Beyond Microcredit: Giving the Poor a Way to Save Their Way out of Poverty

Kumar Aniket *†

February 8, 2010

Abstract

The implicit assumption in microfinance literature has been that offering the poor credit is the most efficient way to alleviate poverty. This paper examines the optimal design of group-lending microfinance institutions that offer both saving and borrowing opportunities. Offering saving opportunities leads to negative assortative matching within the group along wealth lines, i.e., there is significant wealth heterogeneity within the endogenously formed groups. Further, the paper shows that under reasonable assumptions, the microfinance institutions that offer both borrowing and saving opportunities could reach poorer individuals than institutions that only offer borrowing opportunities.

Keywords: Group-Lending, Microfinance, Savings, Outreach, Wealth
JEL Classification: D82, G20, O12, O2

*I am extremely grateful to Maitreesh Ghatak, Oriana Bandiera, Stefan Dercon, Pramila Krishnan, József Sákovics and Jonathan Thomas for their helpful comments.

†Trinity College, University of Cambridge, Cambridge CB2 1TQ, UK, Email: ka323@cam.ac.uk

1 Introduction

Microfinance has almost always been synonymous with microcredit. This is true both in the mainstream media as well as the economics literature on microfinance. There is an implicit assumption that allowing the poor to borrow their way out of poverty is optimal. In this paper we show that offering saving opportunities in conjunction with borrowing opportunities to the poor is a more effective way of alleviating poverty. According to Armendáriz de Aghion and Morduch (2005, pp.172), the microfinance practitioners are coming around to the view that the two approaches are complementary. As far as we are aware, this is the first paper that attempts to look at implications of offering saving opportunities on the internal design of a group lending microfinance institution.

The microfinance institutions are often criticised for not reaching the poorest of the poor (Morduch (1999)). The theoretical literature in microfinance has side-stepped this issue by assuming that the microfinance institutions lend without asking for any collateral. There has been no effort to show that the mechanisms employed by microfinance institutions in practice like group lending, cross-reporting (Rai and Sjöström, 2004), sequential lending (Roy Chowdhury (2005) Aniket (2006b)) actually drive down the wealth threshold required to access financial services.

Based on a case study (Aniket, 2006a), we delineate a particular mechanism through which microfinance institutions could offer saving opportunities whilst lending to groups.[1] We show that this mechanism could potentially allow the microfinance institution to significantly decrease the minimum wealth threshold required to access the financial services offered by it.

There are very clear information problems associated with lending to the poor. Their lack of collateralisable wealth means that these information problems are expensive to solve in terms of economic rents. Conversely, a microfinance institution can easily offer saving opportunities to the poor. There is no information problem associated with offering saving opportunities. Fur-

[1] Aniket (2006a) is a case study of the SHG Linkage Programme, which is the largest microfinance programmes in India.

ther, it can use these small savings to make the savers an equity investor in the borrower's project. This would give the savers the incentive to monitor other borrowers locally. In return the savers would get a higher return on their savings which compensates them both for their monitoring efforts and their opportunity cost of capital. Consequently, offering saving opportunities gives the microfinance institutions a way to alleviate the information problem associated with lending.

The literature on microfinance has hitherto almost exclusively focussed on mechanisms that allow the wealth-deprived (collateral-deficient) individuals to (only) borrow in jointly liable groups. The liability the borrowers bear for each other within the group compensates for their lack of ownership of stock assets which could serve as collateral.[2]

The literature, with the exception of Banerjee et al. (1994), has ignored the implication of offering saving opportunities within the group lending mechanism. Whilst analysing the internal structure of a cooperative, where members of the cooperative borrow both internally and externally, Banerjee et al. (1994) show that if the funds are borrowed internally, a premium[3] needs to be paid on the internally borrowed funds. Our objective in this paper is to push this further and endogenise the group formation process in order to analyse the composition of groups that are formed under this lending arrangement. Our model predicts that offering the opportunity to both save and borrow within the groups would lead to negative assortative matching along wealth lines, i.e., wealthy individuals would group with poorer individuals.

In a seminal paper, Ghatak (1999) has shown that in an adverse-selection

[2]The recurrent theme in the moral hazard literature on group lending has been that when lending to individuals with insufficient wealth (collateral), making borrowers jointly liable for their peer's outcome induces them to effectively collude, i.e., behave co-operatively. Collusion leads to gains in lending efficiency as rents allocated to the group to prevent collusion are lower than rents allocated to the borrowers in individual lending. Stiglitz (1990), Varian (1990) and Ghatak and Guinnane (1999) show that when individuals have no wealth and monitoring is costless, peer monitoring can be engendered by inducing the borrowers in the group to collude on their actions. Conning (1996) and Conning (2000) show that this remains true even when monitoring is costly.

[3]compensating the source of these internal funds for monitoring the borrower(s) and bearing the liability for their failure to repay.

framework with joint liability there is positive assortative matching amongst the borrowers in a group. That is, the borrowers flock together with their own risk type. The safe-type group with the safe-type and the risky-type group with the risky-type of borrowers. The lender can screen the borrowers by varying the interest rate and the degree of joint liability of the loan contract. This paper shows that wealth could be another relevant dimension in group formation.

We have a standard moral hazard set-up with costly monitoring in which the lender lends to a jointly liable group of two. The lender can only offer saving opportunities by restricting the number of people who can simultaneously borrow within a group at a point in time.[4] Thus, only one group member's project is financed and the group members decide[5] amongst themselves which member gets to borrow for her project. This has the effect of creating intra-group competition for the loan.[6]

A group is thus composed of a borrower and a non-borrower. The lender directly influences the borrower's effort choice by requiring her to partly self-finance her project. Further, the lender indirectly influences the borrower's effort choice by giving her peer (non-borrower) incentives to monitor the borrower. This is done by requiring that the non-borrower acquires a stake in the borrower's project. We are able to derive the respective wealth thresholds for joining the groups as a borrower and a non-borrower (i.e., a saver). We find that the wealth threshold to be a borrower is greater than the wealth threshold to be a non-borrower in the group. Thus, the individuals who do not have sufficient wealth to be able to borrow, become equity investors (savers) in the relatively-wealthy borrower's project.

[4] Aniket (2006b), Roy Chowdhury (2005) and Varian (1990) have found that lending sequentially within the group (with the proviso that a group member's loan is contingent on all previous borrowers' successful repayment of their respective loans) increases the lending efficiency by lowering the rents allocated to the borrowers. In sequential lending every group member gets to borrow unless the group disbands prematurely due to default by a borrower. Conversely, in our one period set-up in this paper, the number of loans are restricted such that all members in the group cannot simultaneously borrow. Further, the group necessarily disbands once these loans are repaid or defaulted upon.

[5] If the group is not able to reach a decision, a randomly chosen member gets the loan.

[6] We thus extend the framework of models of financial intermediation like Diamond (1984) and Holmstrom and Tirole (1997) to group lending.

By offering opportunities to save, the lender *unwittingly* provides incentives for the relatively wealthy to group with individuals poorer than themselves. By grouping with individuals who do not have sufficient wealth to borrow, the relatively wealthy are able to eliminate intra-group competition for loans.

We analyse how the respective wealth thresholds vary with the opportunity cost of capital in the economy. We find that as the cost of capital is lowered through subsidy, the minimum wealth required to be a borrower is reduced. This is because as the borrower's interest burden of the loan decreases with subsidy, the lender is able to maintain the borrower's incentive for effort while concurrently reducing her stake in her own project. Conversely, the minimum wealth required to be a non-borrower increases with subsidy. With lower interest rates, the non-borrower is compensated for her monitoring effort through a greater stake in the borrower's project.

Subsidy closes the gap between the minimum wealth required to be a borrower and a non-borrower in the group. This reduces the expected time (in terms of number of loan cycles) it would take an individual below the borrower's wealth threshold to accumulate sufficient wealth to be able to borrow. The aim here is to highlight the dual effect of subsidy. In terms of outreach, subsidy actually harms the interest of the poorest by increasing the wealth threshold for joining the groups. Conversely, it is beneficial for a poor individual who is able to join the group as a non-borrower as it decreases the expected time taken for the non-borrower to graduate on to becoming a borrower. Thus, there exists a clear trade-off between outreach and the expected time it takes to loosen the wealth-deficient non-borrower's credit constraint.

We use the above given framework to analyse how the government can use the interest rate policy[7] to maximise the *outreach* or, in other words, minimise the wealth threshold for accessing the financial services offered by these institutions.

[7] Ramachandran and Swaminathan (2005) document how the Indian government has been able force the banks in India to lend a specified proportion of their total lending to targeted areas, thus affecting the opportunity cost of capital in these areas.

We find that the interest rate policy would have a very different impact in terms of outreach for these two different types of microfinance institutions, i.e., the type that allows their clients to both borrow and save from the type that only allows them to borrow. We are thus able to scrutinise the long held view in microfinance that subsidising the cost of capital is an effective way of helping the poorest. (See Conning (1999), Hulme and Mosley (1996) and Morduch (2000) for articulation of this so called "welfarist" approach.) We find that subsidising the cost of capital actually harms the ability of the poorest to join the type of microfinance institutions which offer opportunities to save as well as borrow.

To make matters concrete, we define the optimal cost of capital, in this context, as the one which minimises the wealth required to join the group as a non-borrower subject to the constraint that these non-borrowers can accumulate sufficient wealth and thus graduate on to becoming borrowers (with a positive probability) in one loan cycle. If the government can influence the cost of capital, they should aim for this rate.

We have confined ourselves to the problem of the borrower's effort choice before the project is undertaken. Other papers in the microfinance literature have shown that joint liability group lending can alleviate information problems like adverse selection (Armendáriz de Aghion and Gollier (2000), Ghatak (2000), Laffont and N'Guessan (2000) and Van Tassel (1999)) and strategic default (Besley and Coate (1995) and Che (1999)) associated with lending to the poor. Ghatak and Guinnane (1999) and Morduch (1999) are two excellent recent surveys in this area.

2 Model

There are two agents. Each agent has access to an identical project which requires a lump-sum investment of 1 unit of capital. The project produces an uncertain and observable outcome x, valued at $\bar{x}$ when it succeeds (s) and 0 when it fails (f).

2.1 Agents

Each agent k is risk neutral, with zero reservation wage income, w_k cash wealth and no collateralizable wealth. ($w_k < 1 \; \forall \; k$)

Agents may choose to pursue the project with a *high* (H) or *low* (L) effort, which is unobservable to everyone. With a high (low) effort, $\bar{x}$ is realised with probability π^h (π^l) and 0 with $1 - \pi^h$ ($1 - \pi^l$). ($\pi^h > \pi^l$)

By exerting low effort, agents obtain a private benefit of value B from the project which is non-pecuniary and non-transferable amongst the agents. The private benefits can be curtailed by monitoring, which is undertaken at cost c to the monitor. The cost of monitoring is non-pecuniary.

The only connection that agents have amongst themselves is their ability to monitor each other and curtail each other's private benefits. The agents can observe each other's monitoring intensity but the lender cannot observe it. We assume that the *monitoring function* $B(c)$ is continuous, twice differentiable, $B(0) > 0$, $B'(c) < 0$ and $B''(c) > 0$.

2.2 Lender

The *lender* is risk neutral and does not have the ability to monitor or punish the agents in any way, except through their payoffs. He can costlessly observe the initial capital invested in the project as well as the output from the project.

The opportunity cost of capital for everyone in the area is ρ. The lender has access to capital at ρ and the agents can obtain a return of ρ on their savings. We assume that the lender, due to the competition he faces, is unable to obtain an ex ante return on the capital he lends, over and above ρ, his opportunity cost of capital.

3 Individual Lending

In this section, we examine the case where an individual borrower undertakes a project by investing 1 unit of capital. The lender's contract requires that the borrower invests w_b of her own cash wealth in the project and the lender lends her the rest $(1 - w_b)$ at an interest rate r. If the project succeeds, the borrower repays the lender $r(1-w_b)$, and keeps the rest, i.e., $\bar{x}-r(1-w_b)$ for herself. If the project fails both get 0. The lender's problem, set out below, is to ensure that the borrower, through w_b, has sufficient stake in her own project.

$$\max_{w_b} \ \pi^h r(1 - w_b)$$

$$E\left[b_i \mid H\right] \geqslant \rho w_b \tag{1}$$

$$E[\, b_i \mid H \,] \geqslant E[\, b_i \mid L \,] + B(0) \tag{2}$$

$$b_i \geqslant 0; \quad i = s, f \tag{3}$$

$$r = \frac{\rho}{\pi^h} \tag{L-ZPC}$$

where b_i is the borrowers payoff in state $i = \{s, f\}$. (1), (2) and (3) are the borrower's participation, incentive compatibility and limited liability constraints. L-ZPC is the lender's zero profit condition. In the first-best world,[8] where effort is observable, there is no minimum wealth required for borrowing from the lender if $\bar{x} \geqslant \frac{\rho}{\pi^h}$. All socially viable projects are feasible.

3.1 Unobservable Effort

In the first-best world, there is no tension between r and w_b because effort is observable and thus contractible. The tension between r and w_b emerges when the effort is unobservable and thus needs to be incentivised.

The borrower's incentive compatibility constraint (2) can be written as $w_b \geqslant 1 - \left[\frac{\Delta\pi\bar{x} - B(0)}{r\Delta\pi}\right]$ where $\Delta\pi = \pi^h - \pi^l$.[9] With unobservable effort, increasing r reduces the borrower's incentive for high effort.[10] This can be

[8] i.e., when (2) is ignored.

[9] Thus, individual lending is feasible if the project is sufficiently productive, namely $\bar{x} \geqslant \frac{B(0)}{\Delta\pi}$.

[10] Increasing r reduces the borrower's expected pecuniary payoff from high effort ($\pi^h[\bar{x} - r(1 - w_b)]$) more than from the low effort ($\pi^l[\bar{x} - r(1 - w_b)]$), given that $\pi^h > \pi^l$. This reduces her incentive to pursue the project with high effort and lose $B(0)$, the private benefits associated with low effort.

compensated by increasing w_b, the borrower's stake in her own project.

With r constrained by the lender's zero profit condition (L-ZPC), there is a minimum threshold w_b required for the contract to be *incentive compatible.* This threshold increases with ρ, the opportunity cost of capital.

The lender's objective function is decreasing in w_b. The incentive compatibility condition puts a lower bound on the w_b. The lender offers the borrower a contract (r, w_b^I), requiring the borrower to invest at least w_b^I of her own cash wealth in the project where

$$w_b^I = 1 - \frac{1}{\left(\frac{\rho}{\pi^h}\right)} \left[\frac{\Delta\pi\bar{x} - B(0)}{\Delta\pi}\right]. \tag{4}$$

Any agent with cash wealth $w(\geqslant w_b^I)$ will accept the contract (r, w_b^I) offered by the lender if $\rho\,(\,w_k - w_b^I\,) + \pi^h[\,\bar{x} - r(1 - w_b^I)\,] \geqslant \rho w_k$. This condition is satisfied if $\bar{x} \geqslant \frac{\rho}{\pi^h}$, that is the agents would take up the offer if the project is socially viable.

Lemma 1 (Individual Lending)**.** *w_b^I, the minimum wealth required to borrow from the lender increases with ρ, the cost of capital and decreases with $\bar{x}$, the productivity of the project.*

We can see from Figure **??** that as ρ increases, the borrower's interest burden on the loan increases, which in turn implies that her incentive for high effort would only be restored if she is required to acquire greater stake in her project.[11]

4 Group Lending

A group is endogenously formed for the purposes of borrowing from the lender. As prescribed by the lender, it consists of two agents, a borrower and a saver (non-borrower). For the lender, group lending has a distinct advantage over individual lending. It allows her to involve the saver (or the

[11] Similarly, the wealth required to borrow decreases in $\bar{x}$, the productivity of the project.

non-borrower) by requiring her to acquire a stake in the borrower's project. With a stake in the borrower's project, the lender is able to align the saver's incentives with her own. The saver has an incentive to monitor the borrower, which in turn lowers the wealth threshold for borrowing from the lender.

Thus, in a group, the borrower is the actual agent that undertakes the project, and the saver is the agent that co-finances the project. Of course, this requires that the lender allows only one member of the group to borrow and the group disbands once the project's outcome has been realised. We restrict our attention to the groups where the combined cash wealth of the borrower and the saver is less than the initial capital required for the project.

4.1 The Mechanism

The lender's contract specifies the amount of wealth the borrower and the saver respectively are required to invest in the project as well as their respective payoffs. The borrower invests w_b and the saver invests w_s in the project. The group borrows $1 - (w_s + w_b)$, which is the rest of the capital required for the project, from the lender.

Source of Capital	**Amount of Capital**	**Return to capital**
Lender's Capital	$1 - w_s - w_b$	r
Saver's Capital	w_s	R
Borrower's Capital	w_b	*residual returns*

Table 1: Source and Return to Capital in Group Lending

If the project succeeds, the saver gets a return R on her capital w_s and the lender gets a return r on his capital $(1 - w_s - w_b)$. The borrower is the residual claimant of the output. That is, the saver gets a payoff $s_s = Rw_s$ and the lender gets a payoff $l_s = r(1 - w_s - w_b)$. The borrower's payoff is $b_s = \bar{x} - Rw_s - r(1 - w_s - w_b)$. Conversely, if the project fails, $s_f = l_f = b_f = 0$.

The timing is as follows:

t=1 The lender announces the group contract. (w_s^*, R^*) and (w_b^*, r) are the saver's (non-borrower's) and the borrower's component of the contract.

t=2 Given the group contract, the agents self-select into the roles of the saver and the borrower. Subsequently, they pair up to form a group.

t=3 The group borrows $(1 - w_b^* - w_s^*)$ from the lender and the borrower invests 1 unit of capital into her project.

t=4 The saver chooses her monitoring intensity c.

t=5 The borrower chooses her effort level.

t=6 The project outcome is realised and the saver, the borrower and the lender get their respective payoffs.

The borrower's and saver's (monitor's) contracts work in conjunction with each other. The lender is able to influence the borrower's effort choice directly through her own payoffs and indirectly through the saver's payoffs. Given that the saver's payoffs are contingent on the outcome of the borrower's project, she has explicit incentives to monitor the borrower and curtail her private benefits. An optimal group contract ensures that the borrower pursues her project with high effort.

The borrower's participation constraint (B-PC) and the incentive compatibility constraint (B-ICC) are given by

$$\pi^h \left[\bar{x} - r(1 - w_s - w_b) - Rw_s\right] \geqslant \rho w_b \tag{B-PC}$$

$$\pi^h \left[\bar{x} - r(1 - w_s - w_b) - Rw_s\right] \geqslant \pi^l \left[\bar{x} - r(1 - w_s - w_b) - Rw_s\right] + B(c) \tag{B-ICC}$$

The saver's participation constraint (S-PC) and the incentive compatibility constraint (S-ICC) are given by

$$\pi^h Rw_s - c \geqslant \rho w_s \tag{S-PC}$$

$$\pi^h Rw_s - c \geqslant \pi^l Rw_s. \tag{S-ICC}$$

4.2 Lender's Problem

The lender would like to maximise his revenue whilst concurrently ensuring that the borrower exerts high effort. The lender's problem is as follows:

$$\max\ \phi = \pi^h r(1 - w_s - w_b)$$

subject to the lender's zero profit condition (L-ZPC), the saver's and the borrower's participation constraints, (S-PC) and (B-PC), and incentive compatibility constraints, (B-PC) and (B-ICC). There is an obvious tension between the lender maximising his objective function and giving the group a sufficient collective stake in the project so that the borrower exerts high effort. The lender's problem is solved in Appendix C. An intuitive discussion of the solution follows.

4.3 Discussion

For a given monitoring intensity c, the borrower's and the saver's participation constraints and the saver's incentive compatibility constraint can be mapped in the saver's contract space (R, w_s).

Figure **??** maps (S-PC), (S-ICC) and (B-PC) for a positive value of c. The saver's participation and incentive compatibility constraints are violated to the left of the curves. The borrower's participation constraint is violated to the right of the curve. Details follow in Appendix A and B.

4.3.1 Saver's Decision

We find that there are two relevant ranges for R. For $R \in \left(\frac{\rho}{\pi^h}, \frac{\rho}{\pi^l}\right)$, the saver's participation constraint binds and the incentive compatibility constraint remains slack. Conversely, for $R > \frac{\rho}{\pi^l}$, the saver's incentive compatibility constraint binds and the participation constraint remains slack. This holds true for all $c > 0$, i.e., (S-PC) and (S-ICC) always intersect and bind at $R = \frac{\rho}{\pi^l}$.

The borrower's participation constraint serves to restrict the contracts that the saver can be offered. Only a saver's contract which is to the left of the (B-PC) in Figure **??** will satisfy the borrower's participation constraint.

Given a contract (R, w_s), the saver will choose c, her monitoring intensity, such that it would make her participation constraint bind if $R \in \left(\frac{\rho}{\pi^h}, \frac{\rho}{\pi^l}\right]$ and make her incentive compatibility constraint bind if $R \geqslant \frac{\rho}{\pi^l}$. The borrower will choose high effort if her incentive compatibility constraint is satisfied and the saver's contract satisfies her participation constraint.

We can also deduce from Figure **??** that for all values of c, if $R \in \left(\frac{\rho}{\pi^h}, \frac{\rho}{\pi^l}\right)$, the saver's contract is on her participation constraint and she gets zero rent. Conversely, the borrower gets positive rents given that her participation constraint is slack.

As R increases in the range $R > \frac{\rho}{\pi^l}$, the saver's incentive compatibility constraint binds and the saver's contract moves away from her participation constraint. The saver's rents increase as the distance between her contract and her participation constraint increases. Concurrently, the borrower's rent decreases as the distance between the saver's contract and the borrower's participation constraint decreases.

Given the saver's contract (R, w_s), the borrower's incentive compatibility constraint gives us the lower bound on w_b, the wealth threshold to be a borrower in the group.

$$w_b \geqslant 1 - \frac{1}{r}\left[\bar{x} - \frac{B(c)}{\Delta\pi}\right] + \left(\frac{R}{r} - 1\right) w_s. \qquad \text{(B-ICC')}$$

By substituting the respective binding constraints, i.e., (S-PC), (S-ICC), (B-ICC) and (L-ZPC),[12] into the lender's objective function, the lender's problem can be written as

$$\min_{R,c} \quad w_b\big(R, c, w_s(R, c)\big) + w_s\big(R, c\big)$$

[12]Appendix A shows that (B-PC) gives us an upper bound on c. (B-PC) remains slack for the projects that are sufficiently productive, $\bar{x} \in \left[\frac{\rho+c^*}{\pi^h}, \infty\right)$, and binds only for low productivity projects, $\bar{x} \in \left(\frac{\rho}{\pi^h}, \frac{c^*+\rho}{\pi^h}\right)$. The optimal contracts for these projects are derived in Appendix C.1.1.

The lender's problem is solved in Appendix C and the result is summarised in Lemma 2.

Lemma 2. *For projects* $\bar{x} \geqslant \frac{\rho + c^*}{\pi^h}$,[13]

i. the lender induces the saver to monitor with intensity c^* *by setting* $R = R^*$ *where* $R^* = \frac{\rho}{\pi^l}$, $B'(c^*) = -1$,

ii. the borrower in the group obtains positive rent while the saver obtains zero rent.

The proof is given in Appendix C. The saver is offered a contract (R^*, w_s^*) where $R^* = \frac{\rho}{\pi^l}$, $w_s^* = \frac{c^*}{R \Delta \pi}$. The borrower is offered a contract (r, w_b^*) where $r = \dfrac{\rho}{\pi^h}$, and $w_b^* = 1 - \frac{1}{\left(\frac{\rho}{\pi^h}\right)} \left[\bar{x} - \frac{B(c^*)}{\Delta \pi} - \frac{c^*}{\pi^h} \right]$. In this contract, the saver's participation constraint binds and the borrower's participation constraint remains slack.

Lemma 3. *Group lending is only feasible if* $\rho > \tilde{\rho}$ *where*

$$\tilde{\rho} = \pi^h \left[\bar{x} - \frac{B(c^*)}{\Delta \pi} - c^* \left(1 - \frac{\pi^l}{\Delta \pi} \right) \right].$$

For $\rho \leqslant \tilde{\rho}$, the wealth threshold to be a borrower is less than the wealth threshold to be a saver, i.e., $w_s^* \geqslant w_b^*$. Agents with wealth in the range $[w_b^*, 1)$ would choose to be a borrower. No agent in this range would choose to be a saver. Consequently, groups would not be formed and the lender would have to revert to individual lending.

Group lending is only feasible if $\rho > \tilde{\rho}$. In this range, the wealth threshold for borrowers is always greater than the wealth threshold for savers, i.e., $w_s^* < w_b^*$. An agent with wealth in the range $[w_b^*, 1)$ can either be a borrower or a saver. They would however choose to be a borrower and thus obtain positive economics rents. Agents with wealth in the range $[w_s^*, w_b^*)$ have no choice but to become savers in the group.

[13] For $\bar{x} \in \left(\frac{\rho}{\pi^h}, \frac{c^* + \rho}{\pi^h} \right)$, the optimal contracts are given in Appendix C.1.1.

Proposition 1. *The minimum collective group wealth required to borrow in group lending is lower than in individual lending.*

$w_s^* + w_b^* > w_b^I$ gives us $B(c^*) + c^* < B(0)$, which holds true given the assumptions on $B(c)$.

4.4 Group Formation

Proposition 2 (Negative Assortative Matching)**.** *If $\rho > \tilde{\rho}$, an agent with enough wealth to be a borrower will always prefer to pair up with an agent who has enough wealth to be a saver but not enough to be a borrower and vice versa.*

Let's assume that agents k_1 and k_2 have enough cash wealth to be borrowers, that is, $w_{k_1}, w_{k_2} \in [w_b^*, 1)$. Agents n_1 and n_2 have enough cash wealth to be savers but not borrower, that is $w_{n_1}, w_{n_2} \in [w_s^*, w_b^*)$.

For agent k_1, paring up with agent n_1 (or n_2) will ensure that she would be able to borrows in the group. Agent k_1's expected payoff from this pairing is

$$\rho(w_{k_1} - w_b^*) + E[b_i \mid H] \tag{5}$$

For agent k_1, pairing up with agent k_2 would imply that she would have to compete with agent k_2 to become the borrower in the group. We assume that if agents in the group compete for the role of the borrower, the role is allocated randomly to an agent. The other agent has to take on the role of the saver. Agent k_1's expected payoff from pairing with agent k_2 is given by

$$\frac{1}{2}\left[\rho(w_{k_1} - w_b^*) + E[b_i \mid H]\right] \; + \; \frac{1}{2}\left[\rho(w_{k_1} - w_s^*) + E[s_i \mid H] - c^*\right] \tag{6}$$

Comparing (5) with (6), agent k_1 would prefer to pair up with agent n_1 over agent k_2 if $\bar{x} \geqslant \frac{c^*+\rho}{\pi^h}$.

Similarly, agent n_1 would prefer to pair up with an agent k_1 (or k_2) over agent n_2 if the following condition holds.

$$\left[\rho(w_{n_1} - w_s^*) + E[s_i \mid H] - c^*\right] \geqslant \rho w_{n_2} \tag{7}$$

Agent n_1's final payoff from pairing up with agent k_1 is given by the LHS. Her payoff from pairing with agent n_2 is given by the RHS. Given that (7) holds with an equality, agent n_1 is indifferent between the two choices.

5 Loan Market Intervention

Let us analyse the costs and benefits of influencing the cost of capital in terms of its ability to reach the poorest. The government intervenes in the loan market by either augmenting or decreasing the supply of loanable funds. This lowers the cost of capital or decreases ρ. We assume that the policymaker's ability to influence ρ is limited. She can influence ρ by a small amount, δ in either direction.

We examine the effect of subsidising (lowering) the cost of capital on *outreach*, i.e., the minimum wealth required for accessing the services offered by the microfinance institutions. This wealth threshold is given by $w_s^*(\rho)$ if $\tilde{\rho} < \rho$ and by $w_b^I(\rho)$ if $\rho \leqslant \tilde{\rho}$.

Proposition 3. *Subsidising the cost of capital decreases the wealth required to participate in the group as a borrower. Conversely, it increases the wealth required to participate in the group as a saver.*

Differentiating w_s^* and w_b^* with respect to ρ allows us to examine the effect of subsidising the cost of capital on the group lending contract. $\left(\frac{dw_s^*}{d\rho} = -\left[\frac{\pi^l}{\Delta\pi}\frac{c^*}{\rho^2}\right] < 0; \frac{dw_b^*}{d\rho} = \frac{\pi^h}{\rho^2}\left[\bar{x} - \frac{B(c^*)}{\Delta\pi} - \frac{c^*}{\pi^h}\right] > 0\right)$ Subsidising the cost of capital or decreasing ρ decreases w_b^* and increases w_s^*.[14] Thus, in group lending, sub-

[14]Overall, $(w_s^* + w_b^*)$, the collective group wealth required increases with ρ. $\left(\frac{d\,(w_s^*+w_b^*)}{d\rho} = \frac{\pi^h}{\rho^2}\left[\bar{x} - \frac{B(c^*)}{\Delta\pi} - \frac{c^*}{\Delta\pi}\right] > 0\right)$

sidy lowers the minimum wealth required to join as a borrower but increases the minimum wealth required to join as a saver[15].

Thus, subsidising the cost of capital has two effects. It curtails access to the group lending for the poor by raising w_s^*. On the other hand, it closes the gap between w_s^* and w_b^*, thus decreasing the expected time a saver takes to graduate on to become a borrower. To take the analysis a step further, we can define the *optimal cost of capital* as the one which minimises the wealth required to join group lending as a saver whilst concurrently allowing each saver to graduate on to becoming a borrower with the probability π^h in just one loan cycle.

Lemma 4. *There exists a $\hat{\rho}$ such that for all $\rho \in (\tilde{\rho}, \hat{\rho}]$ the savers are able to accumulate enough wealth to be able to borrow in the next period, if the current project succeeds.*

If the borrower's project succeeds, the savers of this period can accumulate enough cash wealth to borrow in the next period if the following condition is met.

$$w_s^* R^* \geqslant w_b^*. \tag{8}$$

(8) holds for $\rho \leqslant \hat{\rho}$ where $\hat{\rho} = \frac{\pi^h \left[\bar{x} - \frac{B(c^*)}{\Delta\pi} - \frac{c^*}{\pi^h}\right]}{1 - \frac{c^*}{\Delta\pi}}$.

$\hat{\rho}$ is the optimal cost of capital as it minimizes w_s^* subject to the constraint (8).

With $\rho = \hat{\rho}$, the poorest agents with sufficient wealth to be savers in this period can hope to become borrowers with probability π^h in the next period. This would start a process by which a proportion π^h of all savers in this period would become borrowers in the next period and pair up with agents aspiring to be savers. This process would be particularly helpful if wealth distribution is skewed and the relatively wealthy agents with cash wealth $w_k \geqslant w_b^*$ are in short supply. We summarise this with a proposition.

[15]The intuition is that with a lower ρ, the lender requires the saver to have a higher stake in the borrower's project in order to compensate her for her monitoring costs.

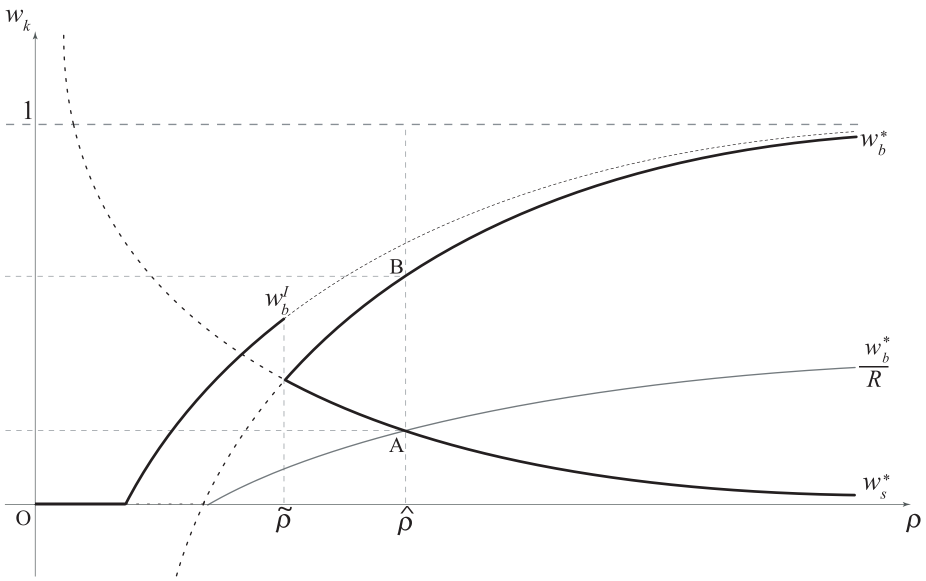

Figure 1: Reaching the Poor with the Interest Rate Policy

Proposition 4. *At the optimal cost of capital $\hat{\rho}$, the group lending programme can concurrently reach the poorest agents and, with probability π^h, enrich them sufficiently at the end of the period so that they can borrow in the next period.*

If ρ in the market is greater than $\hat{\rho}$, then the subsidy is warranted. Conversely, if ρ in the market is less than $\hat{\rho}$, then curtailing the supply of loanable funds and driving up the cost of capital towards $\hat{\rho}$ would increase the outreach.

6 Conclusion

The literature in microfinance has hitherto discussed at length the design of group and individual lending microfinance institutions. There was always been a presumption in the discussions that that giving the poor a way to borrower their way out of poverty is optimal. This paper suggests that allowing the poor to save their out of poverty may be far more efficient.

The paper shows that interlinking the saving and borrowing opportunity within group lending framework would reward the saver for her monitoring efforts over and above the usual returns on her savings. This reduces the wealth threshold for borrowing. It also speeds up the rate at which agents who do not have sufficient wealth to borrower can accumulate wealth and graduate on to become borrowers.

By taking the poor on as savers and then giving them opportunity to graduate on to become borrowers allows the microfiannce organisations to widen its outreach programme and reach the poorest of the poor.

Appendix

A Maximum Feasible Monitoring

A saver's contract is only feasible if (B-PC) is not to the left of (S-PC). This gives us the following condition:

$$(\bar{x} - r) \geqslant w_s (R - r) \geqslant \frac{c}{\pi^h}$$

The borrower's participation constraint gives us the first and the saver's participation constraint gives us the second inequality from the left. From this we get an upper bound on the monitoring intensity c.

Lemma 5. *The maximum monitoring that can be induced for a project is given by the following inequality.*

$$c \leqslant \pi^h (\bar{x} - r)$$

B Existence of $\bar{R}$

For the sake of completeness, we look at conditions under which $\bar{R}$ exists in Figure **??**. $\bar{R}$ is defined by the intersection of the (B-PC) and (S-ICC). But they do not necessarily intersect. If they intersect, it just means that the borrower's rent can be driven down to zero.

$$\bar{R} = \begin{cases} \dfrac{r}{1 - \left[\frac{(\bar{x}-r)}{\frac{c}{\Delta\pi}}\right]} & \text{if } \; c > \Delta\pi(\bar{x} - r), \\ \nexists & \text{if } \; c \leqslant \Delta\pi(\bar{x} - r). \end{cases} \tag{9}$$

(9) implies that $\bar{R}$ exists only for a low-productivity high-monitoring combination. Given a project's productivity $\bar{x}$, a monitoring intensity $c < \Delta\pi(\bar{x} - r)$ can be induced without driving the borrower's rent to zero. For higher monitoring intensity $c \geqslant \Delta\pi(\bar{x} - r)$, the maximum return the saver can be given on her capital is given by $\bar{R}$.

To summarise, the set of all the saver's contracts (R, w_s) that satisfy (S-PC),(S-ICC) and (B-PC) are given by

$$w_s \geqslant \max\left[\frac{c}{\pi^h(R-r)}, \frac{c}{\Delta\pi R}\right] \begin{cases} \forall R \in \left(\frac{\rho}{\pi^h}, \bar{R}\right] & \text{if } c \in \Big(\Delta\pi(\bar{x}-r)\,,\, \pi^h(\bar{x}-r)\Big] \\ \forall R \in \left(\frac{\rho}{\pi^h}, \infty\right) & \text{if } c \in \Big(0\,,\, \Delta\pi(\bar{x}-r)\Big] \end{cases}$$

where $\bar{R}$ is given by (9).

C Group Lending: Lender's problem

Proof of Proposition 2.

The lender's problem is as follows:

$$\max_{R,c} \quad \pi^h r\Big(1 - (w_s + w_b)\Big)$$

subject to (B-PC), (B-ICC), (S-PC), (S-ICC) and (L-ZPC).

Using (L-ZPC) and Lemma 5, we can summarise (S-PC), (S-ICC), (B-

PC) with[16]

$$w_s \geqslant \max\left[\frac{c}{(\pi^h R-\rho)}, \frac{c}{\Delta\pi R}\right] \quad \forall\ c \leqslant \pi^h(\bar{x}-\frac{\rho}{\pi^h}) \tag{10}$$

Using (L-ZPC), the (B-ICC) can be written as

$$w_b \geqslant 1-\frac{1}{\left(\frac{\rho}{\pi^h}\right)}\left[\bar{x}-\frac{B(c)}{\Delta\pi}\right]+\frac{1}{\left(\frac{\rho}{\pi^h}\right)}\left(R-\frac{\rho}{\pi^h}\right)w_s \tag{11}$$

By substituting (10) and (11) as binding constraints, the lender's objective function can be written as a function of R and c.

$$\begin{aligned}\phi = \quad & \pi^h r\Big[1-\big\{w_b\big(R,c,w_s(R,c)\big)+w_s(R,c)\big\}\Big] \\ = \quad & \begin{cases}\pi^h\bar{x}-\pi^h\left(\dfrac{B(c)}{\Delta\pi}+\dfrac{c}{\pi^h-\frac{\rho}{R}}\right) & \text{for } R\in\left(\frac{\rho}{\pi^h},\frac{\rho}{\pi^l}\right] \\ \pi^h\bar{x}-\pi^h\left(\dfrac{B(c)+c}{\Delta\pi}\right) & \text{for} \qquad R\geqslant\frac{\rho}{\pi^l}\end{cases}\end{aligned} \tag{12}$$

For $R\in\left(\dfrac{\rho}{\pi^h},\dfrac{\rho}{\pi^l}\right]$, we find that

$$\frac{\partial\phi}{\partial R}=\frac{\pi^h\rho c}{(\pi^h R-\rho)^2}>0 \qquad \forall\ c>0$$

[16]There are two relevant ranges for R. The (S-PC) binds and (S-ICC) is slack if $R\in\left(\frac{\rho}{\pi^h},\frac{\rho}{\pi^l}\right)$. The (S-ICC) binds and (S-PC) is slack if $R>\frac{\rho}{\pi^l}$. At $R=\frac{\rho}{\pi^l}$ both constraints bind. The (B-PC) is satisfied if $c\leqslant\pi^h(\bar{x}-\frac{\rho}{\pi^h})$.

$$\frac{\partial\phi}{\partial c} = -\pi^h\left(\frac{B'(c)}{\Delta\pi} + \frac{1}{\pi^h - \frac{\rho}{R}}\right)\begin{cases} > 0 & \text{if } B'(c) < -\left[\dfrac{\pi^h - \pi^l}{\pi^h - \frac{\rho}{R}}\right] \\ \leqslant 0 & \text{if } B'(c) \geqslant -\left[\dfrac{\pi^h - \pi^l}{\pi^h - \frac{\rho}{R}}\right] \end{cases}$$

$$\frac{\partial\phi^2}{\partial c^2} = -\pi^h\left(\frac{B''(c)}{\Delta\pi}\right) < 0$$
$$\frac{\partial\phi^2}{\partial c\,\partial R} = -\pi^h\left(\frac{\rho}{\pi^h R - \rho}\right) < 0$$

For $R \geqslant \frac{\rho}{\pi^l}$, $\frac{d\phi}{dc} = 0 \;\Rightarrow\; B'(c) = -1$ and $\frac{d^2\phi}{dc^2} = \frac{\pi^h}{\Delta\pi}B''(c) < 0$.

Thus, the optimal c as a function of R is given by the following function

$$B'(c) = \max\left[-\left(\frac{\pi^h - \pi^l}{\pi^h - \frac{\rho}{R}}\right)\ ,\ -1\right] \tag{13}$$

Consequently, the lender's objective function, $\phi = \pi^h r\left[1 - \big(w_s + w_b\big)\right]$, is maximised if the following set of conditions are met.

$$\begin{aligned} R &\geqslant \frac{\rho}{\pi^l} & &\forall\,\bar{x} \in \left[\tfrac{\rho + c^*}{\pi^h}\ ,\ \infty\right) \quad \text{where } B'(c^*) = -1 \\ R &= \frac{\rho}{\pi^h + \dfrac{\Delta\pi}{B'(\tilde{c})}} & &\forall\,\bar{x} \in \left(\tfrac{\rho}{\pi^h}\ ,\ \tfrac{c^* + \rho}{\pi^h}\right) \quad \text{where } \tilde{c} = \pi^h\bar{x} - \rho \end{aligned} \tag{14}$$

C.1 The Optimal Contract

For projects $\bar{x} \in \left[\frac{\rho + c^*}{\pi^h}, \infty\right)$, the lender induces monitoring c^* where $B'(c^*) = -1$. The saver and the borrower are offered contracts (R^*, w_s^*) and (r, w_b^*) respectively, where $R^* = \frac{\rho}{\pi^l}$, $w_s^* = \frac{c^*}{R\Delta\pi}$, $r = \frac{\rho}{\pi^h}$, and $w_b^* = 1 - \frac{1}{\left(\frac{\rho}{\pi^h}\right)}\left[\bar{x} - \frac{B(c^*)}{\Delta\pi} - \frac{c^*}{\pi^h}\right]$.

C.1.1 Low Productivity Projects

For projects $\bar{x} \in \left(\frac{\rho}{\pi^h}, \frac{c^*+\rho}{\pi^h}\right)$, the lender induces monitoring $\tilde{c} < c^*$ where $\tilde{c} = \pi^h(\bar{x} - r)$. (See Lemma 5)[17] Thus, the saver and the borrower are offered contracts $(\tilde{R}, \tilde{w_s})$ and $(r, \tilde{w_b})$ respectively, where $\tilde{R} = \frac{\rho}{\pi^h + \frac{\Delta\pi}{B'(\tilde{c})}}$, $\tilde{w_s} = \frac{\tilde{c}}{R\Delta\pi}$, $r = \frac{\rho}{\pi^h}$ and $\tilde{w_b} = 1 - \frac{1}{\left(\frac{\rho}{\pi^h}\right)}\left[\bar{x} - \frac{B(\tilde{c})}{\Delta\pi} + \frac{\tilde{c}}{\pi^h}\frac{1}{B'(\tilde{c})}\right]$

C.1.2 Economic Rents

For $\bar{x} \in \left[\frac{\rho+c^*}{\pi^h}, \infty\right)$, the high productivity projects, the optimal contracts (r, w_b^*) and (R, w_s^*) give the borrower positive and the saver zero economic rents.

$$E[b_i \mid H] - \rho w_b^* = \pi^h(\bar{x} - r) - c^* > 0$$

$$E[s_i \mid H] - \rho w_s^* - c^* = 0$$

For $\bar{x} \in \left(\frac{\rho}{\pi^h}, \frac{c^*+\rho}{\pi^h}\right)$, the low productivity projects, the optimal contracts $(\tilde{R}, \tilde{w_s})$ and $(r, \tilde{w_b})$ give the borrower positive and the saver zero economic rents.

$$E[b_i \mid H] - \rho\tilde{w_b} = \pi^h(\bar{x} - r) - \tilde{c} > 0$$

$$E[s_i \mid H] - \rho\tilde{w_s} - \tilde{c} = 0$$

References

Aniket, K. (2006a). Self help group linkage programme: A case-study. Mimeo, University of Edinburgh.

[17]For projects $\bar{x} \in \left(\frac{\rho}{\pi^h}, \frac{c^*+\rho}{\pi^h}\right)$, the lender is not able to induce monitoring intensity c^*. This is because (R^*, w_s^*), the saver's contract which is required to induce the saver to monitor with intensity c^*, violates the borrower's participation contract.

Aniket, K. (2006b). Sequential group lending with moral hazard. *Edinburgh School of Economics Discussion Paper No. 136*.

Armendáriz de Aghion, B. and Gollier, C. (2000). Peer group formation in an adverse selection model. *The Economic Journal*, 110:632–643.

Armendáriz de Aghion, B. and Morduch, J. (2005). *The Economics of Microfinance*. MIT Press.

Banerjee, A. V., Besley, T., and Guinnane, T. W. (1994). Thy neighbor's keeper: The design of a credit cooperative with theory and a test. *The Quarterly Journal of Economics*, 109(2):491–515.

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

Che, Y. (1999). Joint liability and peer sanction under group lending. Mimeo, University of Wisconsin.

Conning, J. (1996). Group lending, moral hazard and the creation of social collateral. *IRIS Working paper*, (165).

Conning, J. (1999). Outreach, sustainability and leverage in monitored and peer-monitored lending. *Journal of Development Economics*, 60:51–77.

Conning, J. (2000). Monitoring by delegates or by peers? Joint liability loans under moral hazard. Mimeo.

Diamond, D. W. (1984). Financial intermediation and delegated monitoring. *Review of Economic Studies*, 51(3):393–414.

Ghatak, M. (1999). Group lending, local information and peer selection. *Journal of Development Economics*, 60:27–50.

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

Ghatak, M. and Guinnane, T. W. (1999). The economics of lending with joint liability: theory and practice. *Journal of Development Economics*, 60(1):195–228.

Holmstrom, B. and Tirole, J. (1997). Financial intermediation, loanable funds, and the real sector. *Quarterly Journal of Economics*, 112(3):663–691.

Hulme, D. and Mosley, P. (1996). *Finance Against Poverty*. Routledge.

Laffont, J. and N'Guessan, T. (2000). Group lending with adverse selection. *European Economic Review*, 44(4-6):773–784.

Morduch, J. (1999). The microfinance promise. *Journal of Economic Literature*, 37(4):1569–1614.

Morduch, J. (2000). The microfinance schism. *World Development*, 28(4):617–629.

Rai, A. S. and Sjöström, T. (2004). Is grameen lending efficient? repayment incentives and insurance in village economies. *Review of Economic Studies*, 71:217–234.

Ramachandran, V. K. and Swaminathan, M., editors (2005). *Financial Liberalization and Rural Credit in India*. Tulika Books.

Roy Chowdhury, P. (2005). Group-lending: Sequential financing, lender monitoring and joint liability. *Journal of Development Economics*, 77:415–439.

Stiglitz, J. (1990). Peer monitoring and credit markets. *World Bank Economic Review*, 4(3):351–366.

Van Tassel, E. (1999). Group lending under asymmetric information. *Journal of Development Economics*, 60(1):3–25.

Varian, H. (1990). Monitoring agents with other agents. *Journal of Institutional and Theoretical Economics*, 146(1):153–174.