Borrower Runs*

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Abstract

If a borrower fails to repay a loan, he/she typically loses access to future credit. In many environments the threat of credit denial is an important source of repayment incentives. We show that in such environments banks are vulnerable to a phenomenon we term a *borrower run*. If a large number of borrowers default, a bank is unable to deliver future credit to borrowers who repay. Consequently a borrower run equilibrium exists in which all borrowers default. We analyze the effect of borrower runs in microfinance, a setting where lenders rely predominantly on credit denial. We show that microfinance lenders can reduce the risk of borrower runs by adopting lending policies that are long-term sustainable.

1 Introduction

Microfinance is an increasingly important form of financial intermediation. Some microfinance institutions (henceforth MFIs), such as the Grameen Bank in Bangladesh, the Bank Rakyat Indonesia, Bank for Agriculture and Agricultural Cooperatives in Thailand and

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BancoSol in Bolivia, are among the largest banks in their respective countries. Worldwide, there are over 2500 MFIs who reach at least 67 million people (Daley-Harris 2003). The specific lending policies employed in microfinance have received considerable attention. The success of the Grameen Bank in making group loans to poor (and predominantly female) borrowers in Bangladesh is especially well known. However, it remains unclear whether the practice of microfinance differs from conventional banking in ways other than the particular form of the loan contract.

In this paper we examine a set of issues that we believe affect MFIs much more acutely than they do conventional commercial banks. Our starting point is the familiar observation that since MFI borrowers possess limited collateral, an important source of repayment incentives is the prospect of receiving future credit.[1]

A promise of future credit, along with a concomitant threat of credit denial, can induce repayment as follows. A borrower who repays today's loan effectively receives a claim to a (valuable) future loan. The borrower repays if the value of this claim exceeds the benefit of defaulting on the loan. Notice, however, that the expected value of a repaying borrower's claim depends on the probability that the bank remains in existence.

Our first result is that this aspect of using future credit to provide repayment incentives can give rise to an analogue of the familiar depositor run:[2] if a borrower believes that many other borrowers will default, he/she will view the value of a claim to a future loan as small, and consequently will also default. We term an equilibrium of this type a *borrower run*. The distinction between borrower and depositor runs is that the former originate on the asset side of the intermediary's balance sheet.

Our second set of results pertains to what an MFI can do to protect itself from a borrower run. A majority of MFIs are subsidized by donors and governments (Morduch 1999). We

[1] This is clearest in the case of MFIs like Bank Rakyat Indonesia that grant individual loans (Churchill 1999). Armendariz and Morduch (2000) present a formal model. It is equally true of group lending schemes: while many academic papers have highlighted the role of groups in ameloriating information asymmetries (Ghatak and Guinnane 1999), borrowers must still be induced to repay an uncollateralized loan. Reflecting this, most group lending schemes offer a group of borrowers repeated loans over time (Morduch 1999).

[2] See in particular Diamond and Dybvig (1983).

focus on the decision of how and when to spend these subsidies. (We briefly discuss other responses in the conclusion.)

Broadly speaking, an MFI can deploy (a fixed amount of) donor funds in two main ways. One option is use these funds to heavily subsidize its initial lending activities, while in the long-term shifting to pricing its loans at-cost. We refer to this as *long-term sustainability.* This approach is heavily favored by microfinance practitioners. An obvious alternative is to spread donor funds more smoothly over time, preserving some degree of loan subsidies even in the long-term.[3] The latter policy is attractive in many ways. In particular, by offering the carrot of a subsidized loan in the future the MFI should be able to improve its ability to collect repayments on earlier loans.

We show that an MFI that is concerned about the threat of borrower runs will pursue a policy of long-term sustainability. The alternative policy of spreading subsidies over time leaves an MFI vulnerable to a borrower run, since if other borrowers default on their loans the MFI will not be able to deliver the promised loan subsidy.

In practice, borrower runs are a concern for MFIs. Consider, for instance, the case of Childreach in Ecuador, where "the number of residents defaulting on loans multiplied as the word spread that few people were paying, that what had been repaid was being pilfered by community leaders in at least a quarter of the communities, and that Childreach was taking little action" (see Goering and Marx, 1998). Since the viability of the MFI had been called to question, default became more attractive for each individual borrower.

Our model's prediction that MFIs should pursue long-term sustainability is highly consistent with prevailing microfinance practice. MFIs (and their donors) do indeed emphasize the goal of long-term sustainability. For example, a core theme of the Microcredit Summit Campaign (an umbrella organization of practitioners, advocates, donors) is to build financially self-sufficient organizations (Daley-Harris 2003). The Grameen Bank stresses its "directional goal" of reaching sustainability (Yunus 2004).

[3]The choice between long-term sustainability vs. long-term subsidization has been a topic of active debate among MFI experts (Drake and Rhyne 2002, Morduch 2000, Zeller and Meyer 2003). However, it has attracted little formal analysis (see Conning 1999 for an exception).

Credit denial is an important — and perhaps primary — source of repayment incentives in microfinance. More generally, credit denial is the main recourse of lenders in low-enforcement environments. As such, lessons learned from microfinance may be applicable in other limited-enforcement regimes.

For example, countries are widely believed to repay their sovereign debt issues in order to preserve their access to credit. Consequently, institutions such as the World Bank and the IMF that specialize in sovereign lending may themselves be susceptible to the borrower run equilibrium we have described. Empirically, the possibility of a borrower run occurring would generate a form of financial contagion: if investors fear that country B will default because country A has done so, then yields will rise on country B's bonds. This form of contagion can arise even if the *only* connection between countries A and B is that both borrow from the same financial institution.

We have emphasized that concerns about borrower runs may prompt MFIs to adopt lending policies that are long-term sustainable. Borrowers must be convinced that the MFI will survive over time Traditionally, the conservative images and opulent offices of commercial banks may have served a similar role. The large literature on relationship banking (see, e.g., Petersen and Rajan 1994) indicates that borrowers receive better loan terms from their existing bank. As such, in common with MFI borrowers they will be less likely to engage in strategic loan default if they believe their bank will still be around in the future. A safe image is, of course, valuable in attracting deposits; our analysis indicates that it may also be valuable for attracting borrowers.

Paper outline

The paper proceeds as follows. Section 2 describes the basic model. Section 3 establishes the existence of the borrower run equilibrium. Section 4 explores the effect of different subsidy policies on an MFI's susceptibility to borrower runs. Section 5 concludes.

2 Model

Loans are made by a financial institution which aims to maximize the welfare of its borrowers. Given the context, we will speak throughout of a microfinance institution (MFI). The MFI is granted per-borrower funds A_0 by a donor. It must spend $F \leq A_0$ of these funds to set up its lending activities.

Aside from funds received from a donor, the MFI can also borrow from financial markets. The MFI pays an actuarially fair rate of interest on these funds. We normalize the risk-free rate to 1.

Borrowers

There is a large number of identical potential borrowers. Each borrower is endowed with a constant returns to scale project that returns R between dates 0 and 1. Borrowers have initial capital k_0. Additionally, at date 2 with probability p each borrower has access to a second constant returns to scale project, which again returns R. With probability $1-p$ borrowers do not have a project at date 2. Borrowers are also able to save at the market risk-free rate, which we normalize to 1.

For simplicity, we assume borrowers are risk neutral, and that their discount rate is equal to the inverse of the market risk-free rate (i.e., 1). As such, their utility can be measured in terms of date 3 consumption.

Loans and subsidies

At date 0 each borrower receives a funds $x_0 + s_0$, in return for which he must repay x_0 at date 1. If the component s_0 is positive, the loan is subsidized; if s_0 if negative, the interest rate on the loan is above the market rate.

The project produces collateral $c \leq Rk_0$ (e.g., crop in the field, a trader's cart, etc.)[4] If

[4] We would obtain similar results if the collateral produced by the project were an increasing function of project scale. All that is needed is that the derivative of collateral produced with respect to project scale is asymptotically less than 1, so that the scale of the project financed is bounded.

a borrower fails to repay the loan, the lender is able to seize this collateral. The borrower is able to retain the remainder of the project's return, i.e., $R(x_0 + s_0) - c$. Additionally, he loses access to date 2 financing.[5]

At date 2, borrowers who have repaid their date 0 loans may receive a second loan. We assume that the bank can observe whether or not borrowers have access to a project at date 2. Similar to date 0, let $x_2 + s_2$ denote the loan received at date 2 by borrowers with a project, and x_2 the repayment expected at date 3. Clearly there is no point in the bank lending to borrowers without a project.

At date 3, if a borrower does not repay a date 2 loan, the lender is again able to seize the collateral c associated with the project, leaving the borrower with the remainder of the returns.

We assume throughout that the project return R is less than $\frac{2-p}{1-p}$. This assumption is needed to ensure that the optimal lending policy is defined: loosely speaking, if R is larger than $\frac{2-p}{1-p}$, it is always possible to increase both the date 0 and date 2 loans and the date 1 repayment, all the while preserving the feasibility and incentive compatibility of the repayment.

Long-term sustainability

We say that an MFI achieves *long-term sustainability* if its date 2 lending is unsubsidized — that is, $s_2 \leq 0$.

[5] If the borrower had access to the same set of financial markets as the lender the threat of credit denial would be ineffective – the borrower would simply default and save/insure on his own. See Bulow and Rogoff (1989) for the original argument, and also Banerjee (2002) who discusses this concern in the microcredit context. In our model we assume that borrowers have limited access to insurance, so the MFI provides the possibility of future lending if it is needed. Another route to understanding why MFIs may not be susceptible to Bulow and Rogoff's "ineffectiveness" result is analyzed by Bond and Krishnamurthy (2004). In their model of repeat lending, if borrowers have seasonal investment opportunities and borrowing needs but MFIs can make higher return investments between "growing" seasons then the threat of denying credit is effective.

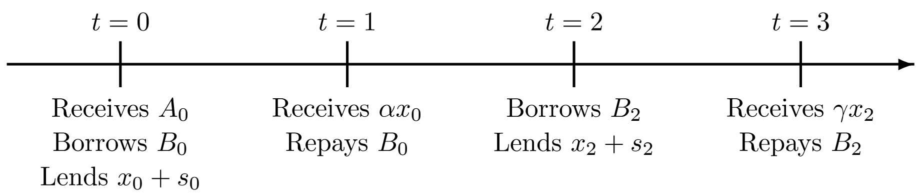

Figure 1: MFI's Timeline

The MFI's financial position

Let A_t denote the MFI's per agent beginning of date t cash balance. Let α be the proportion of date 0 loans that are repaid at date 1. Let γ be the proportion of date 2 loans that are repaid at date 3. Let B_t denote the per agent borrowing/repayment due at date t from financial markets. The MFI's timeline is displayed in Figure 1.

The MFI receives A_0 from the donor at date 0. Let B_0 denote the amount it borrows from financial markets. Given its date 0 loans, the MFI's cash balance entering date 1 is

$$A_1 = A_0 - F - s_0 + B_0 - x_0$$

At date 1 the bank receives repayments of αx_0, and must repay its borrowed funds B_0. If

$$\begin{aligned} B_0 &\leq A_1 + c + \alpha (x_0 - c) \\ &= A_0 - F - s_0 + B_0 - x_0 + c + \alpha (x_0 - c) \end{aligned} \tag{1}$$

the MFI is able to repay. In this case the interest on the loan B_0 is simply the risk-free rate 1. Otherwise the MFI cannot meet its debt payments, and is bankrupt.

What happens if the MFI is forced to default on its loans B_0? Broadly speaking, two different assumptions are possible.

(A) Even though the MFI has defaulted, borrowers who have repaid their date 0 loans are still able to obtain a loan against the collateral generated by their date 2 projects. The original MFI's lenders may allow it stay in business, even though it is in default — either out of charity, or because the MFI has few assets worth liquidating. Alternatively, the lending operation of the insolvent MFI may be acquired by a second (unsubsidized) lender. Finally, a second (unsubsidized) lender may already coexist with the original MFI.[6]

(B) If the MFI has defaulted, borrowers who have repaid their date 0 loans are unable to obtain any loan with which to finance their date 2 projects.

Throughout, we focus on the case in which Assumption A holds. We would obtain qualitatively similar results under Assumption B. Indeed, the payoff to an individual borrower from repaying when others default is higher under Assumption A than with Assumption B. By adopting Assumption A we are biasing our analysis *against* borrower runs arising.

If the MFI is able to repay its loans B_0, its date 2 cash balance is

$$A_2 = A_1 + c + \alpha (x_0 - c) - B_0.$$

If the MFI defaults on its loans, under any of the possibilities underpinning Assumption A, the cash balance of the lender in place at date 2 is simply $A_2 = 0$.[7] For specificity we will act as if the original MFI's loans have simply been forgiven, and continue to refer to the date 2 lender as the MFI. Combining,

$$\begin{aligned} A_2 &= \max\{0, A_1 + c + \alpha (x_0 - c) - B_0\} \\ &= \max\{0, A_0 - F - s_0 - (1 - \alpha)(x_0 - c)\} \end{aligned}$$

At date 2, the MFI lends $x_2 + s_2$ to a fraction p of its borrowers, and borrows B_2. Thus

$$A_3 = A_2 + B_2 - p(x_2 + s_2).$$

[6] For the latter two cases, it is necessary to assume that the second lender grants loans only to borrowers who repaid their loan to the MFI.

[7] Strictly speaking, under the latter two of the explanations discussed for Assumption A, it is of course possible that the replacement lender has a positive cash balance. However, since the replacement lender is by assumption unsubsidized, it will not use these cash balances to subsidize its date 2 lending activity. It is then easily verified that the loan sizes are the same as if $A_0 = 0$.

Finally, the MFI's cash balance after date 3 is

$$A_4 = A_2 - p((1-\gamma)(x_2 - c) + s_2).$$

3 Repayment equilibria

In this section we first work backwards and derive the constraints on repayment at date 3 and then at date 1. We then analyze the repayment game between the borrowers at date 1. A borrower's decision to repay or to default at date 1 depends on the value of the date 2 loan to him which in turn depends on the MFI's financial position at date 2, and therefore on whether the other borrowers repay. Consequently the decision to repay has positive externalities.

The borrower's repayment conditions

Repayment at date 3

At date 3, a borrower will clearly repay if and only if $x_2 \leq c$. Provided this is met, all borrowers repay their date 2 loans, i.e., $\gamma = 1$. The MFI is able to repay its loan of B_2 if and only if this amount is less than its cash balance after borrower repayments, $A_2 + B_2 - p(x_2 + s_2) + px_2$. So the MFI is able to finance any level of date 2 loan $x_2 \leq c$, and the date 2 subsidy is set to $s_2 = A_2/p$.[8]

Repayment at date 1

At date 1, the borrower's decision to repay reflects both the possibility of losing date 2 financing as well as the threat of collateral seizure.

Notationally, let k_t denote a borrower's cash balance at the start of date t. Then

[8] If the MFI sets $x_2 > c$, it will simply recover c from each borrower. Anticipating these losses, it reduces its subsidy to each borrower. The net outcome is exactly the same as if it had loaned $x_2 = c$ in the first place.

measured in terms of date 3 consumption, the expected utility of a borrower who has not defaulted and has k_2 at date 2 is

$$p\left(R(k_2 + c + s_2) - c\right) + (1-p)k_2. \tag{2}$$

The first term is the borrower's consumption if he turns out to have a project — in this case he receives funds $x_2 + s_2 = c + s_2$ from the MFI, and repays $x_2 = c$ at date 3. The second term is the borrower's consumption if he does not have a project. Since the borrower has not defaulted, $k_2 = k_1 - x_0$, and so expression (2) rewrites to:

$$p\left(R(k_1 - x_0 + c + s_2) - c\right) + (1-p)\left(k_1 - x_0\right). \tag{3}$$

On the other hand, if the borrower did default at date 1, he enters date 2 with cash balance $k_2 = k_1 - c$. His expected date 3 consumption given k_1 is then simply

$$pR\left(k_1 - c\right) + (1-p)\left(k_1 - c\right), \tag{4}$$

since in this case he does not receive any funds from the MFI at date 2.

Consequently, the borrower repays the date 0 loan if and only if expression (3) exceeds (4), i.e.,

$$x_0 \leq c + \frac{pR(c+s_2) - pc}{pR + 1 - p} \tag{5}$$

Any repayment that the MFI can recover at date 1 that is in excess of c is supported by the threat of denying a possible date 2 loan.

Repayment externalities

The date 2 subsidy is $s_2 = A_2/p$ — that is, whatever the MFI has left over is divided out between borrowers with a project. Crucially, A_2 depends on the repayment behavior of borrowers at date 1. On the one hand, if all borrowers repaid ($\alpha = 1$), then $A_2 = A_0 - F - s_0$. But if all borrowers defaulted, and the MFI was forced to default on its loans B_0, then

$A_2 = 0$. Clearly in the latter case no loan subsidies are available at date 2.

Formally, write $s_2(\alpha)$ for the date 2 subsidy available given the date 1 repayment rate α,

$$s_2(\alpha) = \frac{1}{p} \max\{0, A_0 - F - s_0 - (1-\alpha)(x_0 - c)\}. \tag{6}$$

The date 2 loan subsidy is a (weakly) increasing function of the proportion of borrowers who repay at date 1. Notice that $s_2(0) = 0$ and $s_2(1) = \frac{1}{p}(A_0 - F - s_0)$.

Since the date 2 subsidy depends on the repayment behavior of other borrowers (α), from the repayment condition (5) each borrower's decision of whether or not to repay his date 0 loan depends on the repayment decisions of other borrowers. Put more abstractly, the repayment game exhibits strategic complementarities. As such, there is scope for multiple equilibria to arise.[9]

Although multiple equilibria are familiar in intermediation contexts, they typically arise on the *liability* side of an intermediary's balance sheet. In contrast, the multiple equilibria here are associated with the MFI's *assets* — that is, its loans. To emphasize the distinction with the depositor runs that are the focus of the existing literature, we will refer to equilibria in which all borrowers default as *borrower runs.*

Specifically, the available subsidy, (6), and the repayment condition, (5), together imply the following equilibrium behavior:

Proposition 1 ***(Repayment equilibria)***
There is an equilibrium in which all borrowers repay if and only if

$$x_0 \leq c + \frac{pR(c + s_2(1)) - pc}{pR + 1 - p} \tag{7}$$

There is a (borrower run) equilibrium in which no borrower repays if and only if

$$x_0 \geq c + \frac{pR(c + s_2(0)) - pc}{pR + 1 - p} \tag{8}$$

[9] Multiple equilibria are a standard consequence of strategic complementarities. See Cooper and John (1988).

If (7) does not hold then the only equilibrium is the borrower run equilibrium in which all borrowers default. If (8) does not hold then the only equilibrium is that in which all borrowers repay.

Borrower runs do not occur if the MFI only uses the threat of denying unsubsidized credit at date 2, i.e., if condition (7) does not hold.[10] There are multiple equilibria, however, if the MFI uses the threat of denying subsidized credit at date 2 (i.e. both conditions (7) and (8) hold). In one equilibrium, all borrowers repay and receive the date 2 loan subsidy $s_2(1)$. In the other borrower run equilibrium, all borrowers default, since the anticipated date 2 loan subsidy $s_2(0) < s_2(1)$ is insufficient to induce repayment.

4 Long-term sustainability

Given that a borrower run equilibrium may exist, is there anything an MFI can do to avoid it? In this section we consider the impact of borrower runs on one important element of microfinance practice: the choice of how and when to spend the funds supplied by donors. As noted in the introduction, since most MFIs are subsidized, this a decision of widespread significance.

To address this question, we clearly need to specify an equilibrium selection rule. To make our exposition as clear as possible, we proceed as follows. We first analyze the case in which the equilibrium selection rule is that whenever repayment and default are both equilibria, the repayment equilibrium occurs. We then consider the opposite extreme in which whenever repayment and default are both equilibria, the borrower run default equilibrium occurs.

We show that the lending policies of the MFI are very different for these two cases. The MFI adopts a loan policy that is long-term sustainable under the latter equilibrium selection rule, but not under the former. Put less formally, fear of borrower runs will prompt an

[10] If assumption B held instead, then borrower runs would occur if $x_0 \geq c$, i.e. they would arise more often.

MFI to adopt sustainable lending.[11]

THE MFI'S LENDING POLICY ABSENT BORROWER RUNS

We will establish that an MFI that does not worry about borrower runs will adopt policies that are the exact opposite of long-term sustainable: it charges an above-cost rate of interest on the date 0 loan, and delivers all of its available donor funds $A_0 - F$, plus the profits from date 0 loans, as a subsidy at date 2.

Informally, postponing the loan subsidy until date 2 has a cost and a benefit. The cost is that the MFI holds the funds even though borrowers could have earned a higher rate of return on these same funds. The benefit is that the MFI relaxes the constraint on how much it can recover at date 1, thereby allowing it to increase the date 0 loan size and hence the scale of the borrower's productive project. Proposition 2 shows that the benefit outweighs the cost:

Proposition 2 ***(Lending absent borrower runs)***
Suppose that borrower runs never occur (i.e., if (7) and (8) both hold, then the repayment equilibrium is assumed to occur). Then the MFI chooses the date 0 *loan and subsidy according to*

$$x_0 = \frac{2pc\,(R-1) + c + (A_0 - F)\,R}{2 - p - R\,(1-p)}$$

$$s_0 = -\frac{R-1}{R} x_0.$$

[11] We would obtain similar results if we examined a continuum of equilibrium selection rules in which the probability of the borrower run equilibrium is given by some exogenously specified parameter $q \in [0, 1]$. The MFI would adopt sustainable loan policies whenever q is large enough. In a similiar vein, it would be possible to embed our existing model into the kind of "global game" framework used by Morris and Shin (1998). This would effectively serve to endogenize the probability that the borrower run occurs. Again, we conjecture that our main conclusion — fear of borrower runs prompts sustainability — would remain unchanged.

The corresponding date 2 loans and subsidy are

$$\begin{aligned} x_2 &= c \\ s_2(1) &= \frac{1}{p}\left(A_0 - F + \frac{R-1}{R}x_0\right). \end{aligned}$$

The borrower's welfare is

$$\frac{(1-p+pR)\,R\,(A_0-F)+(2p\,(R-1)+1)\,(R-1)\,c}{1-(R-1)\,(1-p)}+p\,(R-1)\,c$$

Proof of Proposition 2:

The MFI must choose a set of lending policies to maximize borrower welfare. We have already argued that it will set $x_2 = c$. Given x_0 and s_0, the date 2 subsidy $s_2(1)$ is determined by (6) with $\alpha = 1$.

Given x_0 and s_0, a borrower's cash balance entering date 1 is $k_0 = R(x_0 + s_0)$. Thus from (3), the borrower's welfare is

$$p\,(R(R\,(x_0+s_0)-x_0+c+s_2\,(\alpha))-c)+(1-p)\,(R\,(x_0+s_0)-x_0)\,. \tag{9}$$

Assume for now that the MFI sets x_0 and s_0 so that the incentive constraint (7) holds, so that $\alpha = 1$ (recall we are currently assuming that borrower runs never occur). The MFI's problem is then to set x_0 and s_0 to maximize the borrower's welfare (expression (9) with $\alpha = 1$) subject to (7), and also to the repayment feasibility constraint

$$x_0 \le R\,(x_0+s_0)\,. \tag{10}$$

First, from condition (1), when $\alpha = 1$ the MFI can borrow any amount of funds B_0 provided that $s_0 \le A_0 - F$ and hence finance any loan size x_0. It follows that the repayment constraint must bind: borrower welfare is improved by increasing the loan size. (Note that the bank cannot set $s_0 > A_0 - F$, since in this case it cannot raise any outside funds, and so $s_0 > A_0 - F$ is infeasible.)

Second, we claim that the feasibility constraint (10) must also bind. To see this, suppose instead that it holds strictly. Then if the date 0 subsidy s_0 is reduced by ε, the date 2 subsidy increases by ε/p and x_0 can be increased by

$$\frac{pR}{pR+1-p}\frac{\varepsilon}{p}$$

while still satisfying the repayment constraint (7). The net impact on borrower welfare is

$$-\varepsilon R\left(pR+1-p\right)+pR\frac{\varepsilon}{p}+\left(pR+1-p\right)\left(R-1\right)\frac{pR}{pR+1-p}\frac{\varepsilon}{p}. \tag{11}$$

This can be seen as follows. The borrower earns R on funds between dates 0 and 1, and earns an expected amount of $pR+1-p$ between dates 2 and 3. So the first term is the direct cost of the reduction in the date 0 subsidy, the second term is the direct benefit from the increase in the date 2 subsidy, received only when he has a project, and the third term is the gain to the borrower from the increased loan at date 0 (between dates 0 and 1 he earns the spread $R-1$, which then generates an expected return of $pR+1-p$ between dates 2 and 3). To complete the proof of the claim, just note that expression (11) simplifies to $R\varepsilon\left(R-1\right)\left(1-p\right)$, which is strictly positive.

Finally, what if the MFI chooses an x_0 and s_0 such that the incentive constraint (7) does not hold, and so all borrowers default? From condition (1), the MFI can only borrow funds B_0 if

$$B_0 \leq A_0 - F - s_0 + B_0 - x_0 + c,$$

i.e., if $x_0 + s_0 \leq c + A_0 - F$. (Setting $x_0 + s_0 > c + A_0 - F$ is impossible, since in this case the MFI cannot borrow funds, and its date 0 outflows are infeasible.) The MFI then has a cash balance $A_2 = A_0 - F - x_0 - s_0 + c$ entering date 2.

However, exactly the same transfers allocations result if instead $\tilde{x}_0 = c$ and $\tilde{s}_0 = x_0 + s_0 - c$. Moreover, the repayment constraint (7) is then clearly satisfied. As such, we have already covered this case above.

Together, conditions (7) and (10) at equality give the MFI's choices of s_0 and x_0. Solving explicitly completes the proof. **QED**

THE MFI'S LENDING POLICY GIVEN BORROWER RUNS

Above, we assumed that when both repayment and default are equilibria, it is the repayment equilibrium that occurs. We now consider the opposite extreme. That is, whenever an MFI chooses policies that leave it vulnerable to a borrower run, then a borrower run occurs.

We show that an MFI that is vulnerable to borrower runs will emphasize long-term sustainability in its date 2 loans. It will deliver all of its available grant money $A_0 - F$ as a subsidy at date 0. The difference from Proposition 2 is that postponing the loan subsidy no longer has the benefit of increasing the amount the MFI can recover at date 1, and so does not increase the date 0 loan. The reason is as follows. The borrower only repays more than its collateral c at date 1 because of the MFI's promise to supply funds at date 2. But if the MFI relies on a promise to supply more than c to induce repayment at date 1 it leaves itself vulnerable to a borrower run — borrowers realize that if everyone else defaults the MFI will not have funds to disburse more than c.

Proposition 3 ***(Lending under borrower runs)***
Suppose that whenever an MFI is vulnerable to a borrower run then a borrower run occurs (i.e., if (7) and (8) both hold, then the default equilibrium is assumed to occur). Then the MFI chooses the date 0 *loan and subsidy according to*

$$\begin{aligned} x_0 &= c + \frac{pRc - pc}{pR + 1 - p} \\ s_0 &= A_0 - F. \end{aligned}$$

The corresponding date 2 *loans and subsidy are*

$$\begin{aligned} x_2 &= c \\ s_2(1) &= 0. \end{aligned}$$

The borrower's welfare is

$$(1-p+pR)\,R\,(A_0-F)+(2p\,(R-1)+1)\,(R-1)\,c+p\,(R-1)\,c.$$

Proof of Proposition 3:

If (8) holds and (7) does not, default is the only equilibrium. On the other hand, if both (8) and (7) hold then by the assumption of this subsection a borrower run occurs. So to avoid default by its borrowers, the MFI must choose x_0 and s_0 such that (8) does not hold: that is,

$$x_0 \leq c+\frac{pR\left(c+\frac{A_0-F-s_2(0)}{p}\right)-pc}{pR+1-p} \tag{12}$$

As before, the MFI will set the date 2 loan to $x_2=c$. The remainder of our analysis proceeds in three steps:

Step 1: Consider loan policies such that borrowers repay ((12) holds) but such that the MFI would still be able to repay its own loans B_0 even if all its borrowers were instead to default. >From (1) with $\alpha=0$, this condition is satisfied if $x_0+s_0\leq A_0-F+c$. Loosely speaking, this means that the MFI offers a very small loan.

In this case, condition (12) is

$$x_0 \leq c+\frac{pR\left(c+\frac{A_0-F+c-x_0-s_0}{p}\right)-pc}{pR+1-p}. \tag{13}$$

We claim that within the class of loan policies satisfying $x_0+s_0\leq A_0-F+c$ and (13), the MFI prefers those in which the funds disbursed at date 0 are as high as possible, i.e., $x_0+s_0=A_0-F+c$.

Proof of claim for step 1: To establish this claim, suppose to the contrary that the MFI's best choice within the class of loans specified satisfies $x_0+s_0<A_0-F+c$. Then exactly as in the analysis of the case in which borrower runs are assumed not to occur, we can improve borrower welfare by decreasing s_0 by ε, increasing $s_2\,(0)$ by ε/p, and increasing x_0 by $\varepsilon R/\,(pR+1-p)$. These changes leave condition (13) satisfied. Moreover, they

increase $x_0 + s_0$ by

$$-\varepsilon + \frac{\varepsilon R}{pR + 1 - p} = \varepsilon \frac{(1-p)(R-1)}{pR + 1 - p} > 0.$$

So ε can be chosen so that at the under the new loan policy, $\tilde{x}_0$ and $\tilde{s}_0$ say, $\tilde{x}_0 + \tilde{s}_0 = A_0 - F + c$. It remains only to check that the repayment $\tilde{x}_0$ is feasible for the borrower, i.e., $\tilde{x}_0 \leq R(\tilde{x}_0 + \tilde{s}_0)$. Since condition (13) holds, feasibility is certainly satisfied if

$$c + \frac{pRc - pc}{pR + 1 - p} < R(A_0 - F + c)$$

which rewrites to

$$A_0 - F \geq -\frac{R-1}{R} \frac{c(p(R-1) + 1 - p)}{pR + 1 - p}.$$

This last condition is trivially satisfied, completing the proof of the claim.

Step 2: Consider loan policies such that borrowers repay ((12) holds) and $x_0 + s_0 \geq A_0 - F + c$. This class covers loan policies under which the MFI would *not* be able to repay its own loans B_0 if all borrowers were to default on their loans to the MFI; and also includes the best loan policies from the class considered in step 1. The date 2 subsidy available if everyone were to default is $s_2(0) = 0$ for all loan policies in this class: so condition (12) is

$$x_0 \leq c + \frac{pRc - pc}{pR + 1 - p}. \tag{14}$$

Since when (14) holds all borrowers repay ($\alpha = 1$), borrower welfare is again given by expression (9) with $\alpha = 1$. Given s_0, it is clearly desirable to set x_0 so that condition (14) holds at equality.

Within this class of lending policies we claim it is best to set $s_0 = A_0 - F$.

Proof of claim for step 2: To establish this claim, suppose to the contrary that the MFI's best choice within the class of loans specified features $s_0 < A_0 - F$. Then the date 0 subsidy s_0 can be raised by ε, which lowers the date 2 subsidy $s_2(1)$ by ε/p. The increase in s_0 raises borrower welfare by $\varepsilon R(pR + (1-p))$, while the reduction in $s_2(1)$ reduces borrower welfare by $\frac{\varepsilon}{p} pR$. Crucially, these changes in s_0 and $s_2(1)$ have no effect on the constraint (14), and so the loan size x_0 remains unchanged. The net effect on borrower welfare is

$$\varepsilon R\left(pR+(1-p)\right)-\frac{\varepsilon}{p}pR=\varepsilon Rp\left(R-1\right)>0,$$

completing the proof of our claim.

Step 3: Finally, consider loan policies in which borrowers default on their date 0 loans, i.e., (8) holds. As in the analysis of lending policies absent borrower runs, it is straightforward to see that any allocation achieved by a loan policy engendering default could instead by achieved under a loan policy in which borrowers repay. Formally, given a policy x_0 and s_0 under which borrowers default, define a new policy by $\tilde{x}_0 = c$ and $\tilde{s}_0 = x_0 + s_0 - c$. **QED**

5 Discussion

As Proposition 1 indicates, MFIs are potentially prone to borrower runs. Between them, Propositions 2 and 3 imply that an MFI that is sufficiently concerned about this vulnerability will respond by pursuing long-term sustainability. The policy of sustainable microfinance has a cost — the MFI can no longer use the available grant money $A_0 - F$ to relax the enforcement constraint on current loans, and this lowers borrower welfare.

As discussed in the introduction, long-term sustainability is considered highly desirable among microfinance practitioners. But to reiterate, absent borrower runs, long-term sustainability does not represent an efficient way for the MFI do deploy donor funds in our model. For instance, if the MFI were dealing with a single borrower, then it would be better to use donor funds to subsidize future loans, and thus increase the borrower's incentive to repay early loans. With many borrowers, however, strategic complementarities in the repayment game make borrower runs a possibility. As such, borrower runs provide a possible rationale for why MFIs pursue a policy that in a single-agent model appears suboptimal.

The threat of borrower runs may also impact microfinancing practice in other ways. We conclude with a brief and somewhat speculative discussion of three possibilities.

The choice of scale versus targeting

MFIs must choose how thinly and widely to spread their subsidies. Indeed, this issue is often discussed along with that of sustainability (Drake and Rhyne 2002, Morduch 2000, Zeller and Meyer 2003). The main discussion has resolved around the (conjectured) trade-off between, on the one hand, subsidizing lending to a small number of needy borrowers, and, on the other hand, lending unsubsidized funds on a large scale. MFIs presumably wish both to reach a large number of borrowers, and to provide a high level of welfare to each borrower reached. Notationally, one might represent these preferences by $W(V, N)$, where V is the welfare provided to each borrower, and N is the total number of borrowers. From our analysis, it is clear that the marginal value of a dollar of subsidy is higher absent borrower runs — an MFI is able to deploy its funds more efficiently. (This can be seen formally from the welfare expressions derived in Propositions 2 and 3.) As such, the possibility of a borrower run will tend to tilt an MFI towards a choosing a lending strategy in which it seeks to lend to a large number of borrowers, with each one receiving only a small subsidy. (Appendix A provides a formal version of this argument.)

The emphasis on default rates

MFIs place a great deal of attention on achieving very low default rates (Morduch 1999). Low default rates appear to be a source of considerable pride, and MFIs actively publicize them. Given that by definition MFIs seek to lend to high-risk borrowers who are viewed as uncreditworthy by commercial lenders, it is not clear why a high repayment rate should be viewed as an unambiguous success: instead, it might indicate simply that an MFI's loans have failed to reach their intended recipients.

Since MFI borrowers rarely have much collateral, the threat of future credit denial is key to ensuring repayment. As such, it is crucial for borrowers to believe that an MFI will still be in business in the future. Publicizing high repayment rates is conceivably one way for an MFI to foster this belief.

A lender of last resort for MFIs

MFIs typically lend in rural areas in developing countries and exposed to considerable aggregate risk. For instance, many of the MFIs in Bangladesh were at the risk of collapse after the 1998 floods. According to one report, "[s]ome lenders, Grameen Bank included, have hundreds of millions of dollars in outstanding loans. But their reserves are too small for them to freeze repayments now due from creditors. Nor can they extend fresh bridging loans to help people rebuild their homes and replace livestock" (Chazan 1998).

Aggregate shocks of this type threaten the long-term viability of an MFI, and as such may raise the probability of borrower runs. Just as the existence of a lender of last result can serve to reduce the threat of depositor runs in more familiar banking contexts, an analogous institution may be of use here. Indeed, just such an institution now exists in Bangladesh, and provides grants and loans to MFIs (Ahmed 2000).

References

Salehuddin Ahmed. *Coping with disaster in Bangladesh: PKSF experience of flood 1998 and microcredit*. Initiative in Research and Education for Development in Asia - INASIA, 2000.

Beatriz Armendariz de Aghion and Jonathan Morduch. Microfinance beyond group lending. *The Economics of Transition*, 8(2):401–420, 2000.

Abhijit Banerjee. The uses of economic theory: Against a purely positive interpretation of theoretical results. 2002.

Philip Bond and Arvind Krishnamurthy. Regulating exclusion from financial markets. *Review of Economic Studies*, 71(3):681–707, July 2004.

Jeremy Bulow and Kenneth Rogoff. Sovereign debt: Is to forgive to forget? *American Economic Review*, 79(1):43–50, March 1989.

David Chazan. Flood disaster threatens future of bangladesh microcredit movement. *Financial Times*, 1998.

Craig Churchill. *Client Focused Lending: The Art of Individual Lending*. Toronto: Calmeadow, 1999.

Jonathan Conning. Outreach, sustainability and leverage in monitored and peer monitored lending. *Journal of Development Economics*, 60(1):51–77, 1999.

Russell Cooper and Andrew John. Coordinating coordination failures in Keynsian models. *Quarterly Journal of Economics*, 103(3):441–63, 1988.

Sam Daley-Harris. *State of the Microcredit Summit Campaign Report*. 2003.

Douglas W Diamond and Philip H Dybvig. Bank runs, deposit insurance, and liquidity. *Journal of Political Economy*, 91(3):401–19, June 1983.

Deborah Drake and Elisabeth Rhyne, editors. *The commercialization of microfinance: balancing business and development*. Accion, Kumarian Press, 2002.

Maitreesh Ghatak and Timothy Guinnane. The economics of lending with joint liability: A review of theory and practice. *Journal of Development Economics*, 60(1):195–228, October 1999.

L. Goering and G. Marx. Chaos when credit is due. *Chicago Tibune*, March 15 1998.

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

Jonathan Morduch. The microfinance schism. *World Development*, 28(4):617–29, 2000.

Stephen Morris and Hyun Song Shin. Unique equilibrium in a model of self-fulfilling currency attacks. *American Economic Review*, 88(3):587–597, June 1998.

Mitchell A Petersen and Raghuram G Rajan. The benefits of lending relationships: Evidence from small business data. *Journal of Finance*, 49:3–37, March 1994.

Mohammed Yunus. *What is Microcredit?* Grameen Bank, Dhaka, 2004.

Manfred Zeller and Richard L. Meyer, editors. *The Triangle of Microfinance: Financial Sustainability, Outreach, And Impact*. IFPRI, Johns Hopkins., 2003.

A Scale vs depth

In Section 5 we briefly discussed the MFI's choice of whether to heavily subsidize a small number of loans, or to spread these subsidies more thinly over a larger number of loans. We argued — somewhat informally — that the existence of borrower runs will tend to tilt the MFI towards pursuing the latter course. Below, we give a version of this argument that is tied more tightly to our main model.

The return per dollar of donor funds from providing a subsidy of F (the fixed cost of lending activities per borrower) to a borrower is

$$\frac{(2p(R-1)+1)(R-1)c+p(R-1)c}{F}$$

under borrower runs and

$$\frac{\frac{(2p(R-1)+1)(R-1)c}{1-(R-1)(1-p)}+p(R-1)c}{F}$$

absent borrower runs.

The respective returns on each dollar over F in the two cases are

$$(1-p+pR)R$$

and

$$\frac{(1-p+pR)R}{1-(R-1)(1-p)}.$$

So under borrower runs, an MFI will provide a subsidy of exactly F to each borrower if

$$\frac{(2p(R-1)+1)(R-1)c+p(R-1)c}{F}>(1-p+pR)R$$

i.e., if

$$\frac{R-1}{R}\frac{2p(R-1)+1+p}{1-p+pR}\frac{c}{F}>1.$$

Absent borrower runs, the equivalent condition is

$$\frac{\frac{(2p(R-1)+1)(R-1)c}{1-(R-1)(1-p)} + p\,(R-1)\,c}{F} > \frac{(1-p+pR)\,R}{1-(R-1)\,(1-p)},$$

i.e.,

$$\frac{R-1}{R}\,\frac{2p\,(R-1)+1+p\,(1-(1-p)\,(R-1))}{1-p+pR}\,\frac{c}{F} > 1.$$

For any given p and R, the latter condition is clearly less likely to be satisfied. As such, it is possible that an MFI operates at the minimum scale per borrower when borrower runs occur, but above minimum scale when borrower runs do not occur. That is, the threat of borrower runs pushes the MFI to spread its subsidies more thinly.