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Authors
Aubert, Cecile
de Janvry, Alain
Sadoulet, Elisabeth

Publication Date
2004-06-01

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Cécile Aubert*, Alain de Janvry† and Elisabeth Sadoulet‡

June 2004

Abstract

Microfinance institutions (MFIs) have introduced incentive pay schemes for their credit agents to induce information acquisition on borrowers. Bonuses linked to repayment are efficient for profit-oriented MFIs but insufficient for non-profit MFIs trying to reach very poor borrowers, when repayment and wealth are positively correlated. We show that no incentive scheme is consistent with this (non-verifiable) objective: Random audits on the share of very poor borrowers selected by the agent become necessary. Under the optimal contract, non-profit MFIs generally maximize the number of poor borrowers it services by cross-subsidization between very poor and less poor borrowers.

Keywords: Micro-Credit, Pro-Poor Objectives, Incentives.

JEL Codes: O16, D82, L31.

*Corresponding Author. Université Paris Dauphine. UFR Economie Appliquée, place de Lattre de Tassigny, F-75 016 Paris, France. E-mail: Cecile.Aubert@dauphine.fr.

†Department of Agricultural and Resource Economics, University of California, Berkeley, and Giannini Foundation. E-mail: alain@are.berkeley.edu.

‡Department of Agricultural and Resource Economics, University of California, Berkeley, and Giannini Foundation. E-mail: sadoulet@are.berkeley.edu.

1 Introduction

The incentive issue The microfinance industry is composed of two types of institutions. One is for-profit microfinance institutions (MFIs), including specialized branches of commercial banks, that have been expanding rapidly and tend to increasingly dominate the industry. They have been attracted to microlending by the very large size of the market composed of poor people with no access to financial services. The other type of institution is non-profit MFIs that try to reach very poor people. They typically derive from donor funding of NGOs that have been set up with poverty reduction as their objective. Because donors are not willing to subsidize losses beyond a limited set-up phase, non-profit MFIs must meet a difficult challenge: secure high repayment rates to achieve financial viability, while maximizing their outreach toward the very poor.

- We use two regularities in analyzing the performance of non-profit MFIs. The first is that experts in microfinance have observed a systematic evolution among these MFIs in moving up the poverty scale away from the very poor in selecting their clients (Wright and Dondo, 2001; Sustainable Banking for the Poor, 2002). This 'mission drift' has been attributed to two causes.

One is that it is easier for credit agents to work with less-poor than with very poor borrowers. While there is some contradictory evidence on this regularity, many empirical studies have established the fact that, while willingness to pay tends to be higher among the very poor, ability to pay and ultimately repayment rates are greater among the less poor. Sharma and Zeller (1997) in Bangladesh, SEF (2003) in South Africa, and Zeller (1998) in Madagascar all find that repayment performance increases with wealth. This is because the very poor tend to invest in low-return activities, in saturated and poorly developed markets, where environmental

and economic shocks are frequent while they have low ability to bear risk (Hulme, 2000).

The other cause is that competition with for-profit MFIs makes it increasingly difficult for non-profit MFIs to use lending to less-poor borrowers in order to cross-subsidize loans to very poor borrowers (see McIntosh and Wydick, 2004, using observations for FUNDAP in Guatemala and FINCA in Uganda).

- The second regularity is that increased competition for credit agents among MFIs, and disappearance of the first generation of more idealistic credit officers and their replacement by younger career-oriented agents, imply the need to introduce incentive payment schemes that both reward effort and guide agents toward meeting the MFI's specific objectives. For-profit MFIs have found it easy to create high powered incentives, offering bonuses to agents with high repayment rates in their loan portfolios. Most for-profit MFIs have by now introduced such incentive systems. Setting these incentives is more difficult for non-profit MFIs as they want to induce their agents to not only secure the financial viability of the institution, but also reach very poor borrowers.

Bi-lateral donors like USAID have recently shown increasing concern with the 'mission-drift' in MFI lending away from their expected poverty reduction mandate. This concern has led the U.S. Congress to pass in 2000 the Microenterprise Self-reliance Act that mandates that half of all USAID microenterprise funds should benefit the very poor. New legislation in 2003 defines 'very poor' as people living on less than US$1 a day or being in the bottom 50% of population below the national poverty line. Accurate and practical poverty assessment indicators that can be used to measure the extent of pro-poor orientation of client MFIs are being actively developed to permit verification that this mandate is being met (IRIS Center, 2004). Inducing MFIs to

meet the dual sustainability-poverty challenge is thus at the forefront of current debates in the donor community. We analyze in this paper how non-profit MFIs can set incentives for their credit agents to select very poor borrowers and to allow the MFI to reach as many of them as possible while achieving financial sustainability.

Pro-poor MFIs have responded to concern with mission drift through three strategies that have proved little effective. One consists in limiting the size of loans; however, non-poor borrowers will still be attracted by these loans when the opportunity cost is borrowing from money lenders and when larger loans may be expected in the future (de Wit, 1998). Loan size is thus an inadequate instrument for poverty screening (Simanowitz, 2004). A second strategy consists in imposing transactions costs in accessing loans (e.g., compulsory attendance to weekly meetings or physical labor contributions) to induce self-selection by the very poor. However, these costs reduce the poverty reduction value of the loans, and impose additional costs on lenders that may find meeting them difficult when competition hardens. A third strategy is to locate branches in areas where most potential borrowers are very poor, or to work exclusively with social categories (such as young rural women or indigenous groups) where most members are very poor, provided that their repayment rates be sufficient for financial viability. Yet, as we will show, this limits the ability of the MFI to maximize the number of poor clients served by using cross-subsidization between poor and non-poor borrowers.

In contexts where less-poor potential borrowers are extensively present, it is beneficial to lend them part of the non-profit MFI's portfolio in order to cross-subsidize[1] the very poor while

[1]That cross-subsidization may be optimal is often forgotten. For instance, Amin, Rai, and Topa (2003) test empirically whether micro-credit organizations lend more to more vulnerable groups. They conclude that these organizations fare relatively well in this respect and could improve their targeting by conditioning loans on observable variables such as the gender and marital situation of borrowers, single women being typically more vulnerable than others. But they do not consider the possibility that imperfect targeting be necessary for the

meeting the zero profit constraint (Simanowitz, Nkuma, and Kasim, 2000). We show that this requires introducing a system of incentives for credit agents that include random audits to verify the proportion of very poor borrowers in the agent's lending portfolio. This goes in the direction of the current quest by bi-lateral donors of defining poverty assessment indicators that can be used to verify the pro-poor orientation of loans made by credit agents.

Our approach This paper focuses on incentives for credit agents to select very poor borrowers, given a positive correlation between wealth and reimbursement. The lack of information of the MFI with regard to borrowers implies that credit agents must be given incentives under asymmetric information. For instance, the agent must be given incentives to monitor borrowers to prevent them from shirking or from hiding resources at the time of repayment. Similarly, due to adverse selection on borrowers' type, the MFI must ensure that agents find it profitable to incur costs in order to obtain information on potential borrowers. We will concentrate here on asymmetric information on the effort exerted by the credit agent to acquire information on borrowers' wealth and ability. All contracting issues for which having a pro-poor objective (rather than maximizing profit) makes no difference, will be set aside, except when they prevent the adoption of particular incentive contracts. We will show that giving adequate incentives for borrower selection generally induces higher costs for a pro-poor MFI than for a for-profit, even in the most favorable setting.

Because less poor borrowers reimburse more on average than very poor ones, a pro-poor MFI wants to lend an optimal mix of very poor and less poor borrowers, taken among the most 'able' potential borrowers (the most likely to succeed in their projects). The higher expected

financial viability of the MFI.

reimbursement from less poor borrowers is used to cross-subsidize loans to poorer individuals. Giving agents incentives to select '*able*' borrowers conflicts with the selection of very poor borrowers. An agent whose wage increases with repayment would select too many non-poor borrowers. We show that, lack of information on borrowers' ability and on agents' effort, together with positive correlation between repayment and wealth, would require a pro-poor MFI to offer wage schemes that are non-increasing in the repayment rate, as opposed to incentive schemes in for-profit MFIs.

Such wage schemes are not robust to introduction of either collusion at the repayment stage, or a need for monitoring repayment by the agent. They cannot be used, in addition, when the probability of reimbursement depends on ability only, and not on wealth. Random audits generating signals on the true type of borrowers are then necessary. We show how they can be used to restore incentives, but with the added cost associated to an audit procedure. A pro-poor MFI therefore faces higher information costs than a profit-maximizer.

Related literature The literature on micro-credit is extremely large (see Ghosh, Mookherjee, and Ray, 2001, for instance for a pedagogical survey) but only a few studies consider the issue of screening on wealth. This is in strong contrast to the debate among practitioners who insist that giving incentives to agents is both difficult and crucial, and that financial viability often prevents MFIs from reaching their pro-poor objectives.

The literature on moral hazard and adverse selection on wealth differs from our paper by the perspective taken. Lewis and Sappington (2001) consider a moral hazard setting in which wealth determines the maximal amount that borrowers can reimburse. They show that the optimal lending mechanism seeks complementarity between wealth and ability. Malavolti (2002)

considers how the degree of competition between money-lenders affects the screening contracts they offer to agents with moral hazard and heterogeneous wealth levels. In that paper as well, wealth matters as a way of insuring the lender against failure. Our approach differs from both papers not only because of the correlation between wealth and success, but also, and primarily, because screening according to wealth is an objective for a pro-poor MFI as opposed to a tool in securing repayment.

In a similar perspective, but in a very different context, Cremer and Laffont (2003) study a public good allocation problem when access to the good is costly, and individuals differ in both their financial resources and their cost of access. They show that subsidizing the poor is more costly, under asymmetric information on these two variables, when they have higher access costs to public goods than richer individuals.

Last, the paper is related to the literature on not-for-profit firms. A large part of this literature assumes that the employees of such firms will be 'motivated' or 'altruistic'. Francois (2003), for instance, analyzes the incentives of workers in not-for-profit firms providing public services when the level of effort they exert is non observable. A major assumption is that all workers care for the level of service provided. We focus on the other hand on how to design incentive schemes to align the interests of selfish workers with the not-for-profit objective of their employer.

The remainder of the paper is organized as follows: The model of agent incentives is presented in Section 2. Section 3 stresses the impact of a positive correlation between wealth and ability and sets up the benchmark of a profit maximizing MFI. The specific difficulties encountered by a lending institution with pro-poor objectives are analyzed in Section 4, by isolating first

incentives for information on ability, then for information on wealth. This section also stresses how a correlated signal can be used to improve contracting. Section 5 then considers the optimal incentive scheme for a pro-poor MFI under asymmetric information on both wealth and ability. Section 6 offers comments on the current concerns of MFIs and concludes.

2 The model

We consider the following structure in the remainder of the paper. An MFI lends to borrowers that have independent projects. It uses agents as intermediaries to screen and deal with borrowers.

We consider only poor borrowers, defined as having no collateral they could use in gaining access to formal banking. Pro-poor MFIs will try to reach the very poor among them. In the modeling that follows, we use for simplicity the term 'rich' to refer to 'less poor' borrowers, and the term 'poor' to refer to 'very poor'.

2.1 The micro-finance institution

We compare two types of micro-finance institutions, profit-oriented and 'pro-poor'. Both are subject to a viability constraint, that states that they must earn a minimal return of $\underline{\Pi}$ per unit lent (the net profit made on each unit lent must be at least $\underline{\Pi} - 1$). The larger the profitability target, the less freedom the credit institution will have in choosing borrowers. Let ρ denote the average amount reimbursed per borrower (the 'repayment rate') in their pool of borrowers.

Profit-oriented MFIs design incentive schemes for their agents so as to maximize the expected value of repayments minus the costs of investing and rewarding the agent.

'Pro-poor' MFIs try to lend in priority to poor borrowers. They maximize the share of poor borrowers with a high ability in their pool of borrowers. Since we take the total amount of loanable funds as given, we will focus on the number of poor, able, borrowers per unit lent.

2.2 The borrowers

Each individual borrows the same amount, normalized to 1, to finance a project yielding verifiable benefits, that are strictly positive if it is successful and zero otherwise. Borrowers are protected by limited liability, and thus only reimburse in case of success. They are differentiated according to their 'ability' and their 'wealth'.

Ability Borrowers differ in their 'ability' to generate revenues (e.g., their probability of success). The expected gain obtained by 'unable' borrowers is lower than that for 'able' ones. We normalize the first to 0.

The variables corresponding to able and unable borrowers are indexed by A and U, respectively. We assume that obtaining a loan generates a small private non-monetary benefit so that individuals prefer to borrow even with zero expected monetary gain.[2] The proportion of able borrowers is denoted by μ^A.

Wealth Borrowers can also be distinguished according to their wealth level. Borrowers can be either 'rich' (r), or 'poor' (p). 'Rich' borrowers have a positive initial wealth level that is not pledgable (e.g., illiquid or non monetary assets, such as buildings or land with no title or common property rights, or social capital). 'Poor' borrowers have no wealth.

[2]This assumption is needed to ensure that unable individuals ask for a loan, despite the normalization of their expected revenues. This normalization has otherwise no qualitative impact.

The proportion of poor borrowers is denoted by μ^p. Moreover, the pool of poor borrowers of each ability level is assumed to be large compared to the amount of loanable funds (the current coverage of MFIs is indeed quite limited).

Correlation between wealth and ability We focus on situations in which rich borrowers have higher expected revenues than poor ones, for a given ability level. The proportion of able individuals, μ^A, is the same among rich and poor.[3] But rich able borrowers have higher expected revenues. More precisely, the expected gain from the project is G for a rich able borrower, and only αG, with $\alpha \in]0, 1]$, for a poor able one.

Table 1 summarizes the characteristics of potential borrowers.

Table 1: Potential borrowers' types

Ability	Wealth	Proportion	Expected gain
Able	Rich	$\mu^A(1-\mu^p)$	G
	Poor	$\mu^A\mu^p$	αG
Unable	Rich	$(1-\mu^A)(1-\mu^p)$	0
	Poor	$(1-\mu^A)\mu^p$	0

To consider the most interesting case, we assume that the expected reimbursement for poor able borrowers is below the minimum level needed by an MFI: $\alpha G < \underline{\Pi} < G$.

Success in the project yields a non-monetary value to the borrower. A borrower who succeeds obtains some social capital and will have access to credit at more advantageous terms afterwards. This justifies that a pro-poor MFI maximizes the number of able borrowers receiving a loan.[4]

[3] Extending the framework to the case where rich borrowers are also more likely to be able (different proportions $\mu_r^A \neq \mu_p^A$) has been done in a previous version of the paper and does not raise difficulties.

[4] Since able poor borrowers are very numerous, the MFI will never want to lend to unable ones.

No possibility of self-selection Wealth is not verifiable by the MFI.[5] A contract can only bear, in our setting, on reimbursement. Hence, any contract that is attractive to an able borrower is also attractive to an unable one, since the latter never repays his loan. We, moreover, assume that the non-monetary costs that the MFI can impose on borrowers (like attending regular meetings, filing forms, etc.) are not sufficient to deter richer individuals from asking for a loan.[6] Field observations indeed indicate that screening instruments are not sufficient in practice to induce self-selection: Although credit institutions do impose costs on their borrowers, this simply allows, together with upper bounds on the amounts lent and high interest rates, to screen out borrowers who have access to formal banking. Reaching the poor still constitutes a real challenge.

2.3 The credit agent

Since self-selection is not possible, the MFI uses a credit agent to obtain information on borrowers' wealth and ability. This information is 'soft', i.e., not verifiable by the MFI. We denote by y_i^k the proportion of borrowers of wealth k, $k = r, p$, and ability i, $i = A, U$ required by the MFI, and by x_i^k the proportions actually selected by the agent.

The agent has no pro-poor preferences himself.[7] He is risk neutral and not protected by limited liability. His utility can be written as $U = w - C$ when he incurs a cost of information acquisition C and is paid w. The strong assumption of risk neutrality without limited liability

[5] If wealth could be 'verified', i.e., proved by the borrower, rich able borrowers could be screened according to their ability: Individuals would be asked to show evidence on their wealth, and rich borrowers would have to pay an up-front fee large enough to make the contract unprofitable for unable individuals. The issue of screening ability for poor borrowers would remain.

[6] If non-monetary costs were high enough, it would be possible to use a screening mechanism, as in e.g., Besley and Coate (1992): High costs allow to screen out rich able borrowers, who have the highest expected revenues, and hence the highest willingness to bear costs. Slightly lower costs allow to screen out all able borrowers. But it is not possible to select given proportions of able borrowers according to their wealth level. It is for instance impossible to select poor able borrowers, and not rich able ones.

[7] An MFI would find it easier to give incentives to a motivated agent (see Besley and Ghatak, 2003, on that general topic, and Francois, 2003).

allows us to focus on our main point as this is the case for which it is *easiest* to induce a given behavior from the agent. Yet, we will show that the non-monetary objective of pro-poor MFIs makes it very difficult to give incentives, even in this most favorable setting.

The agent obtains information for sure[8] if he incurs some cost: C^a for information on ability, C^w for information on wealth, and $C^{a,w}$ for information on both ability and wealth, with $\min\{C^a, C^w\} \leq C^{a,w} \leq C^a + C^w$ to reflect possible economies of scope.

3 Lending contracts and full information benchmark

From borrowers' limited liability, the maximum expected reimbursement that the MFI can obtain equals the expected gain from the project, i.e., G for a rich able borrower, αG for a poor able borrower, and 0 for others. Both types of MFI find it optimal to ask for this maximum reimbursement.[9]

The expected profit of an MFI that selects borrowers randomly is thus $[\alpha\mu^p + (1-\mu^p)]\mu^A G = [1-\mu^p(1-\alpha)]\mu^A G$. If the MFI hires an agent and induces the selection of proportions y_A^p and $y_A^r = 1 - y_A^p$ of able borrowers, it becomes $[1 - y_A^p(1-\alpha)]G - w$.

Under full information, since rich borrowers have a higher expected gain, a profit maximizing MFI will only lend to rich able borrowers (assuming them to be numerous enough): $y_A^r = 1$, $y_A^p = 0$.

A pro-poor MFI will lend to rich able borrowers, in order to obtain profits in excess of its profitability target, and use these profits to finance poor able borrowers. With this cross-

[8] This involves no loss of generality since all agents are risk neutral.

[9] A pro-poor MFI does not care for the amount left to poor borrowers after reimbursement in our setting. If it did, it might want to keep the participation constraint of poor borrowers slack, but that would create incentive problems since rich borrowers would then try to pass as poor. And, as noted before, self-selection is not feasible.

subsidization, the viability constraint is binding and the MFI lends to a proportion $y_A^p = \frac{G-\underline{\Pi}}{(1-\alpha)G}$ of poor able borrowers.[10]

4 How to give incentives for information acquisition

For a profit-maximizing MFI, giving adequate incentives to its agents is easy. A wage related to borrowers' reimbursement enables to implement the first best. The problem is more difficult for a pro-poor MFI. In order to highlight the different types of incentive schemes available to a pro-poor MFI, we first analyze two benchmark situations: asymmetric information on ability only, then on wealth only. We will see that the characteristics of the wage received by the agent differ strongly in the two situations. Section 5 will then consider the optimal incentive scheme under asymmetric information on both wealth and ability.

4.1 Inducing information acquisition on ability

To emphasize how incentives for information acquisition on ability are given, let us first assume that the MFI has perfect information on the wealth of potential borrowers. It can hence select the optimal proportion of poor. The agent only needs obtain information on ability.

Ability is correlated to reimbursement, and the latter is verifiable. A contract that relates the agent's wage to borrowers' reimbursement rate therefore allows to implement the first best. The MFI maximizes the proportion of poor able borrowers who obtain a loan, under the viability constraint, and the agent's incentive compatibility (IC) constraint (he must be willing to incur C^a to obtain information). Suppose that the MFI offers a wage with a fixed part W and an

[10] From our assumption on the ranking of G, αG and $\underline{\Pi}$, we know that $y_A^p < 1$. In the following, we will neglect boundary issues and assume that parameter values are such that solutions are interior.

incentive $\omega\rho$ proportional to reimbursement ρ : $w = \omega\rho + W$. If the agent does not search for information, he will select $x_A^p = \mu^A y_A^p$ poor able borrowers, and $x_U^p = (1-\mu^A)y_A^p$ poor unable ones. The incentive compatibility constraint is

$$\omega[1 - y_A^p(1-\alpha)]G + W - C^a \geq \omega[1 - y_A^p(1-\alpha)]\mu^A G + W$$

$$\text{i.e.,} \quad \omega[1 - y_A^p(1-\alpha)](1-\mu^A)G \geq C^a \quad (IC).$$

The fixed fee W can be computed so as to have the participation constraint (P) of the agent binding: $\omega[1-y_A^p(1-\alpha)]G+W-C^a = 0 \quad (P)$. This reduces the cost of information acquisition to the 'physical' cost C^a. One can for instance set $\omega = \frac{C^a}{(1-y_A^p(1-\alpha))(1-\mu^A)G}$ and $W = \frac{-\mu^A}{1-\mu^A}C^a$.

The proportion of poor able borrowers is smaller than in the full information case, since the MFI has to cover the fixed cost C^a of information acquisition: $y_A^p = \frac{G-(\Pi+C^a)}{(1-\alpha)G}$.

4.2 Inducing information acquisition on wealth

Let us now consider incentive schemes inducing information acquisition on wealth. To isolate this issue, we assume here that the MFI and the agent are perfectly informed on ability, but not on wealth. We explore the possibility of an incentive contract that relates the agent's wage to reimbursement, as above, in order to induce an adequate selection of poor borrowers. We will see that, while theoretically possible when expected reimbursement depends on wealth, this scheme is prone to theft and collusion that would deny its validity.

a - Reimbursement independent from wealth Consider first the case in which $\alpha = 1$. Then there exists no verifiable variable correlated with the objective of the MFI (i.e., the number of poor borrowers). The distribution of reimbursement does not depend on information

acquisition (whatever the proportion of poor among the able borrowers selected, expected reimbursement is G). In this case, the agent will receive the same expected wage when he searches for information than when he does not, and searching for information is costly. Trivially, his incentive compatibility constraint cannot be satisfied.

Result 1 *No wage can induce a credit agent to acquire information and select borrowers according to their wealth when the latter is independent from repayment.*

b - Reimbursement increasing in wealth Consider now the case in which wealth increases the expected gain from a project: $\alpha < 1$. Expected reimbursement is $[1 - y_A^p(1-\alpha)]G$ when the agent acquires information and selects the required proportions of borrowers. Selecting borrowers randomly among the able ones will induce an average reimbursement of $[1 - \mu^p(1-\alpha)]G$ (since $x_A^p = \mu^p$). Reimbursement, therefore, reveals whether it is likely that the agent has been shirking and can be used for incentives.

Consider as in the previous subsection a wage w composed of a fixed term W and a proportion ω of repayment. Omitting W that cancels out, the incentive compatibility constraint is now

$$[1 - y_A^p(1-\alpha)]\omega G - C^w \geq [1 - \mu^p(1-\alpha)]\omega G \quad \Leftrightarrow \quad (1-\alpha)(\mu^p - y_A^p)\omega G \geq C^w \qquad (1)$$

An important implication is that, since a pro-poor MFI will choose $y_A^p > \mu^p$, one must have $\omega < 0$. One of the solutions is $\omega = -\frac{C^w}{(y_A^p - \mu^p)(1-\alpha)G} < 0$ and $W = C^w \frac{1-\mu^p(1-\alpha)}{(y_A^p - \mu^p)(1-\alpha)} > 0$. The wage is *decreasing* in repayment. Richer borrowers repay more. Inducing the selection of enough poor borrowers implies that low reimbursement rates should be considered a 'good sign'.

As before, the expected wage of the agent will be exactly equal to his information cost, here C^w. The viability constraint will be binding to allow for maximum cross-subsidization of poor

borrowers; this gives their proportion: $y_A^p = \frac{G-(\underline{\Pi}+C^w)}{(1-\alpha)G}$.

Caveats Using non increasing incentive schemes calls for some comments and caveats:

- *Theft and collusion at the repayment stage*

Clearly, if the agent can hide repayment, he will collect it, keep it, and pretend that the project was a failure to decrease repayment and obtain a higher wage. This problem could be resolved by separating tasks: Having different agents select and collect payments may be a way of decreasing the risk of theft. It is, nevertheless, likely that these tasks are complementary, as they involve economies of scope. Moreover, even if the screening agent cannot hide repayment, he and the borrower can collude in claiming failure, with the borrower keeping the revenue from the project.

- *Monitoring the borrower*

Another important case in which an incentive scheme decreasing with reimbursement is not feasible is the following. Assume that, in addition to adverse selection with respect to borrowers, there is moral hazard: Expected revenues depend on the 'effort' the borrower undertakes. The agent must be given incentives to monitor him. Then the incentive scheme cannot reconcile the necessity of having a bonus in case of high reimbursement to induce monitoring effort, and a bonus in case of low reimbursement rates to induce selection of poor borrowers. The MFI would have to allocate the selection and collection tasks to two different agents when possible. Separation is of course not sufficient if the two agents may perfectly collude. Note also that, as for collusion at the repayment stage, it is likely that the process of selection gives information on (and knowledge of) borrowers that makes monitoring less costly when undertaken by the same agent.

• To summarize, we obtain the following:

Result 2 *If richer borrowers repay more on average than poorer ones, a pro-poor MFI should offer a wage non increasing in repayment. For this to be feasible, the MFI should allocate to different agents the tasks of:*

- Selecting borrowers and collecting repayment, if collusion is possible at the collection stage;

- Selecting and monitoring borrowers, if success also depends on borrowers' effort.

The theoretical result according to which optimal wage schedules for pro-poor MFIs are non increasing in repayment cannot be put into practice. We introduce below another instrument that may help solve the problems associated with non increasing wages.

4.3 Signals on the wealth of selected borrowers

Assume that, as above, the MFI is informed on ability but not on wealth. It can now observe some contractible signal σ on the proportion of poor individuals selected by the agent,[11] at some cost C^s. The signal σ on the number of poor borrowers actually selected, $x_A^p + x_U^p$, can be used to condition the agent's wage.[12] This signal is a 'sufficient statistic', so that there is no need to also condition the wage on repayment (see Holmström, 1979, and Shavell, 1979).

The wage function $w(.)$ should i) just reimburse, in expectation, the agent's cost of becoming informed, C^w, for an adequate selection (binding participation constraint, (P)); and ii) ensure

[11] The signal is obviously useless if not strictly correlated to the variable of interest, x_A^p (see Crémer and McLean, 1988, and Riordan and Sappington, 1988, for more on correlation and the costs of asymmetric information).

[12] Conditioning borrowers' contracts on the signal is useless due to limited liability.

that any other selection yields a lower expected utility (incentive compatibility (IC)):

$$\begin{aligned} \mathbf{E}(w/y_A^p) - C^w &= 0 \quad (P) \\ \mathbf{E}(w/x_A^p) - C^w &\leq 0 \quad \forall x_A^p \quad (IC), \end{aligned}$$

where $\mathbf{E}(w/y)$ is the expected wage given the distribution of the signal σ induced by a selection of y poor able borrowers.

For concreteness, consider a simple case in which the MFI samples a number of clients, say n, then perfectly observes their wealth, and compares the proportion of poor borrowers in this sample to the proportion required, y_A^p. The associated signal is $\sigma = x_A^p + \epsilon$, where ϵ is some noise with a known distribution.

Let us consider a wage linearly related with a share s to the absolute gap between the value of the signal and the recommended selection of rich borrowers, $w(\sigma) = W - s|\sigma - y_A^p|$: The agent receives a fixed wage but is penalized for not selecting agents according to wealth as required. The incentive compatibility constraint ensuring that the agent prefers to become informed rather than select randomly among able borrowers ($x_A^p = \mu^p$) is then given by

$$W - s\mathbf{E}|y_A^p - (y_A^p + \epsilon)| - C^w \geq W - s\mathbf{E}|y_A^p - (\mu^p + \epsilon)| \quad i.e., \quad s(\mathbf{E}|y_A^p - (\mu^p + \epsilon)| - \mathbf{E}|\epsilon|) \geq C^w. \quad (2)$$

The penalty in case of wrong selection ensures that the agent prefers to become informed on wealth, and the MFI can then exactly compensate him for his cost of information acquisition thanks to a fixed wage (W). A contract that ensures that the agent gets informed, for a total cost equal to the information cost C^w plus the audit cost C^s, is the following: $w(\sigma) = W - s|\sigma - y_A^p|$, where $s = \frac{C^w}{\mathbf{E}|y_A^p - (\mu^p + \epsilon)| - \mathbf{E}|\epsilon|}$ and $W = C^w\left(1 + \frac{\mathbf{E}|\epsilon|}{\mathbf{E}|y_A^p - (\mu^p + \epsilon)| - \mathbf{E}|\epsilon|}\right)$.

Proposition 1 *When a correlated signal on wealth is available, the MFI can induce adequate*

borrower selection by the agent at no other additional cost than the cost of audit, even with potential collusion at the repayment stage, and when transfers must increase with repayment to induce the agent to monitor borrowers' effort.

The difficulty in giving adequate incentives associated with pro-poor objectives is thus solved by incurring audit costs, to obtain an additional contracting variable.

Since the wage needs depend only on the signal, and not on repayment, the incentive contract is robust to both collusion at the repayment stage, and moral hazard in monitoring effort. Incentives to monitor effort can be provided (through a wage increasing with repayment) independently from incentives to reveal information: Even though the agent has incentives to select rich borrowers to increase expected repayment, the threat of penalties ensures adequate selection of the poor at no cost, except for 'physical' costs that are increased by audit costs. The audit cost, C^s, is a measure of the cost of inducing a pro-poor behavior from the agent, instead of profit maximization.

Risk aversion and signal precision The above result should nevertheless be taken with caution since it relies on the assumption that the agent is risk neutral. If the agent were risk averse, he would have to receive a risk premium linked to the precision of the signal.[13] Sampling a larger number of borrowers, and more generally choosing a more precise (and hence more costly) signal, would be needed to reduce the risk borne by the agent.

A very simple way of dealing with risk consists in allowing for some margin of error, and punishing the agent only if the observed proportion of poor borrowers exceeds the required one

[13]Under risk neutrality, the agent only takes into account expected values, and precision (variance) does not matter.

by more than a given number, say e (this is obviously not a sufficient solution for all types of risk-averse preferences, but it corresponds to actual practice). The penalty, say $\mathcal{S}$, would then take the following form: $\mathcal{S} = 0$ if $|\sigma - y_A^p| < e$, and $\mathcal{S} = s|\sigma - y_A^p|$ if $|\sigma - y_A^p| \geq e$.

Because wealth verification of individual borrowers (as done by the Grameen Bank through household interviews) is expensive, random audits making use of easily verifiable symptoms (such as Cashpor's housing index and community participatory wealth ranking, see Gibbons, 1998) is recommended.

5 The optimal incentive scheme for a pro-poor MFI

Let us now consider asymmetric information on both wealth and ability. We have seen that wages conditional on repayment rates are not satisfactory with asymmetric information on wealth. As a consequence, we will from now on assume that the MFI uses an audit procedure whenever it wishes to induce information acquisition on wealth.

The MFI can use two instruments, in order to induce two related tasks. Wages increasing with repayment allow to induce information acquisition on ability, while wages conditional on a correlated signal can induce an adequate selection on wealth. The institution must choose whether it will use both instruments, one only, or none. The four corresponding possibilities are characterized below.

To simplify future expressions, let us denote by $\rho^A = (\mu^r + \alpha\mu^p)G = (1 - \mu^p(1-\alpha))G$ the average repayment among able borrowers, i.e., with poor and non-poor in proportions equal to what they are in the population.

a - No incentive Assume that the MFI gives no incentives, neither through repayment rates nor through signals. The agent receives a wage equal to the zero normalization level, and selects borrowers randomly. The proportion of poor (respectively poor able) borrowers is then what it happens to be in the population, i.e., μ^p (respectively $\mu^A\mu^p$). The expected return for the MFI is $[1-\mu^p(1-\alpha)]\mu^A G = \mu^A\rho^A$. It is larger than $\underline{\Pi}$ only if the proportion μ^p of poor potential borrowers in the population is small enough.

b - Incentives to acquire information on ability In order to induce information acquisition on ability and selection of able borrowers only[14], the MFI must use a wage increasing with repayment, for instance a linear wage, $w = \omega\rho + W$. The agent will then incur C^a if his incentive compatibility constraint is satisfied:

$$[1-\mu^p(1-\alpha)]\omega G - C^a \geq \mu^A[1-\mu^p(1-\alpha)]\omega G \quad \Leftrightarrow \quad \omega \geq \underline{\omega} \equiv \frac{C^a}{(1-\mu^A)[1-\mu^p(1-\alpha)]G}. \quad (3)$$

If the incentive ω is too large and if rich borrowers repay much more than poor ones (α small), the agent may decide to also look for information on wealth, so as to be able to select only rich able borrowers. To avoid this, the MFI should ensure that an additional incentive compatibility constraint be satisfied:

$$[1-\mu^p(1-\alpha)]\omega G - C^a \geq \omega G - C^{a,w} \quad \Leftrightarrow \quad \omega \leq \overline{\omega} \equiv \frac{C^{a,w} - C^a}{\mu^p(1-\alpha)G}. \quad (4)$$

Depending on the value of the parameters, and with this very simple wage, the two incentive compatibility constraints may not be compatible (if $\underline{\omega} > \overline{\omega}$). More complex, non monotonous, wage schemes would then be required. For simplicity, we shall assume here that a linear wage

[14] It is easy to show that a pro-poor MFI will maximize the number of poor borrowers obtaining a loan by maximizing the number of able borrowers.

exists that satisfies both incentive constraints, so that the agent selects able borrowers independently of their wealth. The fixed fee W can then be computed so as to have the agent's participation constraint binding: $[1-\mu^p(1-\alpha)]\omega G + W = C^a$.

The expected return of the MFI is then $[1-\mu^p(1-\alpha)]G - C^a = \rho^A - C^A$. Assuming it to be higher than the minimum level $\underline{\Pi}$, the MFI lends only to able borrowers and the average number of poor borrowers lent to is μ^p.

c - Incentives to acquire information on wealth In order to induce information acquisition on wealth only, the MFI should use an audit procedure, and condition the agent's wage on the signal obtained, σ. The situation is identical to the benchmark in which the MFI has perfect information on ability (subsection 4.3), except that the expected gains in case of success for rich and poor borrowers, G and αG respectively, have to be replaced by the expected values when ability is not known, $\mu^A G$ and $\mu^A \alpha G$.

A wage scheme implementing the optimal outcome is therefore a fixed term W and a penalty proportional to the difference between the signal (taken to be $\sigma = x^p + \epsilon$, as before) and the required proportion of poor borrowers, denoted y^p: $w(\sigma) = W - s|\sigma - y^p|$, where $s = \frac{C^w}{\mathbf{E}|y^p-(\mu^p+\epsilon)|-\mathbf{E}|\epsilon|}$ and $W = C^w\left(1+\frac{\mathbf{E}|\epsilon|}{\mathbf{E}|y^p-(\mu^p+\epsilon)|-\mathbf{E}|\epsilon|}\right)$.

The MFI obtains an expected return of $[1-y^p(1-\alpha)]\mu^A G - C^w - C^s$, and equates it to $\underline{\Pi}$ to maximize the proportion of poor able borrowers, that will be[15]: $y_A^p = \mu^A y^p = \frac{\mu^A G-(\underline{\Pi}+C^w+C^s)}{G(1-\alpha)}$.

d - Incentives to acquire information on both wealth and ability Assume now that the MFI wants to induce information acquisition on both characteristics, and a selection of y_A^p

[15] If this expression is negative (for α or μ^A very small), the MFI can only lend to the rich, or not lend at all.

able poor borrowers. It should offer a wage scheme depending on both the repayment rate and the signal obtained by auditing borrowers. Let us consider a simple wage scheme linear in repayment and in the difference between the signal and the recommended proportion of poor borrowers: $w = \omega(\rho) - s|y_A^p - \sigma| + W$.

The constraints faced by the MFI are stated in the appendix. They bear on participation (P), on the acquisition of information on both ability and wealth instead of wealth only, $(IC)^a$, instead of ability only, $(IC)^w$, and last, instead of on nothing, $(IC)^\emptyset$.

We show in the appendix that the agent, if he deviates and does not search for information on ability, will always select the number of poor required by the MFI if the penalty s is large enough ($s \geq w(1-\alpha)\mu^A G$). It is, moreover, optimal for the MFI to choose s 'large', together with an adequate choice of ω. Using the fact that the MFI always prefers the participation constraint to be binding, one can rewrite this set of constraints as follows, for the situation in which s is 'large':

$$\begin{aligned}
C^{a,w} - \omega[1 - y_A^p(1-\alpha)]G - s\mathbf{E}|\epsilon| &= W \quad (P) \\
\omega(1-\mu^A)[1 - y_A^p(1-\alpha)]G &\geq C^{a,w} - C^w \quad (IC)^a \\
\omega(\mu^p - y_A^p)(1-\alpha)G - s[\mathbf{E}|y_A^p - (\mu^p + \epsilon)| - \mathbf{E}|\epsilon|] &\geq C^{a,w} - C^a \quad (IC)^w \\
\omega[1 - \mu^A - (1-\alpha)(y_A^p + \mu^A(1-\mu^p))]G - s[\mathbf{E}|y_A^p - (\mu^p + \epsilon)| - \mathbf{E}|\epsilon|] &\geq C^{a,w} \quad (IC)^\emptyset.
\end{aligned}$$

In order to satisfy all incentive constraints, one can always increase the share of reimbursement, ω (see the appendix for details, and the thresholds obtained for s and ω). The penalty s can then be increased so as to have it 'large' enough. The participation constraint (P) gives the level of the fixed payment W that gives the agent no rent. Hence, whatever the value of the

parameters, the MFI can always design a wage such that the total cost be $C^{a,w} + C^s$.

The expected return of the MFI is thus $[1 - y_A^p(1-\alpha)]G - C^{a,w} - C^s$. From the viability constraint, the number of poor borrowers receiving a loan is $y_A^p = \frac{G-(\underline{\Pi}+C^{a,w}+C^s)}{(1-\alpha)G}$.

e - Which incentive scheme is optimal? Table 2 summarizes the four options that can be available to the MFI, as described in the previous section. In options (a) and (b), the proportions of poor lent to will be the ones in the population (restricted to able borrowers for option (b)). If the MFI chooses to give incentives based on a targeted share of poor, either without (option (c)) or with (option (d)) repayment incentives, it uses profits from lending to the non-poor to cross-subsidize poor borrowers, and the number of able poor is determined by the minimum profit constraint. The optimal choice is the scheme leading to the maximum number of loans

Table 2: Incentives for information acquisition and proportion of able poor

Info. acquisition on	Proportion y_A^p	Net profit made by the MFI
(a) Nothing	$\mu^p \mu^A$	$\mu^A \rho^A - \underline{\Pi}$
(b) Ability	μ^p	$\rho^A - \underline{\Pi} - C^a$
(c) Wealth	$\frac{\mu^A G-(\underline{\Pi}+C^w+C^s)}{(1-\alpha)G}$	0
(d) Wealth and ability	$\frac{G-(\underline{\Pi}+C^{a,w}+C^s)}{(1-\alpha)G}$	0

to poor able borrowers, given the value of the parameters. Comparing the numbers of poor in Table 2 leads to conditions delimiting the choice of incentive schemes, that can all be simply written in terms of the share of able borrowers μ^A in the population, the repayment rate ρ^A, and the different costs of acquisition of information C^a, C^w, $C^{a,w}$, and C^s. They are represented on Figures 1 and 2. Figure 1 considers the case in which the cost of acquisition of information on poverty status $C^w + C^s$ is lower than the cost of acquisition of information on ability C^a.

Figure 2 considers the reverse case.

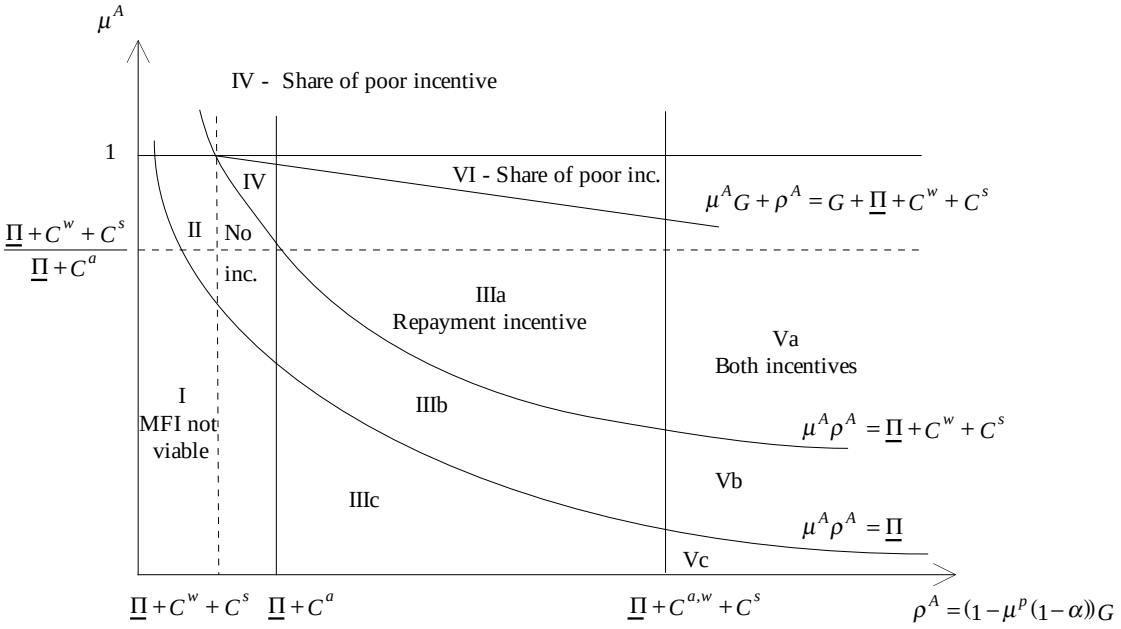

Figure 1: Map of optimal incentive scheme when $C^w + C^s < C^a$

1. Option (a) (no incentives) is feasible (but not necessary optimal) if $\mu^A \rho^A - \underline{\Pi} \geq 0$. This corresponds to all areas above the $\mu^A \rho^A - \underline{\Pi} = 0$ curve, i.e., all areas except I, IIIc, and Vc in Figures 1 and 2.

2. If $\rho^A \geq \underline{\Pi} + C^a$ (areas III, VI, and V), the MFI can afford the cost of selection on ability and would reach more able poor if it does, as $\mu^p \geq \mu^p \mu^A$, with a positive net profit of $\rho^A - \underline{\Pi} - C^a$. Profit incentives (option (b)) are thus better than no incentive, (a), in this area. Note that there may be cases (areas IIIc and Vc) when an MFI would not be viable without incentives ($\mu^A \rho^A < \underline{\Pi}$), while it could make a profit with repayment incentives ($\rho^A \geq \underline{\Pi} + C^a$): this will happen if μ^A is very low, so that selecting on ability makes a

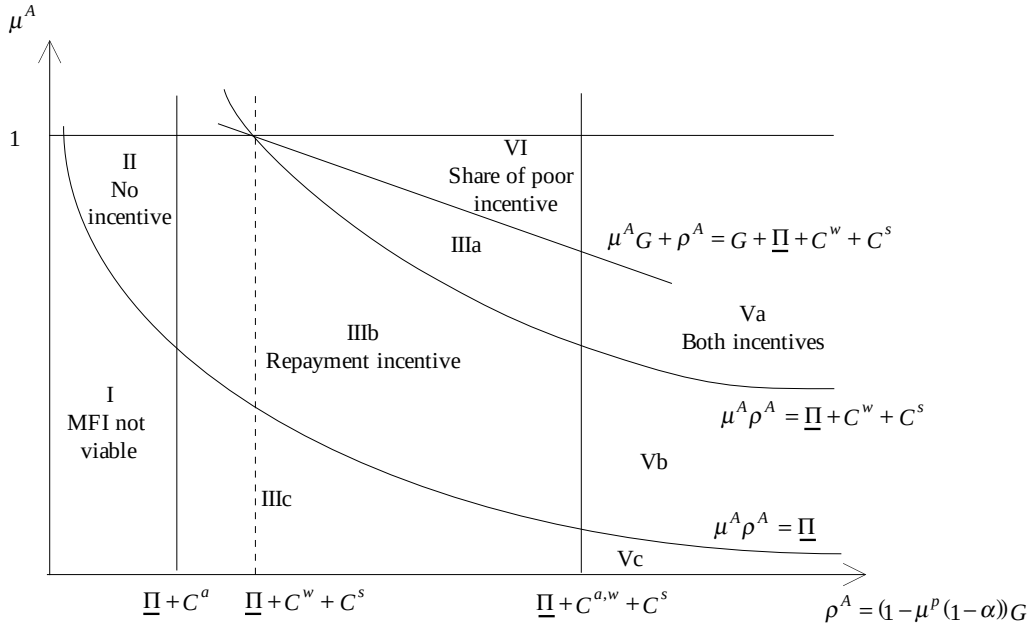

Figure 2: Map of optimal incentive scheme when $C^w + C^s > C^a$

crucial difference in meeting the budget constraint.

3. Comparing options (b) and (d) in Table 2, one can show that incentives on both repayment and targeted share of poor will allow the MFI to include more able poor that under repayment incentives only if $\rho^A \geq \underline{\Pi} + C^{a,w} + C^s$ (area V). Hence, if profits could cover the corresponding information and auditing costs, the MFI could use selection on wealth to increase the proportion of poor.

4. Comparing now options (a) and (c), one can show that if $\mu^A \rho^A \geq \underline{\Pi} + C^w + C^s$ (i.e. the profits obtained when not giving incentives cover the costs of incentives for selection of the poor), as in areas IIIa, IV, VI, and Va, the MFI could have its agents select a higher proportion of poor borrowers than their share in the population with an incentive scheme

based on achieving the targeted proportion of poor.

5. Finally, there may be cases where $\mu^A \rho^A \geq \underline{\Pi} + C^w$ and $\rho^A \geq \underline{\Pi} + C^a$, but $\rho^A \leq \underline{\Pi} + C^{a,w} + C^s$ (area IIIa and VI), meaning that the MFI can select on either wealth or ability, but not on both. Comparing the number of poor under options (b) and (c), one can show that the MFI prefers to select on wealth alone rather than on ability alone if $\frac{\mu^A G - (\underline{\Pi} + C^w + C^s)}{(1-\alpha)G} > \mu^p$, which implies that $\mu^A G + \rho^A > G + \underline{\Pi} + C^w + C^s$. This is represented in area VI.

Collecting the conditions previously established on all two by two comparisons of incentive schemes gives the optimal incentive scheme in each area. To interpret these conditions, let us take as given the returns to projects, G for the non-poor and αG for the poor. The average repayment among able individuals, ρ^A is thus a monotonic function of the social structure, decreasing in the share of poor in the population of potential borrowers, μ^p.

I. MFIs are not viable in area I. In this case, the share of able borrowers is too low and the share of poor too high to allow viability.

II. MFIs are viable and optimally choose to operate without incentive scheme in area II. This is likely to happen when there is a large proportion of able borrowers μ^A and a large share of poor μ^p in the population. This area of operation is larger with a lower minimum profit requirement $\underline{\Pi}$, and higher selection costs C^a, C^w, and C^s. Those are typical of the conditions that prevail in the early years of MFI development. For most MFIs today, this is a bygone situation, hence the need to introduce incentive schemes.

III. MFIs use repayment incentives in areas III. Introducing incentives based on repayment is desirable as soon as profits are sufficient to cover the cost of selection, and the proportion

of poor is not too low in the population. This typically corresponds to the conditions under which most pro-poor MFIs operate when they locate in difficult geographical areas with many poor and heterogeneous ability in borrowers. Note, however, that the MFI does not control the share of poor in its pool of borrowers which is simply what happens to be their share among the able in the region. The MFI may make some extra profit, but not enough to cover the cost of getting information on the poverty status of borrowers.

IV,VI. MFIs use incentives based on the share of poor among borrowers in areas IV and VI. These are contexts with a very high proportion of able borrowers μ^A, and either a small fraction of poor in the population (area VI) or insufficient funds to cover selection on ability (area IV). These contexts are likely to be of minor importance. Recall indeed that the model we used did not allow for moral hazard in repayment: All able borrowers repay their loans. As soon as one introduces moral hazard, repayment incentives become even more necessary to induce the agents to monitor borrowers.

V. MFIs choose to give a complete incentive system linked to both the repayment performance and the share of poor among borrowers in areas V. This is optimal in contexts where there are many non-poor in the population and where lending is sufficiently profitable to cover the cost of information acquisition. These conditions are likely to prevail in urban market environments where most MFIs operate. In this context, pro-poor MFIs engage in cross-subsidization, and use agent incentives for both repayment and pro-poor selection. The repayment incentive leads them to adopt the same incentive bonus formula as implemented in for-profit MFIs. The incentive to work with the desired share of poor is implemented through random audits using poverty assessment indicators of the agents' portfolio of

clients.

6 Conclusion

We have shown that it is difficult for pro-poor MFIs to design incentives for credit agents to specifically select very poor borrowers when the latter have a lower expected repayment rate than less poor borrowers. The fact that the objective of a pro-poor MFI is not verifiable complicates the incentive problem it faces in motivating its agents. If the MFI can locate in difficult contexts with many very poor and heterogeneous ability in borrowers, the agent's incentives will be only directed at insuring high repayment rates. The strategy has the drawback of preventing the MFI from using cross-subsidization between very poor and less poor borrowers to maximize the number of poor reached. The other option is to introduce costly poverty audit mechanisms of the agent's clients, so as to generate a variable correlated with the proportion of very poor among the selected borrowers. This allows the MFI to pursue a cross-subsidization strategy to maximize its poverty outreach.

Implementation of this audit scheme can benefit from the extensive work on the development of low-cost poverty assessment indicators being developed by the IRIS Center on behalf of USAID to implement the pro-poor mandate imposed by the U.S. Congress on microlending programs (IRIS Center; 2004, Zeller, 2004). While these indicators are intended to be applied to a beneficiary pro-poor MFI, they can equally well be applied to monitor the selection performance of individual credit officers. They should consequently help reduce the cost of implementing random audits on the proportion of very poor among clients of each particular agent in a pro-poor MFI. The proposition that we derived here theoretically in designing incentives for microcredit

agents to lend to the very poor thus meets practice, and should be widely implemented to help achieve the poverty reduction objective of MFI lending.

Appendix: No information on potential borrowers' ability and wealth

The MFI faces the following constraints, (P), $(IC)^a$, $(IC)^w$ and $(IC)^\emptyset$ respectively (omitting W that cancels out in the incentive compatibility constraints):

$$\begin{aligned}
\omega[1-y_A^p(1-\alpha)]G - s\mathbf{E}|\epsilon| + W - C^{a,w} &\geq 0 \\
\omega[1-y_A^p(1-\alpha)]G - s\mathbf{E}|\epsilon| - C^{a,w} &\geq \max_{x^p}\{\omega[1-x^p(1-\alpha)]\mu^A G - s\mathbf{E}|y_A^p-(x^p+\epsilon)| - C^w\} \\
\omega[1-y_A^p(1-\alpha)]G - s\mathbf{E}|\epsilon| - C^{a,w} &\geq \omega[1-\mu^p(1-\alpha)]G - s\mathbf{E}|y_A^p-(\mu^p+\epsilon)| - C^a \\
\omega[(1-y_A^p(1-\alpha)]G - C^{a,w} &\geq \omega[1-\mu^p(1-\alpha)]\mu^A G - s\mathbf{E}|y_A^p-(\mu^p+\epsilon)|.
\end{aligned}$$

To simplify constraint $(IC)^a$, we must compute the number of poor borrowers x^p chosen by the agent when he becomes informed on wealth only. His expected wage is linear in x^p, the choice depends only on the sign of the coefficient of x^p: $x^p = 0$ if $s < w(1-\alpha)\mu^A G$, and $x^p = y_A^p$ otherwise. The constraints can be rewritten as follows ((P) binds in equilibrium):

$$\begin{aligned}
C^{a,w} - \omega[1-y_A^p(1-\alpha)]G - s\mathbf{E}|\epsilon| &= W \quad (P) \\
\text{If } s < \omega(1-\alpha)\mu^A G: \quad \omega[1-y_A^p(1-\alpha)-\mu^A]G - s\Big[\mathbf{E}|y_A^p-\epsilon| - \mathbf{E}|\epsilon)|\Big] &\geq C^{a,w} - C^w \\
\text{If } s \geq \omega(1-\alpha)\mu^A G: \quad \omega(1-\mu^A)[1-y_A^p(1-\alpha)]G &\geq C^{a,w} - C^w \quad (IC)^a \\
\omega(\mu^p - y_A^p)(1-\alpha)G - s\Big[\mathbf{E}|y_A^p-(\mu^p+\epsilon)| - \mathbf{E}|\epsilon|\Big] &\geq C^{a,w} - C^a \quad (IC)^w \\
\omega[1-\mu^A-(y_A^p+\mu^A(1-\mu^p))(1-\alpha)]G - s\Big[\mathbf{E}|y_A^p-(\mu^p+\epsilon)| - \mathbf{E}|\epsilon)|\Big] &\geq C^{a,w} \quad (IC)^\emptyset.
\end{aligned}$$

Let us construct a wage scheme that satisfies all constraints. Any such scheme is optimal since one can always adjust the fixed wage W (that does not enter any other constraint) to have the participation constraint binding.

Assume that the penalty s is large so that $s \geq \omega(1-\alpha)\mu^A G$. Then the agent, if he learns about wealth but not ability, will select exactly y_A^p poor borrowers, but these borrowers will not necessarily be able. The relevant incentive constraint is then $\omega(1-\mu^A)[1-y_A^p(1-\alpha)]G \geq C^{a,w} - C^w$ which is satisfied for $\omega \geq \frac{C^{a,w}-C^w}{(1-\mu^A)[1-y_A^p(1-\alpha)]G}$.

The third constraint implies the fourth if $\omega \geq \frac{C^a}{(1-\mu^A)[1-\mu^p(1-\alpha)]G}$. And in order for this third constraint to be satisfied, the share of reimbursement must be high enough so that $\omega \geq \frac{1}{(\mu^p - y_A^p)(1-\alpha)G}\Big[C^{a,w} - C^a - s[\mathbf{E}|y_A^p - (\mu^p + \epsilon)| - \mathbf{E}|\epsilon|]\Big]$ (1).

To characterize one of the possible solutions in terms of ω, let us take $s = \omega(1-\alpha)\mu^A G$. Then the last constraint on ω, (1), becomes $\omega \geq \frac{C^{a,w}-C^a}{(1-\alpha)G[\mu^p - y_A^p - \mu^A(\mathbf{E}|y_A^p - \mu^p - \epsilon| - \mathbf{E}|\epsilon|)]}$

All constraints will thus be satisfied with, for instance,

$$\begin{aligned} \omega = \max \quad & \Big\{\frac{C^a}{(1-\mu^A)G[1-\mu^p(1-\alpha)]}, \frac{C^{a,w}-C^a}{(1-\mu^A)G[1-y_A^p(1-\alpha)]}, \\ & \frac{C^{a,w}-C^a}{(1-\alpha)G[\mu^p - y_A^p - \mu^A(\mathbf{E}|y_A^p - \mu^p - \epsilon| - \mathbf{E}|\epsilon|)]}\Big\}, \\ s = \quad & \omega(1-\alpha)\mu^A G. \end{aligned}$$

This is one of the possible solutions. It shows that the four constraints can be satisfied for all values of the parameters, at no expected cost for the MFI, except for the information acquisition cost, $C^{a,w}$, and the cost of obtaining a correlated signal, C^s.

References

Amin, S., Rai, A.S., and Tapa, G. (2003). 'Does Microcredit Reach the Poor and Vulnerable? Evidence from Northern Bangladesh', *Journal of Development Economics*, vol. 70(1), pp. 59-82.

Besley, T., and Coate, S. (1992). 'Workfare versus Welfare: Incentive Arguments for Work Requirements in Poverty Alleviation Programs', *American Economic Review*, vol. 82(1), pp. 249-261.

Besley, T., and Ghatak, M. (2003). 'Competition and Incentives with Motivated Agents', *mimeo*, LSE, London.

Cremer, H., and Laffont J-J. (2003). 'Public Goods with Costly Access', *Journal of Public Economics*, vol. 87(9-10), pp. 1985-2012.

Crémer, J., and McLean, R. (1988). 'Full Extraction of the Surplus in Bayesian and Dominant Strategy Auctions', *Econometrica*, vol. 56, pp. 1247- 1258.

de Wit, J. (1998). 'Targeting the Poorest and Covering Costs', *Countdown 2005* (Newsletter of Microcredit Summit Campaign), vol. 1(3), pp. 1-2.

Francois, P. (2003). 'Not-for-Profit Provision of Public Services', *Economic Journal*, vol. 113, pp. 53-61.

Ghosh, P., Mookherjee, D., and Ray, D. (2001). 'Credit Rationing in Developing Countries', in Dilip Mookherjee and Debraj Ray, eds., *A Reader in Development Economics*, London: Blackwell Academic Publishers.

Gibbons, D. (1998). 'Cashpor', *Countdown 2005* (Newsletter of Microcredit Summit Campaign), vol. 1(3), pp. 3.

Holmstrom, B. (1979). 'Moral Hazard and Observability', *Bell Journal of Economics*, vol.

10, pp. 74-91.

Hulme, D. (2000). 'Is Microdebt Good for Poor People? A Note on the Dark Side of MicroFinance' *Small Enterprise Development*, vol. 11(1), pp. 26-28.

IRIS Center (2004). 'Developing Poverty Assessment Tools Project', Final workshop report, The IRIS Center at the University of Maryland, College Park.

Lewis, T.R., and Sappington, D.E.M. (2001). 'Optimal Contracting with Private Knowledge on Wealth and Ability', *The Review of Economic Studies*, vol. 68 (234), pp. 21-44.

Malavolti, E. (2002). 'The Impact of the Market Structure on Credit Rationing', *mimeo* Toulouse.

McIntosh, Craig, and Bruce Wydick (2004). 'Competition and Microfinance.'*Journal of Development Economics*, forthcoming.

Riordan, M., and Sappington, D.E.M. (1988). 'Optimal Contracts with Public ex-post Information', *Journal of Economic Theory*, vol. 45, pp. 189-199.

SEF (Small Enterprise Fund) (2004). *Overview*, 2003, www.sef.co.za/sef%20overview/more_about_sef.htr

Sharma, M, and Manfred Zeller (1997). 'Repayment Performance in Group Based Credit Programs in Bangladesh: An Empirical Analysis.' *World Development* 25(10): 1731-1742.

Shavell, S. (1979). 'Risk Sharing and Incentives in Principal and Agent Relationship', *Bell Journal of Economics*, vol. 10, pp. 55-73.

Simanowitz, A. (2004). 'Ensuring Impact: Reaching the Poorest While Building Financially Self-Sufficient Institutions, and Showing Improvement in the Lives of the Poorest Families', www.microcreditsummit.org/papers/#5Simanowitz.doc.

Simanowitz, A., Nkuma, B., and Kasim, S. (2000). 'Overcoming the Obstacles of Identifying

the Poorest Families', Institute for Development Studies, Sussex, UK.

Sustainable Banking for the Poor (2002). Report. http://www.microfinancegateway.org/download/SBP/

Wright, G., and Dondo, A. (2001). ' 'Are you Poor Enough?': Client Selection in MicroFinance Institutions', *Microsave-Africa, Briefing Note* 7.

Zeller, M. (2004). 'Review of Poverty Assessment Tools', The IRIS Center at the University of Maryland.

Zeller, M. (1998). 'Determinants of Repayment Performance in Credit Groups: The Role of Program Design, Intra-group Risk Pooling, and Social Cohesion.' *Economic Development and Cultural Change*, vol. 46, pp. 599-620.