Who does the grace-period really grace? Repayment flexibility in microfinance contracts*

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Abstract

Repayment rigidity in microfinance contracts has always been crucial in order to discipline borrowers and ensure repayments. However, a strict repayment schedule might also inhibit entrepreneurship and force borrowers to undertake low-risk but also low-return investments. A possible solution is therefore to introduce more flexibility in the repayment mechanism. We build a simple adverse selection model where a monopolistic microfinance lender faces two types of present-biased borrowers who have different misperceptions about their future utility; the MFI's problem is to decide whether or not to provide a flexible repayment schedule within the microfinance contract. Our main result is that if the pool of clients is made of a sufficiently high share of entrepreneurial borrowers, it is always more profitable for the lender to provide both a rigid and a flexible repayment schedule than simply a rigid repayment contract. Surprisingly, it is still more profitable even though the contract doesn't perfectly screen out very present-biased borrowers who enter the flexible schedule but end up not being able to repay in the final period. However, this implies that more entrepreneurial borrowers are always charged a higher repayment rate in order to compensate the other borrowers' potential default.

Keywords: Microfinance, Adverse Selection, Repayment Flexibility.
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1 Introduction

A very distinctive feature of microfinance contracts is the tight repayment discipline borrowers are asked to comply with. Since the start of the Grameen experience, microfinance contracts

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have been characterized by frequent repayments, mostly originating from the very beginning of the loan life. Besides, repayment obligations are usually fixed and microfinance borrowers are not given the possibility to renegotiate their debt.

The importance of having *"equal weekly installments* [and] *repayments start one week after the loan"* was indeed first emphasised by Muhammad Yunus (Banker to the Poor, p.110): small, frequent repayments appear in fact more manageable and easier to be repaid, as *"[...] large amounts are difficult to part with"* (*ibid.*, p. 31). The underlying idea is that if the borrowers have to repay the whole debt through fewer, larger installments, they would need to save greater amounts of money; it is however a consolidated result in the literature that the poor have difficulties in savings, either because they are present-biased and tend to yield to immediate consumption (Ashraf et al. (2006)), or because they face unforeseen expenditures or pressures from relatives or friends (Platteau (2000)). Rigid and frequent repayments thus prove to be an effective tool in helping microfinance clients to commit to repay in the future, by mitigating time-inconsistency problems.

However, a strict repayment schedule can have major drawbacks, particularly in terms of investment decisions and consumption smoothing: at one end of the spectrum, as most of the business activities require at least some time to become profitable, immediate repayments represent a great obstacle to entrepreneurship; there is indeed widespread evidence that entrepreneurial activities of microfinance borrowers grow under subsistence level (Fischer (2010); Field et al. (2011)). At the other end, a rigid debt structure does not meet the needs of borrowers with unstable, seasonal income, which is particularly common in rural areas. Moreover, fluctuations in income are strongly correlated with fluctuations in consumption (Khandker (2012)). The difficulties on the borrowers' side to comply with repayment obligations have thus pushed several MFIs to introduce a series of innovations within microfinance contracts, like, for instance, the provision of a grace-period after the loan disbursement as well as different repayment frequencies other than weekly. Yet, evidence on the impact of repayment flexibility is quite limited and mixed (Field et al. (2011)). While providing a grace-period may enhance borrowers' entrepreneurship, it may also attract borrowers who are more inclined to consume, and would strategically opt for a grace-period in order to increase their present consumption as well as risk-taking. Similarly, relaxing repayment frequency leads to a reduction in transaction costs, but it also decreases the degree of social interactions between group members.

In this paper, I develop a theoretical model to test for the impact of a grace-period in the repayment schedule, when microfinance clients have different levels of present-bias. In particular, I consider a monopolistic lender who provides different contracts, which may include both a rigid and a flexible repayment schedule. The lender faces two types of borrowers: the 'good' type who prefers to invest in more entrepreneurial activities, which take more than one period to become profitable, and therefore takes advantage from the grace-period option. The 'bad' type, on the contrary, prefers to invest in liquid activities which yield a certain income in each period. When he offers a flexible repayment schedule, the lender faces a trade-off: from one side, the grace-period option is beneficial for more entrepreneurial borrowers who can finally invest in illiquid projects. From the other side, the more borrowers discount their future utility,

the more they will be tempted to enter the flexible contract as it allows them to increase their consumption in the periods before the repayment is due. In particular, this model moves from the intuition that more impatient borrowers may underestimate the magnitude of their repayment obligation if a grace-period is provided, and therefore may enter the flexible repayment schedule but default at the end of the loan cycle. At the same time, they will increase their consumption in the periods before the repayment is due. Therefore, observed default could be driven by an increase both in consumption and in entrepreneurship. Can the lender design a contract in order to discourage the bad type to undertake the flexible repayment schedule? I consider two types of flexible contracts and compare them with the traditional microfinance contract. In the first of the two, the lender designs the repayments such that all bad borrowers enter and repay within the rigid repayment schedule, while good borrowers are selected into the grace-period option; in the second, on the contrary, more impatient borrowers enter the flexible schedule, anyway. The analysis shows that if there is a considerable share of good borrowers in the pool, the lender is able to achieve a higher profit than in the rigid, traditional microfinance contract by offering a contract where bad borrowers are not perfectly screened out of the flexible schedule. Besides, *ceteris paribus*, the separating contract where all bad borrowers repay under repayment rigidity is always dominated. As a share of bad borrowers still enters the flexible repayment schedule, in order to reach the highest profit the lender will increase the required repayment for the grace-period option: it follows that good borrowers will pay more in order to compensate for bad borrowers' default. Results from my model suggest that introducing more flexibility in microfinance contracts may have different impacts according to borrowers' way of discounting the future; in particular, it may not always be optimal for more entrepreneurial borrowers' welfare to enjoy more repayment flexibility.
The paper proceeds as follows: after a brief literature review in Section 2, where the major innovations in microfinance contracts are discussed, Section 3 presents the model and Section 4 provides a summary of results. Section 5 concludes.

2 Related Literature

In the last years, the myth of microfinance has been challenged by a series of works who have emphasized the positive impact of microcredit on business activities, though showing that its effects are heterogenous across borrowers (Crépon et al. (2011); Banerjee et al. (2010)). Most of the early contributions on microfinance have focused on the relative advantages and disadvantages of joint-liability; at one end of the spectrum, it has been shown that joint-liability increases repayment rates (Van Tassel (1999); Ghatak (1999); Stiglitz (1990)); Banerjee et al. (1994); Wydick (2001)); at the other end, they have pointed out that joint-liability may favour risk-taking behavior (Giné et al. (2010); Fischer (2010); Barboni et al. (2012)). More recently, a growing number of studies have also begun to analyze the debt structure of microfinance contracts, questioning the benefits of repaying at a very frequent rate, starting almost immediately after the loan disbursement. In particular, two aspects of the repayment mechanism have undergone serious critique: from one side, *how frequent* repayments should be; from the other, *when* repayments should start. On a theoretical ground, Fischer and Ghatak (2010) have shown that repayment frequency increases the maximum incentive-compatible loan size of present-biased borrowers, though a major drawback of frequent repayments is overborrowing. From an empirical perspective, the effect of repayment frequency is more controversial: Armendariz and Murdoch (2005) argue that more frequent repayments lead to higher default; on the contrary, McIntosh (2008) finds that allowing clients for more frequent repayments improves repayment rates. Finally, Field and Pande (2008) don't find any effect of changing repayment frequency, while Feigenberg et al. (2010) observe that allowing microfinance borrowers to meet more frequently lowers default rates and increases the degree of social interaction.

The issue of flexibility in the microfinance contracts, namely the provision of a *moratorium* or a *grace-period* before repayments start, has also started to receive attention. The closest paper to our focus is that of Field et al. (2011) who, at least to our knowledge, conducted the first randomized controlled trial testing for the impact of a grace-period on investment choices with a sample of Indian microfinance clients. To do so, borrowers assigned to the control had to repay under a regular debt structure, with the first payment starting after two weeks from the loan disbursement, and from then repaying their loan fortnightly. Borrowers in the treatment, on the contrary, were given a two months grace-period before repayments started, again on a fortnight basis. All borrowers where under individual liability, and the interest rate charged in the control and the treatment was the same (thus making the interest in the treatment implicitly lower). Results from their field experiment seem to confirm the common belief that allowing for a more flexible debt structure may lead to an increase in default rates. Besides, including a grace-period option in the microfinance contract also enhances entrepreneurship, by increasing average profits.

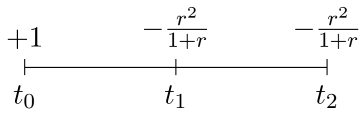
3 The model

We start with a three-period adverse selection model where a monopolistic bank is endowed with a capacity $\alpha \geq 1$ of capital at time 0 and faces a population of N households. Each agent lives for three periods $\tau = 0, 1, 2$. There is no initial endownment and no possibility of savings; in period 0, each household borrows one unit of capital from the lender and invests in a productive input that generates a certain income y both at time 1 and at time 2. We refer to this project as the "liquid activity". Besides, there is another available investment opportunity, which yields y^* at time 2 with probability p and 0 with probability $1-p$, where $\delta p y^* \geq (1+\delta)y$, with δ being the discount factor which is common among the borrowers and the lender. We call this project "illiquid activity". Undertaking the illiquid investment opportunity requires a further investment of y at time 1: borrowers who plan to invest in this input must therefore sacrifice their consumption in period 1.

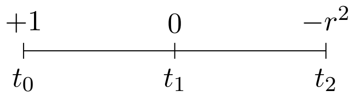
Repayment is made individually. Let P_1 and P_2 define the repayment obligations at time 1 and time 2, respectively. For the lender's break-even condition we get:

$$\frac{P_1}{r} + \frac{P_2}{r^2} = 1 \tag{1}$$

The above equality means that $rP_1 = r^2 - P_2$. In the traditional microfinance contract, repayments obligations are equal, therefore $P_1 = P_2 = \frac{r^2}{1+r}$. The regular debt structure timeline is the following:



Now let's suppose that borrowers can ask for a grace-period, that is a delay in the first repayment. The grace-period allows them to start the loan repayment one period ahead. Back to (1), this means that $P_1 = 0$ and that $P_2 = r^2$.



There are two types of borrowers in the population, good (G) borrowers and bad (B) borrowers, who remain the same throughout the periods; we define ϕ the proportion of good types in the population, and $1 - \phi$ the proportion of bad types. Borrowers' utility function is given by

$$U^t = u_t + \beta_i \sum_{\tau=t+1}^{T} \delta^{\tau-t} u_\tau$$

where $u_t \geq 0$, $\delta \in [0, \infty)$ and $\beta_i \in (0; 1]$, i=$\{B, G\}$. The value of any outside option is normalized to 0.

We make the following assumptions about borrowers' types: from one side, good borrowers always prefer the riskier, but also more profitable project, to the safe, low-return project, even at the cost of sacrificing her current consumption. The following condition holds for the good type:

$$\beta_G \delta p y^* \geq (1 + \beta_G \delta) y$$

for which we obtain

$$\beta_G \geq \frac{y}{\delta(py^* - y)} \tag{2}$$

From the other side, bad types always undertake the liquid activity:

$$\beta_B \delta p y^* \leq (1 + \beta_B \delta) y$$

for which we obtain

$$\beta_B \leq \frac{y}{\delta(py^* - y)} \tag{3}$$

Defining $\beta^* = \frac{y}{\delta(py^* - y)}$, the following condition relates the two discount rates:

$$\beta_B \leq \beta^* \leq \beta_G \tag{4}$$

The lender knows that households have different degrees of self-control, which are embedded in the β_i parameter. However, he cannot distinguish among good and bad types. The following analysis shows that as long as the lender only offers the traditional, rigid microfinance contract, borrowers are “obliged” to invest the liquid project. The lender is thus able to enforce repayments, $\forall\ \beta_i$. The adverse selection problem instead arises once the lender wants to increase contractual flexibility. When repayments are postponed, discount rates become crucial for borrowers' repayment behavior. As β_i is unknown to the lender, the only way he can successfully screen among borrowers is by designing an appropriate set of contracts.

3.1 The lender only offers a contract with a rigid repayment schedule

Let us suppose that the lender at time 0 only offers the traditional microfinance contract, which requires two equal repayments P_{NGP} in exchange of the lent amount. We assume that there is no strategic default: therefore borrowers will repay in every period if their participation constraint is satisfied. However, if they don't comply with their repayment obligation, the limited liability constraint ensures that the lender will only seize their current income.

We consider bad borrowers' decision of entering the contract proceeding by backward induction. The following participation constraint at time 2 must be satisfied:

$$y - P_{NGP} \geq 0$$

which implies

$$P_{NGP} \leq y \equiv \overline{P^B_{NGP,2}} \tag{5}$$

where $\overline{P^B_{NGP,2}}$ defines the largest repayment satisfying bad borrowers' participation constraint in a rigid microfinance contract at time 2. Bad borrowers' participation constraint at time 1 will be:

$$y - P_{NGP} + \beta_B \delta (y - P_{NGP}) \geq 0$$

It is easy to see that for bad borrowers the same participation constraint applies, both at time 1 and time 2:

$$\overline{P^B_{NGP,1}} \equiv \overline{P^B_{NGP,2}}. \tag{6}$$

We now turn to good borrowers' decision problem. By assumption, good types always prefer to invest the borrowed amount into the illiquid activity. Their participation constraint in period 2 will thus be:

$$\beta_G \delta p (y^* - P_{NGP}) \geq 0$$

which implies

$$P_{NGP} \leq y^* \equiv \overline{P^G_{NGP,2}} \tag{7}$$

where $\overline{P^G_{NGP,2}}$ defines the largest repayment satisfying good borrowers' participation constraint in a rigid microfinance contract at time 2. However, investing in the illiquid project implies that at time 1 they won't be able to repay the first loan installment. Turning to good borrowers' decision in the first period, the participation constraint requires:

$$0 - P_{NGP} + \beta_G \delta p(y^* - P_{NGP}) \geq 0.$$

As households are borrowing constrained, they can never attain negative negative values of consumption. Therefore, good borrowers' participation constraint is never satisfied, which means that they will never enter the rigid contract.
We now turn to the lender's problem. The bank sets its contract to solve the following problem:

$$\max[x_G \phi((1+\delta)P_{NGP} - 1) + (1-\phi)x_B((1+\delta)P_{NGP} - 1)]$$

subject to

$0 - P_{NGP} + \beta_G \delta p(y^* - P_{NGP}) \geq 0$ **(PCG1)**

$P_{NGP} \leq y^*$ **(PCG2)**

$P_{NGP} \leq y$ **(PCB)**

$x_i(1+\beta_i\delta)(y - P^i_{NGP}) \geq x_j(1+\beta_i\delta)(y - P^j_{NGP})$ for all $i, j{=}G, B$ **(IC)**

$w_i \geq 0$ **(LL)**

$0 \leq x_i \leq 1$ for all $i, j{=}G, B$

The binding participation constraint, $P_{NGP} \leq y$, implies that setting the price for the rigid repayment schedule $P_{NGP} = y$, all good borrowers will be screened out from the pool, $x_G = 0$, $\forall\ P_{NGP}$. At that price, however, all bad borrowers will enter the contract. The lender ends up with the following profit:

$$\Pi = (1-\phi)((1+\delta)y - 1)$$

Results are summarized by the following proposition:

Proposition 1 *The traditional microfinance contract excludes more entrepreneurial clients from borrowing. Less entrepreneurial clients will repay instead if and only if the price of the contract satisfies their participation constraint,* $P_{NGP} \leq y$*.*

3.2 The lender only offers a contract with a grace-period

We now study the case in which, by default, the grace-period is always provided. From now on, we refer to this contract as the "fully flexible" contract. This contract allows more entrepreneurial borrowers to undertake the illiquid activity, which wouldn't be feasible without a grace-period option. In this case, which investment opportunity the borrowers decide to invest in depends on their discount rates. If the lender could perfectly screen across borrowers, the first-best is to offer this contract only to good borrowers, and screen out bad borrowers. However, as there is imperfect information upon the borrowers, the only way to screen across borrowers is by charging the appropriate interest rate for the contract.

In offering this contract, the lender must decide which interest rate to apply. Let's proceed again by backward induction. Good borrowers' participation constraint at time 2 is satisfied for:

$$p(y^* - P_{GP}) \geq 0$$

that is, for

$$P_{GP} = r^2 \leq y^* \equiv \overline{P^G_{GP,2}} \tag{8}$$

Similarly, their participation constraint at time 1 will be:

$$\beta_G \delta p(y^* - P_{GP}) \geq 0$$

that is, for

$$P_{GP} \leq y^* \equiv \overline{P^G_{GP,1}} \equiv \overline{P^G_{GP,2}} \equiv \overline{P^G_{GP}} \tag{9}$$

where $\overline{P^G_{GP}}$ defines the largest repayment which satisfies good borrowers' participation constraint in the "fully flexible" contract. On the contrary, bad borrowers' decision to enter the contract at time 2 will be:

$$y - P_{GP} \geq 0$$

tha is for

$$P_{GP} \leq y \equiv \overline{P^B_{GP,2}}. \tag{10}$$

While their participation constraint at time 1 will be:

$$y + \beta_B \delta(y - P_{GP}) \geq 0$$

which is satisfied for

$$P_{GP} \leq \frac{1 + \beta_B \delta}{\beta_B \delta} y \equiv \overline{P^B_{GP,1}} \tag{11}$$

where $\overline{P^B_{GP}}$ denotes the largest repayment which satisfies bad borrowers' participation constraint. It's easy to see that, as β_B decreases, the maximum repayment bad borrowers are willing to pay in order to enter the contract, $\overline{P^B_{GP}}$, increases. In particular, the bank faces the following problem:

$\max[x_G \phi(\delta p P_{GP} - 1) + x_B(1 - \phi)(\delta p P_{GP} - 1)]$

subject to

$P^G_{GP} \leq y^*$ **(PCG)**

$P^B_{GP,1} \leq \frac{1+\beta_B\delta}{\beta_B\delta} y$ **(PCB1)**

$P^B_{GP,2} \leq y$ **(PCB2)**

$\beta_G \delta p(y^* - P^G_{GP,1}) \geq \beta_G \delta p(y^* - P^B_{GP,1})$ **(ICG1)**

$\beta_G \delta p(y^* - P^G_{GP,2}) \geq \beta_G \delta p(y^* - P^B_{GP,2})$ **(ICG2)**

$y + \beta_B \delta(y - P^G_{GP}) \geq y + \beta_B \delta(y - P^B_{GP,1})$ **(ICB1)**

$y - P^G_{GP} \geq y - P^B_{GP,2}$ **(ICB2)**

$w_i \geq 0$ **(LL)**

If the lender offers a grace-period contract, he certainly wants to achieve a higher profit than under the traditional, rigid microfinance contract. It follows that the repayment which is due at time 2, P_{GP}, must be greater than $(1 + \delta)y$.
As the grace-period contract is tailored to meet good borrowers' repayment conditions, the binding participation constraint is therefore $P^G_{GP} \leq y^* = \overline{P^G_{GP}}$. If the bank sets $P_{GP} = \overline{P^G_{GP}}$ as the repayment for the fully flexible contract, it means that bad borrowers whose $\overline{P^B_{GP,1}}$ falls below $\overline{P^G_{GP}}$ will not enter the contract at all. That is:

$$\overline{P^B_{GP,1}} < \overline{P^G_{GP}} \iff \beta_B > \frac{y}{\delta(y^* - y)}.$$

Let $\tilde{\beta} = \frac{y}{\delta(y^* - y)}$, where $\tilde{\beta}$ is always smaller than β^*. If $\beta_B \in (\tilde{\beta}; \beta^*)$, borrowers will be excluded; otherwise, if $\beta_B \in (0; \tilde{\beta}]$ bad borrowers will still enter the contract, because the repayment which satisfies their participation constraint at time 1 is higher than $\overline{P^G_{GP}}$. This implies that bad borrowers' participation constraint at time 1 is always satisfied, for $\beta_B \in (0; \tilde{\beta}]$. What happens instead at time 2? The binding incentive constraint,

$$y - P^G_{GP} \geq y - P^B_{GP,2}$$

requires that bad borrowers who entered the contract at time 1 repay as long as $P^G_{GP} \leq \overline{P^B_{GP,2}}$. This constraint is never satisfied, as extracting all the rents from good borrowers, $P_{GP} = \overline{P^G_{GP}}$, implies that $\overline{P^G_{GP}} > \overline{P^B_{GP,2}}$. It follows that bad borrowers whose β_B falls into $(0; \tilde{\beta}]$ will enter the contract at time 1, but then default at time 2. As the lender cannot seize borrowers' income at time 1, these borrowers will consume y in the first period and default afterwards.
This is a very crucial point, and it is especially related to the ongoing debate on repayment flexibility in microfinance contracts. As many claim that more flexibility in microfinance contracts is necessary in order to allow borrowers to undertake riskier but also more profitable activities, we show that if the lender only provides a grace-period contract, this will not only attract more entrepreneurial borrowers but also borrowers who heavily discount their future lifetime utility and underestimate the magnitude of the repayment at time 2. Observed default will therefore not only be driven by an increase in projects' riskyness, but also by bad borrowers' inability to repay at time 2.

Let's define $\rho_0(1-\phi)$ the probability that $\beta \in (\tilde{\beta}; \beta^*]$, or, in other words, the share of bad borrowers who do not enter the flexible contract; similarly, we call $(1-\rho_0)(1-\phi)$ the probability that $\beta \in (0; \tilde{\beta})$, that is the share of bad borrowers who enter the flexible contract and then default. The lender's profit when he offers the "fully flexible" contract will thus be as follows:

$$\phi(\delta p y^* - 1) + (1-\phi)(1-\rho_0)(-1)$$

Proposition 2 *If the lender only offers a grace-period contract and sets as repayment $P_{GP} = y^*$, good borrowers will always enter the contract and repay, whereas a share $1-\rho_0$ of bad borrowers will enter the contract and then default, as long as $\beta_B \in (0; \frac{y}{\delta(y^*-y)}]$; on the contrary, a share ρ_0 of bad borrowers with $\beta_B \in (\frac{y}{\delta(y^*-y)}; \frac{y}{\delta(py^*-y)})$ will not borrow at all.*

Lemma 1 *In order to maximize the value of ρ_0, that is, in order to retain the least share of bad borrowers in the flexible contract, the lender sets the highest possible repayment which satisfies good borrowers' participation constraint. This implies that good borrowers will have to sacrifice their utility in order to compensate for bad borrowers' default.*

From (9), it follows that the grace-period "only" contract entirely dominates the traditional microfinance contract $\iff$

$$\phi > \frac{(1+\delta)y - \rho_0}{\delta p y^* - \rho_0 + (1+\delta)y - 1} = \underline{\phi}. \tag{12}$$

Figure 1 shows a comparison between the two contracts we have analyzed in section 3.1 and 3.2[1]. The lender's profit is computed as a function of ϕ. The dotted line represents the lender's profit under repayment rigidity, while the continuous line defines the profit associated to the grace-period "only" contract. The intersection between the two lines falls in correspondence of $\underline{\phi}$. Therefore, if the share of good borrowers in the pool, ϕ, is greater than $\underline{\phi}$, it will be optimal for the lender to offer a grace-period "only" contract; on the contrary, for $\phi < \underline{\phi}$, it will be instead more profitable to offer the traditional, microfinance contract with the rigid repayment schedule. Given how $\underline{\phi}$ is defined, keeping y^* constant, the lower y, the lower the value of $\underline{\phi}$ for which the grace-period contract dominates the rigid one. Similarly, as ρ_0 decreases, $\underline{\phi}$ decreases, as well.
It is natural to wonder whether the lender can do better than simply offering a grace-period "only" contract, especially because borrowers with $\beta_B \in (\tilde{\beta}; \beta^*)$ won't enter the contract at all, whereas they could still borrow, if also a rigid contract is provided.
We will thus analyze whether the lender could design a more sophisticated contract in which both the rigid and the flexible repayment schedule are offered.
In particular, our interest lies in studying whether such contract is able to attract good borrowers into the flexible schedule and bad borrowers into the rigid one. In the next section, we will study whether such a contract exists and what are its implications on the borrowers' choices and the lender's profit.

[1] We use, as parametrization, y=10, y^*=50, $p = 0.5$, $\delta = 1$, $\rho_0 = 0.3$.

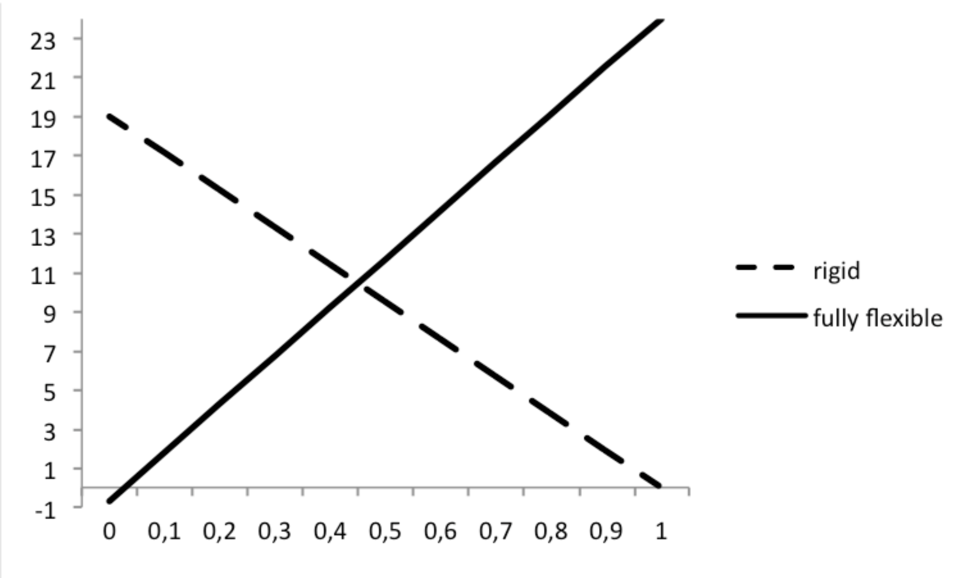


Figure 1

3.3 The lender offers the grace-period as a contract option

If the lender had information on borrowers' quality, the first best solution would be to offer good borrowers a fully flexible contract at y^*, while retaining bad borrowers under the traditional contract at y; such strategy allows him to extract all borrowers' rents. However, as information is imperfect, the lender can only provide both a flexible and a rigid debt structure and rely on the charged interest rates to screen across borrowers. In doing so, his main objective is to prevent bad types from choosing the grace-period contract.

3.3.1 The "separating" contract

When he offers both contracts at the same time, the lender must solve the following problem:

$$\max[x_G\phi\delta(pP_{GP} - 1) + x_B(1-\phi)((1+\delta)P_{NGP} - 1)dx$$

subject to

$P_{GP}^{G,s} \leq y^*$ **(PCG)**

$P_{NGP,1}^{B,s} \leq y$ **(PCB)**

$\beta_G\delta p(y^* - P_{GP}^{G,s}) \geq (1+\beta_G\delta)(y - P_{NGP}^{B,s})$ **(ICG)**

$(1+\beta_B\delta)(y - P_{NGP}^{B,s}) \geq y + \beta_B\delta(y - P_{GP}^{G,s})$ **(ICB)**

$w_i \geq 0$ **(LL)**

where the superscript s stands for *separating* contract. Let's start by assuming that the binding participation constraint is $P_{GP}^{G,s} \leq y^*$. For the limited liability constraint it follows that, for any $P_{GP}^{G,s} > y$, the binding incentive constraint for bad borrowers becomes $(1+\beta_B\delta)(y - P_{NGP}^{B,s}) \geq y$, which is satisfied for $P_{NGP}^{B,s} \leq \frac{\beta_B\delta}{1+\beta_B\delta}y = \overline{P_{NGP,1}^{B,s}}$. The highest repayment compatible with bad borrowers' incentive constraint, $\overline{P_{NGP,1}^{B,s}}$ is stricly increasing in δ_B, given $\overline{P_{NGP,1}'^{B,s}} > 0$. Therefore, as β_B is defined in the interval $(0;\beta^*]$, the highest repayment the lender can achieve under repayment rigidity, $\overline{P_{NGP,1}^{B,s}}$, is obtained for the upper threshold of β_B, that is $\beta^* = \frac{y}{\delta(py^*-y)}$. With few algebraic passages, we see that the highest repayment the lender can charge for the rigid schedule is $\overline{P_{NGP,1}^{B,s}} = \frac{y^2}{py^*}$. As $\overline{P_{NGP,1}^{B,s}} < y$, this ensures that every bad borrower will always repay both at time 1 and at time 2, $\forall\ \beta_B$.
Besides, as the lender wants the good borrowers to opt for the grace-period, the following incentive constraint must hold:

$$\beta_G\delta p(y^* - P_{GP}^{G,s}) \geq (1+\beta_G\delta)(y - \frac{y^2}{py^*})$$

The above inequality is satisfied if and only if:

$$P_{GP}^{G,s} \leq y^* - \frac{(1+\beta_G\delta)}{\beta_G\delta}\frac{1}{p}(y - \frac{y^2}{py^*}) = \overline{P_{GP}^{G,s}}$$

where $\overline{P_{GP}^{G,s}}$ defines the maximum repayment which satisfies good borrowers' incentive constraint. Let's call $\psi(\beta_G) = \frac{(1+\beta_G\delta)}{\beta_G\delta}\frac{1}{p}(y - \frac{y^2}{py^*})$, where $\psi(\beta_G) > 0$ and $\psi(\beta_G)' < 0$. This tells us that as β_G increases, good borrowers will demand a lower reduction in the price of the grace-period in order to enter the contract. Indeed, $\lim_{\beta_G\to\infty}\psi = 0$. Which value of $\overline{P_{GP}^{G,s}}$ will the lender choose?
In order for the grace-period contract to be more profitable than the actual price of the rigid repayment schedule, the lender must ensure that

$$\delta p(y^* - \frac{(1+\beta_G\delta)}{\beta_G\delta p}(y - \frac{y^2}{py^*})) > \frac{(1+\delta)y^2}{py^*},$$

The above condition holds $\iff$

$$\beta_G > \frac{y(py^*-y)}{\delta p^2y^{*2} - \delta py^*y - y^2} = \underline{\beta_G}$$

As β_G is defined in $[\beta^*;1]$, it means that $\beta_G \in [\max(\underline{\beta_G}, \beta^*);1]$. By comparing $\underline{\beta_G}$ with β^*, we see that the following relation holds, $\forall\ \delta$:

$$\beta^* \geq \underline{\beta_G}.$$

Therefore,

$$\delta P_{GP}^{ic,g} > (1+\delta)P_{NGP}^{ic,b},\ \forall\ \beta_G.$$

Because the lender wants all good borrowers to enter the grace-period contract, this is possible for the lowest value of β_G, which ensures that all good borrowers will opt for the flexibile schedule. Therefore, the lender will set

$$P_{GP}(\beta_G = \beta^* = \frac{y}{\delta(py^*-y)}) = \frac{y}{p}$$

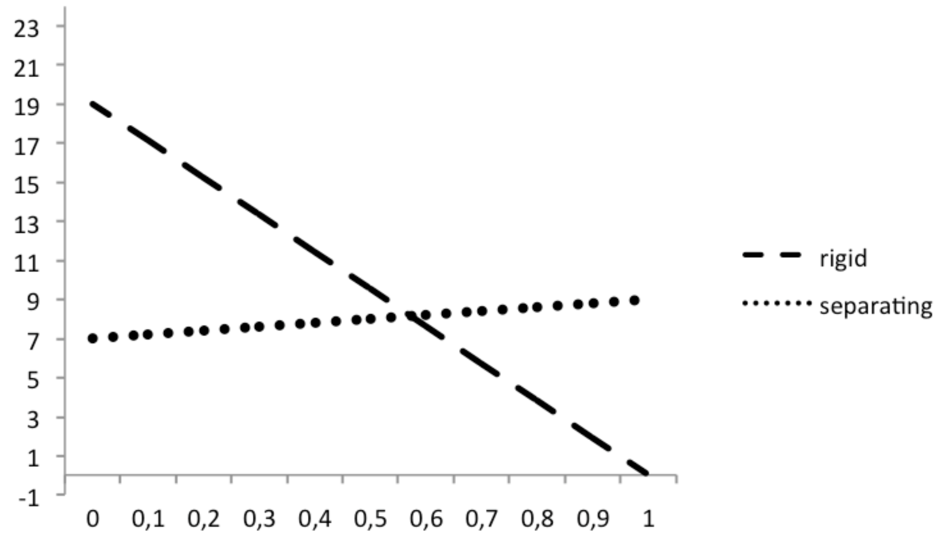


Figure 2

as the repayment for the flexible contract, for which the lender obtains a higher profit than $(1+\delta)P^{ic,b}_{NGP} = \frac{(1+\delta)y^2}{py^*}$.

As the lender has enough funds to finance all borrowers, $x_G = x_B = 1$. His profit will thus be:

$$\Pi^p_L = \phi\delta p\frac{y}{p} + (1-\phi)\frac{(1+\delta)y^2}{py^*} - 1$$

If we compare the profit the lender achieves under the rigid and the separating contract, the latter dominates the former as long as:

$$\phi > \frac{(1+\delta)y(1-\frac{y}{py^*})}{y(2\delta+1) - 1 - (1+\delta)\frac{y^2}{py^*}} = \hat{\phi} \tag{13}$$

Figure 2 shows the relationship between the separating contract and the traditional, rigid microfinance contract, where the intersection between the curves corresponds to $\hat{\phi}$[2].
In the graph, the lender's profit is computed as a function of ϕ.

3.3.2 The "semi-separating" equilibrium

In the previous section we have studied a contract where the bank is able to retain all bad borrowers under the rigid repayment schedule, while good borrowers enjoy more flexibility. Although this contract allows the lender to reach the separating equilibrium, it prevents the bank to extract all the surplus from the borrowers. In other words, borrowers will enjoy more consumption, both at time 1 (bad borrowers) and at time 2 (both good and bad borrowers).

In what follows we therefore study another type of contract where both the rigid and the flexible repayment schedules are offered, but the lender sets the repayment such that he is able to extract

[2]Again, $y = 10$, $y^* = 50$ and $p = \frac{1}{2}$.

a higher surplus from borrowers. We start from the same maximization problem as before:

$$\max[x_G\phi(\delta pP_{GP}-1)+x_B(1-\phi)((1+\delta)P_{NGP}-1)dx$$

subject to

$P_{GP}^{G,s}\leq y^*$ **(PCG)**

$P_{NGP,1}^{B,s}\leq y$ **(PCB)**

$\beta_G\delta p(y^*-P_{GP}^{G,s})\geq(1+\beta_G\delta)(y-P_{NGP}^{B,s})$ **(ICG)**

$(1+\beta_B\delta)(y-P_{NGP}^{B,s})\geq y+\beta_B\delta(y-P_{GP}^{G,s})$ **(ICB)**

$w_i\geq 0$ **(LL)**

Let $P_{NGP}^{B,s}\leq y$ be the binding participation constraint. The binding incentive constraint, $\beta_G\delta p(y^*-P_{GP}^{G,s})\geq(1+\beta_G\delta)(y-P_{NGP}^{B,s})$, implies that extracting all the rents from bad borrowers is compatible with extracting all the rents from good borrowers, as well. We know, however, that as long as the lender keeps the price for the rigid contract to $P_{NGP}=y=\overline{P_{NGP}}$, borrowers with $\beta_B\in(0;\tilde{\beta}]$ will enter the flexible contract and default. On the contrary, given that by assumption borrowing is always preferred to being financially excluded, borrowers with $\beta_B\in(\tilde{\beta};\beta^*]$ will enter the rigid contract.
Let us now consider for a moment good borrowers' behavior. By setting y^* as the price for the repayment schedule, good borrowers' participation constraint is satisfied both at time 1 and time 2. This implies that they will enter the flexible contract. The lender thus ends with a profit of:

$$\Pi=\phi(\delta py^*-1)+(1-\phi)[\rho_0((1+\delta)y-1)+(1-\rho_0)(-1)]$$

Intuitevely, the profit the lender is able to achieve by charging $P_{NGP}=y$ for the rigid repayment schedule and $P_{GP}=y^*$ for the flexible repayment schedule is greater than the profit in the fully flexible contract, $\forall\ \rho_0$. It follows:

Proposition 3 *The semi-separating contract always dominates the fully flexible one,* $\forall\ \rho_0$*.*

On the contrary, the semi-separating contract dominates the rigid microfinance contract for:

$$\phi>\frac{(1+\delta)(1-\rho_0)y}{\delta py^*-1+(1+\delta)(1-\rho_0)y}=\underline{\underline{\phi}} \tag{14}$$

It is easy to see that as $\rho_0\to 0$, $\underline{\underline{\phi}}\to\underline{\phi}$. Figure 3 shows a comparison between the profit achieved under the semi-separating contract and the rigid contract, as a function of ϕ.
As ρ_0 increases, $\underline{\underline{\phi}}$ decreases, up to the point where, for $\rho_0=1$, the semi-separating contract always dominates the rigid repayment schedule.

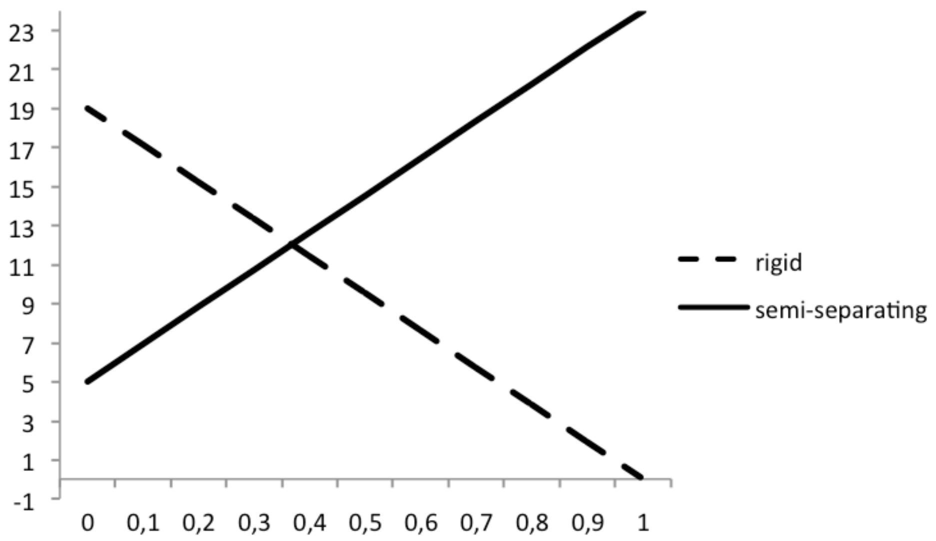


Figure 3

3.3.3 Decreasing the price of the flexible schedule

In this section, we generalize the analysis of the semi-separating contract by assuming that, when the lender sets the price for the grace-period option, he will charge an arbitrary value $y^* - \epsilon$, where $\epsilon \geq 0$, while the price of the rigid contract remains at y. For ϵ equal to 0, results from the previous paragraph apply. The reason why we make this extension is to see whether, for some $\epsilon > 0$, the lender may still design a contract which (almost) dominates the rigid one and, in turn, he is able to leave good borrowers' with some rents. The problem the lender faces is to choose the right value of ϵ. For instance, the lender must choose ϵ s.t. $\delta p(y^* - \epsilon) > (1+\delta)y$, otherwise it would have been once again more convenient only to offer the rigid contract.
If the lender lowers the price of the flexible schedule from y^* to $y^* - \epsilon$, where $\epsilon \in (0; y^* - \frac{1+\delta}{\delta p}y)$, this has also consequences on bad borrowers' take-up.
Indeed, as long as $\delta p(y^* - \epsilon) > (1+\delta)y \Rightarrow y^* - \epsilon > y$, $\forall\ \delta$, p; this means that bad borrowers would (still) default if they opt for the flexible repayment schedule. As the price for the rigid contract is y, we already know that bad borrowers with $\beta_B \in (\tilde{\beta}; \beta^*)$ prefer the rigid contract, while bad borrowers with $\beta_B \in (0; \tilde{\beta}]$ will enter the flexible contract, if the cost for the grace-period option is set to y^*.
What happens on the contrary if the grace-period contract is made cheaper?
Similar to the previous analysis, bad borrowers will enter the flexible contract if and only if the new price satisfies their participation constraint, that is:

$$y^* - \epsilon > \frac{1 + \beta_B\delta}{\beta_B\delta} y \tag{15}$$

The above inequality is now satisfied for

$$\beta_B \in (\frac{y}{\delta(y^* - y - \epsilon)}; \beta^*). \tag{16}$$

Let's denote $\frac{y}{\delta(y^*-y-\epsilon)} = \hat{\beta}$, where $\hat{\beta} > \tilde{\beta}$, $\forall\ \delta$. Moreover, $\hat{\beta} < \beta^*$. This implies that another condition has to be satisfied, that is:

$$\frac{y}{\delta(y^*-y-\epsilon)} < \frac{y}{\delta(py^*-y)} \iff \epsilon < (1-p)y^*$$

Given that ϵ is defined in $(0; y^* - \frac{1+\delta}{\delta p}y)$, and that $y^* - \frac{1+\delta}{\delta p}y > (1-p)y^*$, $\forall\ p$, we get:

$$\epsilon \in (0; (1-p)y^*).$$

Indeed:

$$lim_{\epsilon \to 0}\hat{\beta} = \tilde{\beta}$$

and

$$lim_{\epsilon \to (1-p)y^*}\hat{\beta} = \beta^*.$$

Besides,

$$\frac{d\hat{\beta}}{d\epsilon} = \frac{y}{(y^*-y-\epsilon)^2} > 0;$$

this means that as the value of ϵ increases, also the $\hat{\beta}$ increases. Let's now define $\pi(\hat{\beta} < \beta_B < \beta^*)$ $= (1-\phi)\rho_1(\epsilon)$ and $\pi(\beta_B < \hat{\beta}) = (1-\phi)(1-\rho_1(\epsilon))$, where $\rho_1'(\epsilon) < 0$: as ϵ increases, the probability that a bad borrowers opts for the rigid repayment schedule decreases. Therefore, for a given ϵ^* arbitrarily chosen by the lender, a share $(1-\phi)\rho_1(\epsilon^*)$ of borrowers whose β_B falls into $(\hat{\beta}; \beta^*]$ will find more convenient to undertake the rigid repayment schedule. Notice however that, as $\hat{\beta} > \tilde{\beta}$, it follows that $(1-\phi)\rho_1(\epsilon^*) < (1-\phi)\rho_0$. In other words, compared to the grace-period "only" contract, the semi-separating contract leads a larger share of bad borrowers to enter the flexible contract and then default.

On the contrary, a share $(1-\phi)(1-\rho_1(\epsilon^*))$ of borrowers with $\beta_B \in (0; \hat{\beta}]$ will still prefer the grace-period option. Given that $y^* - \epsilon > y$, this means that they will consume y at time 1 but then default at time 2.

Recalling that $\rho'(\epsilon) < 0$, we can thus define $\rho_1(\epsilon)$ as:

$$\rho_1(\epsilon) = (1 - \frac{\epsilon}{(1-p)y^*})\rho_0.$$

where $\rho_0 \in [0; 1]$. The above function satisfies the conditions upon $\rho_1(\epsilon)$ and ϵ. Indeed, as $\epsilon \to 0$, $\rho_1(\epsilon) \to \rho_0$. Moreover, as $\epsilon \to (1-p)y^*$, $\rho_1(\epsilon) \to 0$.

The lender's profit will thus be:

$$\Pi_L^{GP} = \phi(\delta p(y^* - \epsilon) - 1) + (1-\phi)[\rho_1(\epsilon)((1+\delta)y - 1) + (1-\rho_1(\epsilon))(-1)] \tag{17}$$

The lender will thus choose an arbitrary value of $\epsilon \in (0; (1-p)y^*)$ which maximizes his profit. Deriving the profit for ϵ we see that:

$$\frac{d\Pi_L}{d\epsilon} = -\phi\delta p + (1-\phi)(1+\delta)y\rho'(\epsilon) < 0 \tag{18}$$

Condition (18) is always negative, as $\rho'(\epsilon) < 0, \forall\ \epsilon$. It immediately follows that the least value of ϵ leads to the largest profit for the lender.

Proposition 4: *As the lender makes the flexible schedule cheaper, that is, as ϵ increases, a larger share of bad borrowers will enter the grace-period contract and default. This implies that the lender's profit will decrease as the value of ϵ increases.*

Corollary: *In order to achieve the highest profit, the lender will set the lowest value of ϵ; that is, he will set $\epsilon = 0$.*

By comparing the profit the lender obtains under the grace-period only and the semi-separating contract, we obtain that the latter dominates the former for:

$$\epsilon < \frac{(1-\phi)\rho_0((1+\delta)y-1)}{\phi\delta p+(1-\phi)\rho_0\frac{(1+\delta)y}{(1-p)y^*}} = \underline{\epsilon}.$$

Or, in other words, the semi-separating equilibrium dominates the grace-period only contract $\iff$:

$$\phi < \frac{\rho_0((1+\delta)y - 1 - \frac{(1+\delta)y\epsilon}{(1-p)y^*})}{\rho_0((1+\delta)y - 1 - \frac{(1+\delta)y\epsilon}{(1-p)y^*}) + p\epsilon} = \overline{\phi} \qquad (19)$$

As ϵ goes to 0, $\underline{\underline{\phi}} \rightarrow 1$, that is the semi-separating contract always dominates the grace-period only contract, $\forall\ \rho_0$. On the contrary, as ϵ increases, the blue line rotates downwards and $\underline{\underline{\phi}}$ decreases. Besides, as $\frac{d\underline{\underline{\phi}}}{d\rho_0} > 0$, as ρ_0 increases, $\underline{\underline{\phi}}$ increases, as well.

Unsurprisingly, the lender will always extract all the rents from good borrowers. As we have seen in this section, the cheaper the grace-period becomes, the more bad borrowers will prefer the flexible to the rigid repayment schedule. Therefore, in order to screen out from the pool the highest number of bad borrowers, the lender will keep the semi-separating contract to the highest price.

3.3.4 Contract choice

In this section, we compare the separating and the semi-separating contract with the traditional, rigid, microfinance contract and see under which conditions offering a flexible schedule is more profitable than only offering the traditional, rigid microfinance contract. We won't consider the fully flexible contract anymore, as we have seen that it is fully dominated by the semi-separating contract. Recalling (13), we have seen that the separating contract dominates the rigid microfinance contract for $\phi > \hat{\phi}$, whereas the semi-separating contract dominates the rigid microfinance contract for $\phi > \underline{\underline{\phi}}$. With few algebraic passages, we can see that the following condition:

$$\underline{\underline{\phi}} > \hat{\phi} \qquad (20)$$

is always satisfied. Figures 4 and 5 show the relationship between the rigid repayment contract, the separating equilibrium and the semi-separating contract. For values of $\phi < \underline{\underline{\phi}}$, the rigid

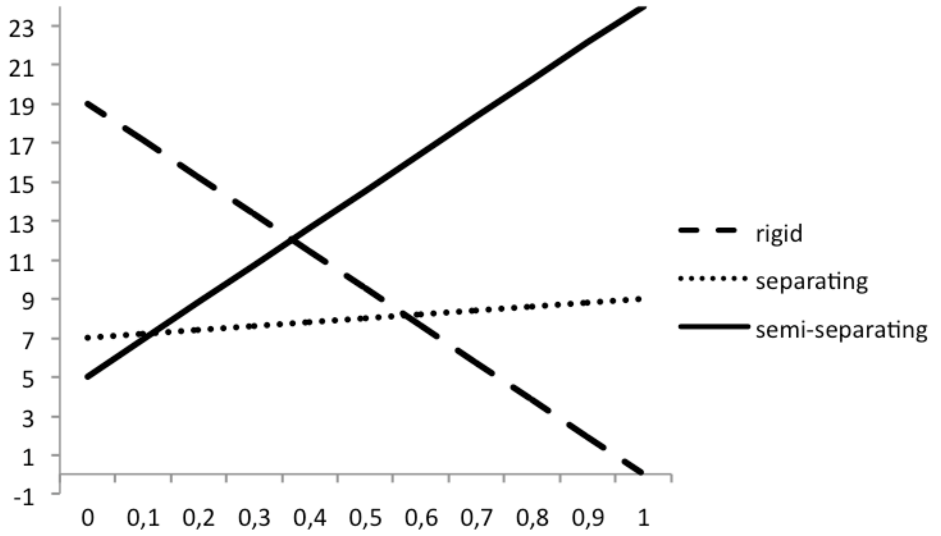


Figure 4

contract dominates both the separating and the semi-separating contract. However, *ceteris paribus*, as the share of bad borrowers whose β_B falls above $\tilde{\beta}$, that is ρ_0, increases, the semi-separating contract becomes more profitable for a lower value of ϕ, up to the point where, as shown in Figure 5, $\rho_0 = 1$, for which this contract entirely dominates the rigid microfinance contract, $\forall\ \phi$.

4 Summary of theoretical predictions

This paper studies a situation where the lender wants to provide more flexibility to the debt structure of the contracts he provides, and analyzes its implication on borrowers' take-up and on the lender's profit. We assume that the lender faces a pool of borrowers who display different discount rates, and therefore are classified into good (high β) and bad (low β) borrowers. We study two possible flexible contracts, one in which repayments start one period ahead by default and no borrowers can repay under repayment rigidity, while the other offers both a rigid and a flexible repayment schedule. We then compare results from the flexible contracts with the traditional, rigid microfinance contracts that every MFI usually provides.

Our model leads to several interesting results: first, we show that, assuming no strategic default, the rigid repayment contract always screens out more entrepreneurial clients, or, in other words, forces the clients to invest in low risk-low profit activities, unless they want to be "stigmatized" as defaulters. Second, we find that, if the lender wants to increase the degree of flexibility in the contract(s) he offers - because in the pool there is a considerable amount of potential clients asking for it -, he is never able to design a contract which perfectly screens out bad borrowers from undertaking the grace-period or, if he does, this contract is always dominated by the semi-separating contract, up to a certain share of entrepreneurial borrowers in the pool. The main implication of this result is that, when the lender provides a flexible contract, a share of bad borrowers will increase consumption in period 1 but will always default in period 2, when

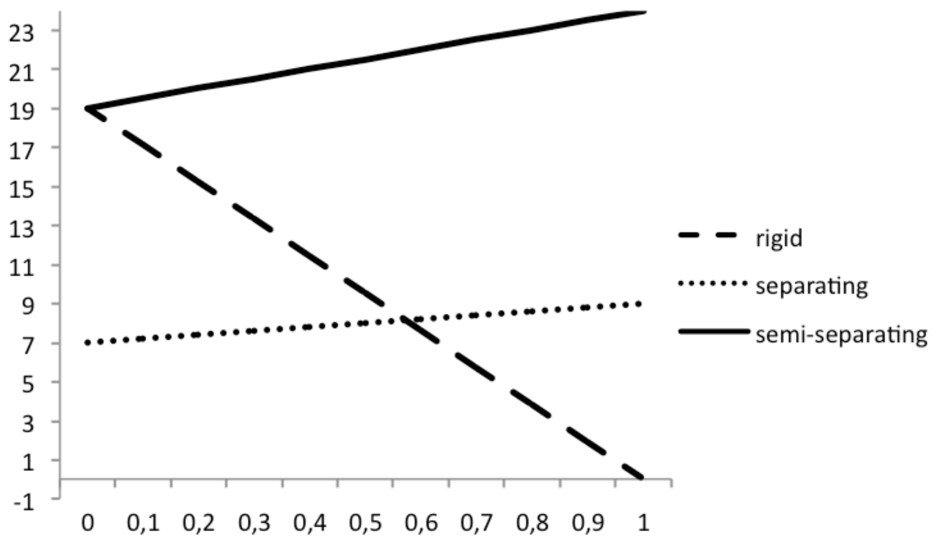


Figure 5

repayment is due. Third, we do find that, it is never optimal for the lender to offer the grace-period at a cheaper rate, as this implies that a larger share of bad borrowers will default. It follows that the lender will always extract all the rents from good borrowers, in order to screen out from the flexible schedule as many bad borrowers as possible. Therefore, good borrowers will always pay more for the flexible schedule in order to compensate not only for their default (which is driven by an increase in the riskyness of the project) but mainly for bad borrowers' default (which instead is driven by low discount rates).

5 Conclusions

We build a simple adverse selection model in order to study the impact of repayment flexibility on lender's profit and borrowers' behavior in microfinance contracts. In this framework, a monopolistic microfinance lender faces two types of borrowers who discount their future utility at a high and a low rate, respectively; this implies that if the lender offers a grace-period, there are two sources of default: from one side, it may be related to entrepreneurial borrowers' project failure, from the other side, it may be caused by an incorrect evaluation of future payoffs by heavy discounting-borrowers. We show, however, that if the pool of clients is made of a sufficiently high share of entrepreneurial borrowers, it is always more profitable for the lender to provide both a rigid and a flexible repayment schedule than simply the rigid repayment contract. Surprisingly, it is still more profitable even though the contract doesn't perfectly screen out very impatient borrowers who enter the flexible schedule but end up not being able to repay in the final period. Although with several limitations, this paper contributes to the ongoing debate on repayment regimes by showing that when a grace-period option is offered, the lender can design a contract which dominates the rigid one. We also show, however, that the lender maximizes his profit by extracting the highest surplus from good borrowers in order to compensate for bad borrowers' default. Therefore, a grace-period seems to increase the lender's profit, present consumption, but not entrepreneurial borrowers' welfare.

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