*

The intuition behind Proposition 5 is the following. Given that the agent has all the bargaining power, he can extract the entire surplus that the borrower stands to earn as a result of his recommendation. In effect the agent becomes a residual claimant on the recommended borrowers' projects, besides earning the TRAIL commissions. In the adverse selection model, this reduces the effective cost of credit to $p_i(1-K)r_T$ when a type i borrower is recommended, as the TRAIL agent internalizes the commission into the cost of credit. The agent therefore prefers to recommend a risky borrower rather than a safe borrower from within his own segment, as the effective cost of credit for the former is smaller. It can be shown that it is always optimal to select a borrower from a different segment, either on the basis of screening by the bribe demand or random selection.[42]

In the moral hazard model, we obtain a different conclusion in the presence of bribery. Recommending a floating borrower is always dominated by recommending a connected borrower from a different segment, on account of a lower TFP of the former which implies a lower loan size and willingness to pay a bribe, while both default with the same probability. Hence the agent will definitely recommend a connected borrower. There is a trade-off between recommending an own-segment borrower and an other-segment borrower: the former is less likely to default but also selects a smaller loan size (owing to a higher effective cost of credit which arises from the lower default risk) which implies a smaller commission. The former consideration dominates if the discount factor is large enough.[43]

With adverse selection, we see that the presence of collusion implies that the agent will never recommend safe borrowers from his own segment, and will be inclined to exhibit a bias in favor of other-segment borrowers. Whereas in the absence of collusion, he will select own-segment safe borrowers if the commission rate is high enough. Empirically we see the latter outcome, so this could be viewed as evidence in favor of the model without any collusive side payments. The adverse selection model without collusion produces the same predictions as the model in the text: the agent selects low-risk high-productivity borrowers from his own segment.

The moral hazard model also generates the same prediction, given the assumption that the agent is patient enough, irrespective of whether or not there is collusion. If the agent is not so patient, we see that the agent could conceivably switch to recommending a connected borrower from a different segment, but not a floating borrower. High productivity connected borrowers will be selected, irrespective of the discount rate (and also irrespective of whether or not there is collusion).

[42]Details are available in the Appendix in Maitra et al (2013).

[43]Recommending an own-segment borrower generates an expected present value payoff of

$$\frac{Kp_c r_T l_c(p_c r_T) + \{\Pi_c(p_c r_T) - \Pi_c(\rho_I)\}}{1 - \delta p_c} \tag{A-6}$$

while recommending an other-segment borrower generates

$$\frac{Kp_f r_T l_c(p_f r_T) + \{\Pi_c(p_f r_T) - \Pi_c(\rho_I)\}}{1 - \delta p_f} \tag{A-7}$$

and recommending a floater generates

$$\frac{Kp_f r_T l_f(p_f r_T) + \{\Pi_f(p_f r_T) - \Pi_f(\rho_I)\}}{1 - \delta p_f} \tag{A-8}$$

Here $\Pi_i(r)$ denotes the borrower's profit function, the maximized value of $g_i f(l) - rl$. It is evident that an other-segment borrower dominates a floater, while the comparison between an own-segment and other-segment borrower is ambiguous (with the own-segment borrower being the best option if the agent is patient enough).

GBL

Neither model makes a definite prediction regarding which type of group should be more likely to apply for a GBL loan. The adverse selection model predicts positive assortative matching but it is unclear whether a risky group or a safe group stands to gain more from GBL. GBL loans are more attractive to the safe borrowers relative to the risky type, because they are exploited in the informal market implying a lower outside option. However, the safe type also expects to repay more often, compared to a risky type, which reduces the attractiveness of a TRAIL loan. The net impact of these two contrasting impacts is ambiguous.

In the moral hazard model, a group consisting of connected borrowers will be less likely to default, which will raise their value of participating in a low-interest group loan compared with a group which contains floating borrowers. On the other hand, floating borrowers have a lower effective cost of credit owing to a higher default risk, which makes the low interest loan more attractive to them compared with connected borrowers. Which effect dominates is ambiguous.

Compounding this ambiguity, the costs of attending group meetings and meeting savings requirements may also differ between the two types (safe/risky in the adverse selection model, and connected/floater in the moral hazard model) in a way that is difficult to predict *a priori*. Hence it is possible for GBL to comprise only of groups consisting of risky types/floaters, or a mixture of these with safe/connected types. Consequently the composition of GBL could involve lower productivity and higher default risk on average compared to TRAIL.

For Online Publication

A-2 Additional Tables

Table A-1: Impact on Farm Income

	Total Farm Income
TRAIL	100.184
	(449.420)
TRAIL × Control 1	11,466.308***
	(1,357.722)
TRAIL × Treatment	14,087.352***
	(1,756.879)
GBL × Control 1	10,065.811***
	(1,500.573)
GBL × Treatment	10,119.055***
	(1,093.911)
Landholding	7,824.408***
	(772.377)
Year 2	2,175.697***
	(299.017)
Information	1,574.616**
	(755.062)
Constant	-5,650.377***
	(673.451)
TRAIL Treatment	2621***
GBL Treatment	53.24
TRAIL Selection	11466***
GBL Selection	10066***
Sample Size	4,163
Mean Control 1	10328

Notes:
The sample consists of sample households in TRAIL and GBL villages with at most 1.5 acres of land. Standard errors clustered at the village level in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table A-2: Program Impacts. Total Borrowing and Cost of Borrowing.

	All Loans				Non-program Loans			
		Total Borrowing		Cost of Borrowing		Total Borrowing		Cost of Borrowing
	All Households	Borrowing Households	Heckman 2-step	(APR)	All Households	Borrowing Households Households	Heckman 2-step Households	(APR)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TRAIL	1,094.254	1,704.645	1,746.997***	-0.006	1,062.212	1,665.675	1,702.941***	-0.005
	(945.728)	(1,308.410)	(488.485)	(0.019)	(935.991)	(1,306.636)	(471.188)	(0.019)
TRAIL × Control 1	47.326	-417.019	-428.268	-0.006	65.011	-372.194	-381.244	-0.007
	(371.871)	(661.254)	(625.369)	(0.009)	(361.071)	(642.224)	(603.412)	(0.009)
TRAIL × Treatment	7,579.477***	6,709.212***	6,675.995***	-0.035***	-82.520	-867.933	-964.129	-0.001
	(888.288)	(890.298)	(582.656)	(0.010)	(416.302)	(616.041)	(614.693)	(0.012)
GBL × Control 1	78.576	-919.860	-809.764	0.042**	-2.199	-930.275	-831.534	0.041*
	(623.694)	(906.190)	(640.958)	(0.021)	(628.424)	(895.678)	(618.635)	(0.021)
GBL × Treatment	5,527.292***	5,544.600***	5,597.085***	-0.026**	42.640	-675.566	-660.068	0.027***
	(1,086.979)	(1,138.491)	(600.825)	(0.012)	(733.259)	(1,068.298)	(622.590)	(0.010)
Landholding	9,860.229***	10,362.743***	8,776.287***	-0.020**	9,076.121***	10,175.240***	8,723.097***	-0.030***
	(947.583)	(1,074.144)	(633.095)	(0.009)	(909.033)	(1,077.420)	(641.741)	(0.011)
Year 2	-295.288	557.355	988.271***	0.035***	-1,194.769***	-967.172***	-564.873	0.047***
	(220.161)	(335.761)	(376.855)	(0.012)	(196.727)	(278.993)	(376.023)	(0.015)
Information	841.956	1,232.649	1,334.164***	-0.008	631.290	1,038.375	1,131.793***	-0.010
	(890.136)	(1,143.823)	(359.296)	(0.013)	(835.111)	(1,158.007)	(355.956)	(0.017)
λ			-3,402.336***				-2,857.281***	
			(955.461)				(910.291)	
Constant	-228.497	919.534	3,070.452***	0.228***	697.530	1,822.373*	3,825.254***	0.230***
	(654.453)	(916.659)	(774.882)	(0.022)	(659.398)	(922.888)	(794.714)	(0.024)
TRAIL Treatment	7532.15***	7126.23***	7104.26***	-0.03**	-147.53	-495.74	-582.89	0.01
GBL Treatment	5448.72***	6464.46***	6406.85***	-0.07***	44.84	254.71	171.47	-0.01
TRAIL Selection	47.33	-417.02	-428.27	-0.01	65.01	-372.19	-381.24	-0.01
GBL Selection	78.58	-919.86	-809.76	0.04**	-2.20	-930.27	-831.53	0.04**
Sample Size	4,140	2,758	4,140	2,429	4,140	2,601	4,140	2,159
Mean Control 1	4826.45	7279.76	4826.45	0.24	4826.45	7279.76	4826.45	0.24

Notes:
The sample consists of sample households in TRAIL and GBL villages with at most 1.5 acres of land. Standard errors clustered at the village level in parentheses. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$. In columns (3) and (7) we present the the second step of a Heckman two-step regression. The first stage selection regression estimates the likelihood that the households produces the relevant crop. Explanatory variables included in the first stage are land owned by the household, an indicator variable for cultivator household, a Year 2 dummy and price information treatment dummy.

Table A-3: Program Impacts. Treatment and Selection Effects.

	Cultivate	Acreage (Acres)	leased-in acres (Acres)	Output Kg	Cost of production Rs	Family labor hours Hours	Revenue Rs	Value added Rs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Potato								
TRAIL	0.055	0.001	0.004	-115.238	97.615	-0.958	-1,486.249	-1,589.679
	(0.055)	(0.058)	(0.028)	(669.726)	(1,333.226)	(7.009)	(2,750.641)	(1,551.934)
TRAIL × Control 1	0.095***	0.001	-0.003	145.390	372.820	-0.200	942.021	555.596
	(0.027)	(0.031)	(0.028)	(340.508)	(802.783)	(3.895)	(1,413.094)	(772.692)
TRAIL × Treatment	0.149***	0.091**	0.044	1,033.433***	2,146.572**	5.830	4,370.949***	2,242.245***
	(0.036)	(0.037)	(0.028)	(382.309)	(871.933)	(3.874)	(1,438.652)	(761.007)
GBL × Control 1	0.061	-0.042	0.004	-417.906	-1,111.024	4.951	-2,533.858	-1,371.324
	(0.056)	(0.054)	(0.031)	(651.373)	(1,251.406)	(7.196)	(2,799.426)	(1,646.360)
GBL × Treatment	0.111**	-0.002	0.027	-139.874	197.007	9.857	-896.902	-1,099.531
	(0.041)	(0.037)	(0.027)	(430.239)	(955.507)	(6.133)	(1,551.877)	(756.493)
Landholding	0.380***	0.495***	-0.118***	5,469.185***	9,383.561***	15.447***	25,291.922***	15,729.890***
	(0.037)	(0.049)	(0.029)	(560.767)	(1,182.893)	(4.003)	(2,506.055)	(1,464.911)
Year 2	-0.053***	-0.008	-0.016**	-430.967***	62.384	4.826***	6,514.608***	6,626.796***
	(0.009)	(0.008)	(0.007)	(105.858)	(258.183)	(1.273)	(670.838)	(613.263)
Information	0.020	0.053	0.034	596.451	926.414	5.073	1,561.330	602.351
	(0.050)	(0.053)	(0.023)	(613.697)	(1,268.748)	(6.294)	(2,615.559)	(1,440.187)
Constant	0.425***	0.178***	0.161***	2,092.029***	4,562.177***	43.865***	3,897.719*	-756.274
	(0.049)	(0.048)	(0.030)	(572.784)	(1,090.692)	(5.284)	(2,159.238)	(1,234.441)
TRAIL Treatment	0.0545	0.0896***	0.0467**	888.0***	1774**	6.030	3429***	1687**
GBL Treatment	0.0492	0.0401	0.0222	278.0	1308	4.906	1637	271.8
TRAIL Selection	0.0949***	0.000956	-0.00265	145.4	372.8	-0.200	942.0	555.6
GBL Selection	0.0614	-0.0421	0.00447	-417.9	-1111	4.951	-2534	-1371
Sample Size	4163	2718	2718	2718	2718	2718	2718	2718
Mean Control 1	0.677	0.432	0.111	4760	9538	57.86	19137	9498
Panel B: Sesame								
TRAIL	0.101	0.015	0.008	11.712	-24.437	1.593	135.763	156.846
	(0.063)	(0.037)	(0.022)	(19.248)	(66.943)	(2.441)	(378.014)	(345.314)

Continued ...

Table A-3 (Continued): Program Impacts. Treatment and Selection Effects.

	Cultivate (1)	Acreage (Acres) (2)	leased-in acres (Acres) (3)	Output Kg (4)	Cost of production Rs (5)	Family labor hours Hours (6)	Revenue Rs (7)	Value added Rs (8)
TRAIL × Control 1	0.107***	0.019	0.001	-4.657	102.349**	0.081	-13.851	-115.552
	(0.027)	(0.028)	(0.026)	(13.536)	(45.830)	(1.801)	(311.201)	(291.653)
TRAIL × Treatment	0.128***	0.062**	0.009	1.537	121.289**	1.974	184.743	61.565
	(0.027)	(0.023)	(0.017)	(12.945)	(55.199)	(1.708)	(251.764)	(229.696)
GBL × Control 1	0.110**	-0.005	0.006	-3.592	-123.154*	5.252**	-44.667	73.646
	(0.047)	(0.043)	(0.024)	(14.780)	(63.018)	(2.355)	(336.784)	(294.467)
GBL × Treatment	0.072*	0.006	0.009	-9.488	-129.753	4.387**	-213.993	-84.676
	(0.043)	(0.037)	(0.028)	(12.353)	(78.938)	(1.985)	(244.533)	(211.506)
Landholding	0.395***	0.394***	-0.141***	117.164***	570.860***	5.763**	2,782.291***	2,208.820***
	(0.035)	(0.037)	(0.024)	(15.859)	(55.230)	(2.220)	(311.658)	(280.557)
Year 2	-0.044***	0.022**	-0.011	2.902	30.745	4.630***	1,125.419***	1,095.483***
	(0.014)	(0.011)	(0.008)	(6.106)	(39.870)	(1.091)	(152.713)	(133.379)
Information	-0.029	0.091***	0.038**	16.229	65.313	1.417	334.426	265.557
	(0.060)	(0.030)	(0.019)	(14.337)	(62.366)	(2.288)	(277.557)	(247.071)
Constant	0.250***	0.137***	0.147***	59.264***	346.167***	18.156***	606.102*	263.871
	(0.050)	(0.035)	(0.024)	(15.763)	(64.600)	(2.256)	(316.109)	(283.038)
TRAIL Treatment	0.0209	0.0424*	0.00796	6.193	18.94	1.893	198.6	177.1
GBL Treatment	-0.0377	0.0111	0.00273	-5.896	-6.598	-0.866	-169.3	-158.3
TRAIL Selection	0.107***	0.0192	0.00124	-4.657	102.3**	0.0811	-13.85	-115.6
GBL Selection	0.110**	-0.00519	0.00584	-3.592	-123.2*	5.252	-44.67	73.65
Sample Size	4163	2037	2037	2037	2037	2037	2037	2037
Mean Control 1	0.544	0.414	0.0921	132.5	683.8	27.25	2812	2126
Panel C: Paddy								
TRAIL	-0.019	0.014	0.020	-6.338	-143.502	-1.150	214.124	382.545
	(0.037)	(0.052)	(0.036)	(109.673)	(544.045)	(4.426)	(787.181)	(546.951)
TRAIL × Control 1	0.114***	-0.040	-0.035	-56.110	-219.156	1.452	-700.064	-505.665
	(0.028)	(0.033)	(0.032)	(46.281)	(257.134)	(2.559)	(518.429)	(366.657)
TRAIL × Treatment	0.093***	-0.008	0.012	-55.121	-58.746	-0.724	-239.936	-197.674
	(0.030)	(0.035)	(0.032)	(48.004)	(276.427)	(2.885)	(546.477)	(412.309)
GBL × Control 1	0.033	-0.002	-0.015	127.751**	411.864	5.864**	-350.043	-725.624*
	(0.034)	(0.037)	(0.031)	(56.408)	(374.376)	(2.692)	(611.068)	(431.453)

Continued . . .

Table A-3 (Continued): Program Impacts. Treatment and Selection Effects.

	Cultivate	Acreage (Acres)	leased-in acres (Acres)	Output Kg	Cost of production Rs	Family labor hours Hours	Revenue Rs	Value added Rs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GBL × Treatment	0.030	0.049	0.040	101.543	452.041	10.452***	202.923	-156.909
	(0.035)	(0.039)	(0.036)	(69.433)	(420.198)	(3.536)	(660.932)	(419.408)
Landholding	0.481***	0.916***	-0.136***	853.654***	5,118.839***	23.771***	7,686.338***	2,748.557***
	(0.026)	(0.058)	(0.048)	(93.595)	(548.070)	(3.682)	(852.889)	(570.041)
Year 2	-0.020*	-0.006	-0.018**	924.978***	825.094***	6.291***	1,304.679***	278.458
	(0.011)	(0.012)	(0.008)	(63.374)	(153.752)	(1.235)	(414.488)	(361.593)
Information	-0.032	-0.042	0.034	-66.922	-492.203	-5.315	76.243	576.528
	(0.037)	(0.044)	(0.025)	(96.763)	(512.177)	(3.714)	(684.021)	(461.329)
Constant	0.522***	0.197***	0.165***	-198.219	1,455.659**	25.995***	2,407.988***	1,034.253**
	(0.031)	(0.056)	(0.045)	(120.074)	(583.654)	(4.089)	(896.958)	(482.411)
TRAIL Treatment	-0.0210	0.0324**	0.0466***	0.988	160.4	-2.176	460.1**	308.0
GBL Treatment	-0.00369	0.0516	0.0543	-26.21	40.18	4.588*	553.0	568.7
TRAIL Selection	0.114***	-0.0402	-0.0351	-56.11	-219.2	1.452	-700.1	-505.7
GBL Selection	0.0334	-0.00237	-0.0147	127.8**	411.9	5.864**	-350.0	-725.6*
Sample Size	4163	3054	3054	3054	3054	3054	3054	3054
Mean Control 1	0.767	0.641	0.0852	708.0	4324	42.02	6718	2490
Panel D: Vegetables								
TRAIL	0.018	-0.014	0.020	781.525	306.603	3.894	-181.983	-678.376
	(0.049)	(0.029)	(0.024)	(519.171)	(455.798)	(14.993)	(3,326.134)	(3,050.016)
TRAIL × Control 1	-0.011	-0.016	-0.035*	-20.969	-43.546	4.025	1,182.277	1,328.894
	(0.011)	(0.022)	(0.020)	(183.535)	(307.927)	(18.392)	(1,288.349)	(1,025.976)
TRAIL × Treatment	-0.007	0.142**	0.045	302.504	1,072.094	22.135	3,626.783*	2,583.865
	(0.011)	(0.067)	(0.046)	(232.142)	(745.138)	(17.945)	(1,844.248)	(1,587.705)
GBL × Control 1	0.045**	-0.014	-0.010	-110.290	-102.531	3.206	-1,010.409	-957.482
	(0.021)	(0.032)	(0.021)	(215.276)	(611.214)	(9.885)	(2,248.128)	(1,645.141)
GBL × Treatment	0.068***	-0.034*	0.017	-35.956	-165.752	3.478	-3,080.971*	-2,912.706**
	(0.023)	(0.019)	(0.018)	(104.440)	(502.244)	(10.686)	(1,772.812)	(1,378.714)
Landholding	0.065**	0.049	-0.122***	1,001.805**	349.959	-2.970	7,774.166***	7,263.317***
	(0.026)	(0.040)	(0.025)	(430.355)	(440.349)	(12.961)	(2,354.370)	(1,980.563)
Year 2	-0.007	0.026*	-0.008	740.838*	1,001.058***	20.512	6,169.337***	5,035.842***
	(0.010)	(0.015)	(0.008)	(374.548)	(198.930)	(12.729)	(1,723.776)	(1,700.895)

Continued ...

Table A-3 (Continued): Program Impacts. Treatment and Selection Effects.

	Cultivate (1)	Acreage (Acres) (2)	leased-in acres (Acres) (3)	Output Kg (4)	Cost of production Rs (5)	Family labor hours Hours (6)	Revenue Rs (7)	Value added Rs (8)
Information	0.050	0.059**	-0.002	1,005.792**	1,062.282***	46.768**	7,452.088**	6,186.548**
	(0.051)	(0.025)	(0.017)	(479.856)	(332.893)	(17.833)	(3,131.713)	(2,829.793)
Constant	0.028	0.140***	0.110***	-448.654	2,173.384***	48.213***	91.940	-1,874.682
	(0.025)	(0.040)	(0.026)	(721.773)	(404.649)	(16.376)	(2,990.169)	(2,665.239)
TRAIL Treatment	0.00376	0.159**	0.0793*	323.5	1116**	18.11**	2445	1255
GBL Treatment	0.0236	-0.0197	0.0276	74.33	-63.22	0.272	-2071	-1955
TRAIL Selection	-0.0112	-0.0161	-0.0345*	-20.97	-43.55	4.025	1182	1329
GBL Selection	0.0446**	-0.0145	-0.0104	-110.3	-102.5	3.205	-1010	-957.5
Sample Size	4163	402	402	402	402	402	402	402
Mean Control 1	0.100	0.196	0.0204	1381	3564	90.22	12030	8325

Notes:
The sample consists of sample households in TRAIL and GBL villages with at most 1.5 acres of land.
Standard errors clustered at the village level in parentheses. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$

Table A-4: Program Impacts. Heckman estimates

	Potato			Sesame		
	Cost of production	Revenue	Value added	Cost of production	Revenue	Value added
	(1)	(2)	(3)	(4)	(5)	(6)
	Potato			Sesame		
	(1)	(2)	(3)	(4)	(5)	(6)
	Cost of production	Revenue	Value added	Cost of production	Revenue	Value added
TRAIL	135.922	-1,411.725	-1,553.780**	-23.061	145.876	165.614
	(500.423)	(973.981)	(629.503)	(46.030)	(176.605)	(158.528)
TRAIL × Control 1	388.004	971.560	569.825	101.908*	-16.177	-117.443
	(621.431)	(1,209.502)	(782.135)	(54.341)	(208.405)	(187.092)
TRAIL × Treatment	2,104.936***	4,289.951***	2,203.227***	119.731**	175.755	54.115
	(613.238)	(1,193.556)	(771.625)	(54.244)	(208.059)	(186.776)
GBL × Control 1	-969.847	-2,259.210*	-1,239.025	-119.017*	-17.900	96.338
	(678.740)	(1,321.044)	(854.366)	(61.572)	(236.134)	(211.986)
GBL × Treatment	204.778	-881.783	-1,092.248	-130.027**	-218.662	-89.023
	(655.451)	(1,275.716)	(824.983)	(63.218)	(242.425)	(217.638)
Land	7,955.755***	22,514.242***	14,391.876***	500.000***	2,366.826***	1,863.323***
	(611.934)	(1,191.004)	(765.550)	(67.486)	(260.270)	(233.339)
Information	825.136**	1,364.303*	507.442	69.919**	361.512***	288.080**
	(370.492)	(721.088)	(463.790)	(33.538)	(129.308)	(115.936)
Year 2	283.407	6,944.590***	6,833.919***	38.944	1,175.618***	1,137.585***
	(373.948)	(727.813)	(468.106)	(33.800)	(130.317)	(116.840)
λ	-2,920.583***	-5,681.754***	-2,736.912***	-121.883	-719.302**	-598.946*
	(813.710)	(1,583.721)	(1,018.762)	(91.587)	(352.973)	(316.502)
Constant	6,616.633***	7,894.495***	1,168.980	467.974***	1,320.403***	857.887**
	(772.043)	(1,502.624)	(966.455)	(102.897)	(396.648)	(355.646)
TRAIL Treatment	1717**	3318**	1633*	17.82	191.9	171.6
GBL Treatment	1175	1377	146.8	-11.01	-200.8	-185.4
TRAIL Selection	388.0	971.6	569.8	101.9*	-16.18	-117.4
GBL Selection	-969.8	-2259*	-1239	-119.0***	-17.90	96.34
Sample Size	4,163	4,163	4,163	4,163	4,163	4,163
Mean Control 1	6457	12954	6430	371.9	1529	1156

	Paddy			Vegetables		
	Cost of production	Revenue	Value added	Cost of production	Revenue	Value added
	(7)	(8)	(9)	(10)	(11)	(12)
TRAIL	-141.786	222.203	389.124	308.939	-157.742	-656.307
	(195.251)	(363.432)	(276.877)	(405.084)	(1,447.774)	(1,229.151)
TRAIL × Control 1	-223.150	-700.581	-502.693	-45.264	1,164.444	1,312.659
	(249.130)	(463.859)	(353.426)	(528.898)	(1,890.210)	(1,604.765)
TRAIL × Treatment	-51.742	-229.043	-192.900	1,071.083**	3,616.288*	2,574.311
	(253.828)	(472.499)	(359.979)	(529.019)	(1,890.682)	(1,605.171)
GBL × Control 1	394.038	-356.353	-716.361*	-97.383	-956.970	-908.831
	(261.633)	(487.176)	(371.202)	(499.585)	(1,785.826)	(1,516.199)
GBL × Treatment	459.679*	220.473	-146.032	-171.444	-3,140.056*	-2,966.499**
	(260.680)	(485.421)	(369.870)	(465.492)	(1,663.537)	(1,412.313)
Land	5,547.607***	8,091.820***	2,779.448***	449.884	8,811.439***	8,207.665***
	(302.001)	(560.657)	(426.716)	(536.442)	(1,935.738)	(1,646.084)

Continued . . .

Table A-4 (Continued): Program Impacts. Heckman estimates

	Cost of production	Revenue	Value added	Cost of production	Revenue	Value added
Information	-512.905***	64.940	583.312***	1,144.137***	8,301.785***	6,960.124***
	(146.338)	(271.827)	(206.931)	(441.079)	(1,591.981)	(1,353.816)
Year 2	808.721***	1,297.769***	285.852	990.220***	6,056.830***	4,933.414***
	(145.200)	(269.709)	(205.317)	(295.063)	(1,065.574)	(906.246)
λ	711.531*	692.495	70.869	344.704	3,578.222	3,257.660
	(394.867)	(733.784)	(558.687)	(1,372.699)	(4,954.280)	(4,213.077)
Constant	999.727***	1,951.444***	976.031**	1,480.118	-7,104.547	-8,426.458
	(321.275)	(596.774)	(454.299)	(2,794.411)	(10,085.317)	(8,576.448)
TRAIL Treatment	171.4	471.5	309.8	1116*	2452	1262
GBL Treatment	65.64	576.8	570.3	-74.06	-2183	-2058
TRAIL Selection	-223.1	-700.6	-502.7	-45.26	1164	1313
GBL Selection	394.0	-356.4	-716.4**	-97.38	-957.0	-908.8
Sample Size	4,163	4,163	4,163	4,163	4,163	4,163
Mean Control 1	3317	5153	1910	356.4	1203	832.5

Notes:
Second step of a Heckman two-step regression are presented.
The first stage selection regression estimates the likelihood that the households produces the relevant crop.
Explanatory variables included in the first stage are land owned by the household, an indicator variable for cultivator household, a Year 2 dummy and price information treatment dummy.
Standard errors, clustered at the village level are in parentheses.
$^{***}: p < 0.01, ^{**}: p < 0.05, ^{*}: p < 0.1$. Sample restricted to households with at most 1.5 acres.

Table A-5: Effect on Non-Farm Incomes

	Rent (Rs) (1)	Income From Animal Products (Rs) (2)	Labor Income Year (Rs) (3)	Wage Employment last 2 weeks (Hours) (4)	Self-employment last 2 weeks (Hours) (5)	Reported profits (Rs) (6)	Current value of business (Rs) (7)	Total non-farm income (Rs) (8)
TRAIL	108.560	5.554	635.466	1.781	0.596	-2,534.427	-1,126.579	-1,784.848
	(532.085)	(355.240)	(7,068.918)	(3.580)	(4.820)	(1,771.661)	(2,678.297)	(8,184.392)
TRAIL × Control 1	-182.095	62.660	-12,729.069**	-6.855*	0.215	100.867	952.105	-12,747.637**
	(500.805)	(202.625)	(5,437.318)	(3.583)	(2.921)	(988.988)	(3,415.009)	(5,461.814)
TRAIL × Treatment	-28.469	229.463	-12,336.034**	-6.240*	7.099	2,443.751	5,869.309*	-9,691.290
	(584.958)	(167.812)	(5,786.361)	(3.405)	(4.420)	(1,529.128)	(3,208.141)	(6,311.356)
GBL × Control 1	-427.992	-279.106	-4,948.024	1.745	5.914*	-1,917.362	354.307	-7,572.483
	(588.114)	(188.273)	(6,249.854)	(3.505)	(3.485)	(1,971.453)	(4,569.906)	(6,067.983)
GBL × Treatment	356.382	-229.930	-10,589.894**	-2.751	10.208**	1,000.666	7,045.903	-9,462.776*
	(679.482)	(196.540)	(4,472.769)	(2.465)	(4.474)	(2,358.029)	(5,808.770)	(4,864.195)
Landholding	2,687.798***	267.666	-358.910	-22.727***	39.051***	3,920.037***	9,864.171***	6,516.591
	(399.336)	(171.962)	(3,894.848)	(2.092)	(3.811)	(1,319.515)	(3,084.993)	(4,418.838)
Year 2	618.637***	-50.971	9,365.086***	2.587***	10.004***	1,545.952***	-95.606	11,478.704***
	(117.937)	(50.638)	(810.267)	(0.548)	(1.852)	(426.144)	(782.110)	(1,104.196)
Information	-112.776	-90.339	-2,107.285	-2.224	0.137	287.369	-48.114	-2,023.031
	(351.375)	(289.516)	(5,156.547)	(2.927)	(4.568)	(1,637.636)	(2,990.193)	(6,138.902)
Constant	350.758	824.185***	42,521.843***	51.408***	96.781***	5,410.073***	6,250.040***	49,106.859***
	(449.002)	(284.628)	(5,251.554)	(2.429)	(4.515)	(1,351.452)	(2,161.766)	(6,245.452)
TRAIL Treatment	153.6	166.8	393.0	0.615	6.884	2343	4917	3056
GBL Treatment	784.4	49.18	-5642	-4.496	4.294	2918	6692	-1890
TRAIL Selection	-182.1	62.66	-12729**	-6.855*	0.215	100.9	952.1	-12748**
GBL Selection	-427.9	-279.1	-4941	1.749	5.914*	-1917	353.8	-7565
Sample Size	4162	4162	4162	4162	4162	4162	4162	4162
Mean Control 1	1508	771.0	37465	40.24	121.8	5802	10465	45546

Notes:
The sample consists of sample households in TRAIL and GBL villages with at most 1.5 acres of land. Standard errors clustered at the village level in parentheses. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table A-6: Repayment and Eligibility (end of Cycle 6)

	Repayment (1)	Eligibility (2)
TRAIL	0.086***	0.062*
	(0.030)	(0.036)
Landholding	-0.050	-0.064
	(0.044)	(0.068)
Landholding Squared	0.011	0.002
	(0.010)	(0.030)
Constant	0.923***	0.830***
	(0.028)	(0.029)

Notes
Dependent variable in column (1) takes the value of 1 if the household successfully repaid the loan (within 30 days of the date of repayment) in Cycle 6. Dependent Variable in column (2) takes the value of 1 if the household remains eligible for a program loan at the end of Cycle 6 and 0 otherwise. The sample consists of treatment households in TRAIL and GBL villages. Robust standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table A-7: Sensitivity of Potato Value Added to Price Changes

	Actual (1)	2011 prices (2)	2012 prices (3)	2008 prices (4)
TRAIL	-1,589.679	-681.103	-981.553	-382.080
	(1,551.934)	(1,425.721)	(2,386.433)	(629.108)
TRAIL × Control 1	555.596	-63.118	-42.655	-83.485
	(772.692)	(697.545)	(1,201.742)	(349.626)
TRAIL × Treatment	2,242.245***	1,770.263**	3,327.452**	220.468
	(761.007)	(816.831)	(1,426.712)	(389.260)
GBL × Control 1	-1,371.324	-258.233	-764.343	245.474
	(1,646.360)	(1,349.746)	(2,317.721)	(468.574)
GBL × Treatment	-1,099.531	-799.660	-1,064.052	-536.524
	(756.493)	(828.295)	(1,462.097)	(344.318)
Landholding	15,729.890***	11,518.215***	19,718.261***	3,357.112***
	(1,464.911)	(1,186.455)	(2,016.228)	(519.378)
Year 2	6,626.796***	-1,587.446***	-2,243.538***	-934.469***
	(613.263)	(361.422)	(507.059)	(252.254)
Information	602.351	1,421.686	2,334.476	513.232
	(1,440.187)	(1,236.508)	(2,102.137)	(542.645)
Constant	-756.274	3,585.035***	6,958.038***	228.050
	(1,234.441)	(1,292.965)	(2,133.777)	(555.589)
TRAIL Treatment	1687**	1833***	3370	304.0
GBL Treatment	271.8	-541.4	-299.7	-782.0
TRAIL Selection	555.6	-63.12	-42.65	-83.48
GBL Selection	-1371	-258.2	-764.3	245.5
Sample Size	2718	2516	2516	2516
Mean Control 1	9498	8687	15859	1550

Notes:
The sample consists of sample households in TRAIL and GBL villages with at most 1.5 acres of land. Standard errors clustered at the village level in parentheses. $^{***}p < 0.01,^{**}p < 0.05,^{*}p < 0.1$ Sample in Columns (2) - (4) restricted to the 68 villages that were also surveyed as a part of an earlier project as discussed in Mitra, Mookherjee, Torero, and Visaria (2013)

Table A-8: Effects on Potato Cultivation. Robustness to Alternative Clustering

	Cultivate	Output	Cost of production	Family labour hours	Revenue	Value added	Agricultural Income
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
TRAIL	0.055*	-115.796	93.385	-0.989	-1,488.198	-1,587.492	-1,586.918*
	(0.028)	(380.534)	(805.738)	(3.529)	(1,634.807)	(972.165)	(947.199)
TRAIL × Control 1	0.095*	151.936	392.224	-0.235	976.978	570.811	478.369
	(0.049)	(513.788)	(1,147.261)	(4.479)	(2,173.439)	(1,188.446)	(1,168.674)
TRAIL × Treatment	0.149***	1,039.587*	2,164.464*	5.664	4,402.500*	2,255.587*	2,151.543*
	(0.040)	(566.385)	(1,260.021)	(3.988)	(2,386.021)	(1,239.065)	(1,204.041)
GBL × Control 1	0.035	-17.484	-296.812	6.770	-559.851	-218.571	-558.360
	(0.045)	(525.387)	(1,088.376)	(6.557)	(2,214.644)	(1,340.869)	(1,325.603)
GBL × Treatment	0.114**	-51.683	403.830	10.449	-530.708	-944.247	-1,300.749
	(0.047)	(476.750)	(1,006.425)	(6.892)	(2,032.389)	(1,140.104)	(1,086.478)
Landholding	0.380***	5,545.846***	9,549.262***	14.903***	25,701.365***	15,969.069***	15,660.449***
	(0.026)	(405.070)	(929.099)	(3.693)	(1,763.803)	(1,000.462)	(978.687)
Year 2	-0.054***	-424.243***	93.039	5.065***	6,637.673***	6,721.975***	6,377.538***
	(0.008)	(96.864)	(232.454)	(1.103)	(529.659)	(491.487)	(498.982)
Information	0.023	509.441	777.030	4.185	1,180.579	371.460	265.762
	(0.026)	(332.960)	(732.170)	(3.048)	(1,407.725)	(775.764)	(755.626)
Constant	0.425***	2,086.371***	4,521.095***	44.525***	3,783.681**	-828.040	-1,700.583*
	(0.029)	(399.873)	(832.060)	(3.820)	(1,677.875)	(968.571)	(943.829)
TRAIL Treatment	0.0546	887.7***	1772**	5.899	3426***	1685***	1673***
GBL Treatment	0.0782	-34.20	700.6	3.680	29.14	-725.7	-742.4
TRAIL Selection	0.0949*	151.9	392.2	-0.235	977.0	570.8	478.4
GBL Selection	0.035	-17.48	-298.81	6.770	-559.85	-218.57	-558.36
Sample Size	4,103	2,668	2,668	2,668	2,668	2,668	2,668
Mean Control 1	0.677	4760	9538	57.86	19137	9498	8076

Notes:
The sample consists of sample households in TRAIL and GBL villages with at most 1.5 acres of land. Standard errors clustered at the group/network level. In GBL villages, for each Treatment and Control 1 household the GBL group they formed is the cluster; each Control 2 household is a singleton cluster. In TRAIL villages, all Treatment and Control 1 households belong to the same cluster, and all Control 2 households belong to singleton clusters.
. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table A-9: Transactions with TRAIL Agent Input Market

	Ever buy from Agent	Share buy from Agent	Input Price (Rs/unit) Inorganic Fertilizer	Organic Fertilizer	Outside Seed	Pesticide	Powertiller	Water/irrigation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Inorganic fertilizer	-0.030***	-0.011*						
	(0.007)	(0.006)						
Organic fertilizer	-0.100***	0.011						
	(0.011)	(0.017)						
Outside seed	-0.054***	-0.044***						
	(0.011)	(0.009)						
Plough/bullock	-0.156***	-0.101***						
	(0.011)	(0.010)						
Powertiller	-0.160***	-0.102***						
	(0.010)	(0.009)						
Local seed	-0.158***	-0.086***						
	(0.010)	(0.013)						
Water/irrigation	-0.160***	-0.103***						
	(0.010)	(0.009)						
Treatment	0.004	0.015						
	(0.013)	(0.013)						
Control 1	0.008	0.019						
	(0.013)	(0.013)						
Buy from agent			0.070	-10.833***	-0.644	66.470**	36.711**	147.802
			(0.323)	(3.677)	(1.343)	(28.633)	(14.958)	(131.529)
Buy from agent × Treatment			-0.152	25.365*	-0.690	-56.406	-65.564***	
			(0.428)	(15.010)	(1.574)	(48.582)	(15.024)	
Buy from agent × Control 1			0.170	-4.024	-2.863*	-25.323	-33.231**	-148.345
			(0.508)	(2.631)	(1.568)	(45.789)	(15.136)	(132.129)
Landholding	-0.040***	-0.020	0.291	-3.600	-4.804*	-20.291	0.996	12.531
	(0.013)	(0.013)	(0.226)	(7.811)	(2.719)	(18.900)	(3.606)	(11.597)
Year 2	-0.021***	0.007**	6.406***	9.052	-2.174	36.118***	19.594***	-20.841***
	(0.003)	(0.003)	(0.132)	(6.914)	(1.517)	(10.393)	(2.161)	(5.864)
Information Village	0.003	0.009	0.111	6.908	1.342	-2.178	1.220	-2.888
	(0.010)	(0.010)	(0.175)	(6.071)	(1.889)	(15.979)	(2.403)	(6.256)
Constant	0.190***	0.101***	10.081***	19.101***	26.283***	533.145***	183.253***	83.088***
	(0.015)	(0.014)	(0.171)	(4.702)	(1.270)	(17.676)	(2.401)	(3.991)
TRAIL Treatment	-0.00338	-0.00359	-0.322	29.39*	2.174	-31.08	-32.33***	148.3
TRAIL Selection	0.00780	0.0187	0.170	-4.024	-2.863*	-25.32	-33.23**	-148.3
Sample Size	12,448	10,196	1,672	370	1,654	2,691	1,403	1,230
Mean Control 1	0.0875	0.0760	13.78	16.12	22.36	533.5	195.2	72.30

Table A-10: Transactions with TRAIL Agent Output Market

	Ever sold output to agent	Share of output sold to agent	Output (price/kg)		
			Potato	Paddy	Sesame
	(1)	(2)	(3)	(4)	(5)
Paddy	-0.089***	-0.005			
	(0.019)	(0.018)			
Sesame	-0.132***	-0.019			
	(0.015)	(0.014)			
Treatment	0.011	0.062**			
	(0.027)	(0.026)			
Control 1	0.006	0.046*			
	(0.026)	(0.024)			
Landholding	-0.114***	0.005	0.282***	-0.045	0.640
	(0.027)	(0.024)	(0.086)	(0.200)	(0.567)
Year 2	-0.084***	0.016**	1.267***	-0.563***	8.195***
	(0.010)	(0.008)	(0.053)	(0.117)	(0.681)
Information Village	0.128***	0.107***	-0.287***	-0.238*	-0.892***
	(0.020)	(0.019)	(0.063)	(0.141)	(0.250)
Sell to agent			-0.286***	0.245	0.619
			(0.108)	(0.166)	(0.511)
Sell to agent × Treatment			0.195	-0.120	0.612
			(0.184)	(0.206)	(0.795)
Sell to agent × Control 1			0.096	-0.149	8.429
			(0.148)	(0.195)	(7.904)
Constant	0.297***	0.047**	3.894***	9.849***	23.110***
	(0.024)	(0.023)	(0.057)	(0.153)	(0.222)
TRAIL Treatment	0.00559	0.0152	0.0998	0.0289	-7.817
TRAIL Selection	0.00560	0.0465**	0.0955	-0.149	8.429
Sample size	2,990	2,765	1,386	498	881
Mean Control 1	0.209	0.151	4.507	9.282	28.42

Notes:
The sample consists of sample households in TRAIL and GBL villages with at most 1.5 acres of land. Standard errors clustered at the village level in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table A-11: Transactions with TRAIL Agent Credit Market

	Ever Borrow from Agent (1)	Share Borrow from Agent (2)	APR (3)
Treatment	-0.022	-0.020	
	(0.031)	(0.013)	
Control 1	0.060*	0.016*	
	(0.031)	(0.009)	
Loan from Agent			0.026
			(0.019)
Loan from Agent × Treatment			-0.004
			(0.045)
Loan from Agent × Control 1			-0.007
			(0.029)
Landholding	-0.029	-0.019	-0.002
	(0.059)	(0.019)	(0.007)
Year 2	-0.037**	0.008	-0.011**
	(0.017)	(0.009)	(0.005)
Information Village	0.101	0.018	0.024***
	(0.115)	(0.025)	(0.006)
Loansize			0.004***
			(0.001)
Duration > 120 days			0.045***
			(0.007)
Constant	0.099	0.031	0.089***
	(0.077)	(0.025)	(0.008)
TRAIL Treatment	-0.082*	-0.036**	0.003
TRAIL Selection	0.060*	0.016*	-0.007
Sample size	1,398	1,398	4,320
Mean Control 1	0.173	0.049	0.145

Notes:
The sample consists of sample households in TRAIL and GBL villages with at most 1.5 acres of land. Standard errors clustered at the village level in parentheses. $^{***}p < 0.01$,$^{**}p < 0.05$,$^{*}p < 0.1$. Borrowing restricted to agricultural purposes.