Repayment Flexibility in Microfinance Contracts: Theory and Experimental Evidence on Take-Up and Selection*

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Abstract

This paper studies the impact of introducing repayment flexibility in microfinance contracts. I build an adverse selection model that predicts the existence of a separating equilibrium where lenders are able to achieve higher profits by simultaneously offering a rigid and a flexible repayment schedule, instead of just a rigid contract. Lab-in-the field games with Indian microentrepreneurs confirm the model predictions. I offer subjects both a flexible and a rigid repayment schedule and exogenously vary the price of the flexible schedule. I find that more entrepreneurial borrowers are more likely to take-up the flexible schedule than less entrepreneurial ones, and even more so when the flexible schedule is more expensive than the rigid one. Risk-averse borrowers, on the contrary, are more likely to stick to the rigid contract when this is cheaper than the flexible contract. The paper thus indicates that lenders should offer a menu of contracts where the flexible and the rigid contract are provided simultaneously, at different prices. Back-of-the-envelope calculations indeed suggest that this mixed contract is more profitable than the standard, rigid microfinance contract.

Keywords: Microfinance, Adverse Selection, Repayment Flexibility.

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1 Introduction

Despite the almost universal acclaim for the "microfinance revolution", the findings from a series of Randomized Controlled Trials set up in different parts of the developing world (Banerjee et al., 2015; Crépon et al., 2015; Angelucci et al., 2015) have shown that microfinance has a positive, but not transformative, impact on microentrepreneurs' lives. As a result, still little is known about how the provision of small, uncollateralised loans can translate into business growth.

One potential obstacle for startups and small firms to become larger businesses in developing countries is the lack of credit contracts that fit their financial needs (Beck, 2007). In addition, the information frictions lenders face in developing countries (due, for instance, to the absence of credit bureaus, to difficulties in monitoring borrowers' activities and in enforcing on-time repayments) translate into high costs of capital, which, in turn, make access to finance for small, opaque businesses more difficult and expensive than in developed countries. For instance, the average cost of capital in mid-2000 for Pakistan and India was 19.51% and 14.39% respectively, compared to 10.05% in Germany or 10.24% United States (see Hail and Leuz, 2006). This lack of appropriate products could explain why, despite the very high returns to capital (McKenzie and Woodruff, 2006; De Mel et al., 2008; Banerjee and Duflo, 2014) and the abundance of lending institutions (Gulesci et al., 2014), credit demand is very low. In the case of microfinance contracts, not only business growth can be limited by the high costs of borrowing, but also by other stringent contract features, like weekly repayments (Feigenberg et al., 2013), strict collateral requirements (Gulesci et al., 2014), or repayment rigidity (Field et al., 2013).[1]

The structure of microfinance contracts has been justified by the fact that borrowers display problems of self-control, which make them more prone to yield to immediate consumption and to default on their repayment obligations. It follows that the traditional rigid and frequent repayment schedule, commonly used by Microfinance Institutions (MFIs), has always been considered the most effective tool to retrieve repayments, as it forces borrowers to manage their debt in a very short-term perspective.

Yet, a strict repayment schedule can also have major drawbacks, particularly in terms of investment decisions and liquidity management. First, immediate repayments represent a great obstacle to firms' growth because they limit borrowers' ability to invest in more profitable investment projects whose risk and cash-flows are more volatile. These projects may indeed pay off too late to meet the first repayment obligations. Second, a rigid debt structure is not very suitable for borrowers with unstable, seasonal income, which is particularly common among microentrepreneurs in developing countries.

Therefore, innovating the repayment structure of microfinance contracts represents another potential

[1] It is well known that, from the start of the Grameen Bank's experience, microfinance borrowers had to comply to a very tight repayment discipline. This included weekly or fortnightly repayments; repayments starting at the very beginning of the loan cycle; no possibility of debt renegotiation; group-lending schemes (now dismissed, almost everywhere).

channel through which micro and small enterprises' entry in credit markets, and their growth, could be promoted.

Flexibility in microfinance contracts, either in the form of relaxing repayment frequency (Fischer and Ghatak, 2010; McIntosh, 2008; Field and Pande, 2008) or as a grace-period before repayments start (Field et al., 2013; Czura, 2015), has begun to receive attention. Field et al. (2013) conducted the first randomized controlled trial testing the impact of the provision of a grace-period on the investment choices of a sample of Indian microfinance clients. Their study shows that allowing for a more flexible debt structure increases investments in business activities and variance of profits, but also default rates. A possible explanation is that not only repayment flexibility allows borrowers to invest in riskier and more profitable activities, but also it may be an attractive feature for borrowers with little or no self-control, who may underestimate the magnitude of future repayments and default. Therefore, results from the experiment of Field et al. (2013) raise important questions on the relevance of relaxing repayment rigidity in microfinance contracts: Which borrowers are more likely to want a grace-period? Is it possible for MFIs to offer a menu of contracts which allow them to offer the right repayment structure to the right borrower? Does this menu of contracts pay-off for lenders? Finally, from a policy perspective, is it possible to design a "screening instrument" that allows lenders to know ex-ante who the flexible contract should be offered to?

In this paper, I address these questions by studying the impact of "endogenously" introducing a grace-period to the standard repayment schedule. In doing so, I investigate borrowers' take-up decisions when they are offered the flexible and the rigid repayment contract simultaneously, at the beginning of the loan cycle. Because borrowers will self-select into one of the two contracts based on their preferences and individual characteristics (entrepreneurship, time preferences, risk aversion, among others) and on the price of the contracts, the paper asks whether the lender's is able to design a (profitable) menu of contracts that keep less creditworthy borrowers away from the flexible repayment schedule. This is an extremely policy-relevant question, as lenders, in order to introduce and scale-up the flexible repayment schedule in microfinance contracts, must find it profitable. My analysis tackles this question both theoretically and experimentally.

In the first part of the paper, I develop a theoretical model that allows me to study the adverse selection problem lenders face when they offer both repayment schedules simultaneously. I consider a monopolistic lender who faces two types of borrowers, who differ in terms of self-control and can choose between a short-term and a long-term investment project. In particular, the "good" type is time-consistent, while the "bad" type is present-biased. If the lender only offers a rigid contract, the sole business activity borrowers can undertake is the short-term one, irrespectively of their present-bias.[2] If, instead, the lender offers both the rigid and the flexible contract, bad borrowers might choose the flexible schedule to invest in the long-term activity. This could represent a problem for the bank as very present-biased borrowers

[2]Unless they deliberately default, which I assume here is not the case.

might default if they opt for the flexible schedule, having underestimated the repayment burden that is far away in time. Therefore, the lender's objective is to price each contract such that bad borrowers would find the flexible schedule too expensive and decide to take-up rigid schedule, instead. The model indeed predicts that offering a menu of contracts which attract good borrowers to the flexibile repayment schedule and retain bad borrowers in the rigid repayment scheme, by charging different prices, dominates the rigid repayment schedule, even when a significant share of borrowers are time-inconsistent. Thus, from a theoretical point of view, offering exclusively a rigid repayment contract is not an optimal strategy for the lender.

In the second part of the paper, I test the model predictions through a series of lab-in-the-field experiments in India with real microfinance borrowers. The purpose of the experiments is to compute the (hypothetical) demand curve for the flexible repayment schedule, and relate it to borrowers' characteristics. To this end, I use a Willingness-To-Pay (WTP) lottery to estimate how take-up rates change when the flexible contract is offered at different prices. In addition, I elicit individual time and risk preferences, along with entrepreneurial ability, and collect socio-demographic characteristics.

The experiment confirms the model's predictions. I find that the take-up rates of the flexible schedule are very sensitive to price, and that borrowers' individual characteristics can be good predictors of the selection into the flexible contract. More entrepreneurial borrowers are more likely to take-up the flexible schedule than less entrepreneurial ones, and even more so when the flexible schedule is more expensive than the rigid one. Risk-averse borrowers, on the contrary, are more likely to stick to the rigid contract when this is cheaper than the flexible contract.

As a final step, I compute the lender's profit based on the take-up rates estimated throught the experiment. I find, consistent with my theoretical predictions, that the profit the lender achieves by offering the rigid and the flexible repayment schedule simultaneously is higher than the profit he would obtain by simply offering the rigid repayment schedule. My paper thus shows that increasing repayment flexibility represents a win-win situation for both lenders and borrowers. Lenders can achieve higher profits by targeting the right borrowers with this innovative product. Borrowers can choose which repayment schedule fits their profile and that of their business activity best.

From a policy perspective, this study suggests that lenders should offer these innovative contracts to a larger extent, and use borrowers' characteristics as predictors of take-up rates. For instance, they could collect a broad set of information on borrowers' quality and create a "screening algorithm",[3] which can ultimately be used to design more profitable menus of microfinance contracts. Last, findings from my paper suggest that, even when the lender can screen across borrowers, take-up rates of the flexible contract might still be far from 100% among suitable borrowers.[4] Anecdotal evidence from the field

[3]A similar project, not strictly related to repayment flexibility, is the one carried out by the Entrepreneurial Finance Lab at the Harvard Kennedy School, https://www.hks.harvard.edu/centers/cid/programs/entrepreneurial-finance-lab-research-initiative

[4]With few exceptions (as in Prina, 2015), many studies that analyze the take-up of microfinance products display very low take-up rates.

indicates that one of the reasons why borrowers may not take-up the flexible contract, even when they could be eligible for it, is their concerns about not being able to comply with repayment obligations. This is in line with Bauer et al. (2012)'s findings that individuals choose the (rigid) microfinance contract to self-disciplinate. Although this is not necessarily a bad news (borrowers somehow anticipate a potential default and therefore prefer to stick to the rigid contract), a potential solution to boost take-up rates among "good" borrowers is through an increase in financial and business training. This, in turn, would allow microentrepreneurs to correctly evaluate their future profits and thus choose the repayment schedule that best fit their entrepreneurial activity.

The paper thus proceeds as follows: Section 2 presents the theoretical model; Section 3 the data collected through a set of lab-in-the-field experiments; results are commented in Section 4. Section 5 shows back-of-the-envelope calculations of the lender's profit, computed through experimental data. Section 6 concludes.

2 The model

In this section, I study an adverse selection model where a monopolistic bank is endowed with a capacity $\alpha \geq 1$ of capital at time 0 and faces a unit mass of borrowers.[5] There are two types of borrowers in the pool, a good (G) and a bad (B), who remain the same throughout the periods. We define ϕ as the proportion of good borrowers, and $1 - \phi$ as the proportion of bad borrowers. There is no initial endowment; in period 0, each borrower receives one unit of capital from the lender and may invest it in a productive input that generates a certain income y^L each period, starting from time 1. I refer to this project as the "short-term activity". Besides, there is another investment opportunity available in the market, which yields a steady flow of revenue y^H, but only starting at time 2. I call the second project "long-term activity". Assuming both investment projects are evaluated at time 1, the following condition holds:

$$\delta y^H > y^L + \delta y^L \tag{1}$$

where $\delta \in [0, \infty)$ is the time discount factor. That is, the "long-term activity" dominates the "short-term activity" in terms of returns.

2.1 Rigid *versus* flexible repayment contracts

In the traditional, rigid, microfinance contract, repayments are made on a monthly basis. Let P_1, P_2 define the repayment obligations at time 1 and 2, respectively. Repayment is made individually.

The regular debt structure timeline is structured as follows:

[5] The assumption of a monopolistic Microfinance Institution offering repayment flexibility mirrors a situation where a bank offers these innovative contracts, while none of its competitors does. This assumption is confirmed by anecdotal evidence that, currently, only a negligible share of lenders in developing countries has introduced some degree of repayment flexibility in the credit contracts they offer.

$+1$	$-P_1$	$-P_2$	$+V$
t_0	t_1	t_2	t_3

That is, borrowers receive a unit of capital at time t_0 and repay at both t_1 and t_2. Conditional on a successful repayment, they will be able to borrow again at time t_3.[6]

In the flexible repayment contract, the grace-period allows borrowers to start the loan repayment one period (or even more) ahead, which means that the loan repayment starts in t_2 instead of t_1.

$+1$	0	$-P_1$	$-P_2$	$+V$
t_0	t_1	t_2	t_3	t_4

To simplify the model, I assume here that, in the flexible contract, borrowers have to repay their entire debt at time 2. Thus, the repayment schedule will be as follows:

$+1$	0	$-P$	$+V$
t_0	t_1	t_2	t_3

with $P = P_1 + \frac{P_2}{R}$, being R the gross interest rate.

The underlying intuition is that the long-term project allows the microentreprises to grow to a larger extent than the short-term project. Let's think, for example, to a blouse tailor that borrows from a microfinance institution at time 1. She may use the loan for one of the above-mentioned investment projects. If she opts for the short-term activity, then she would buy cloth to produce saris. Given her productive capability, and assuming she is able to produce the same amount of saris every month by sewing them, she would earn y^L every month. Let's assume, now, that the repayment at the first month is not due. As she is not bound by the repayment at time 1, she may opt then for the long-term activity: she may use the loan to buy, at the beginning of the loan cycle, a sewing machine and some cloth. The sewing machine would speed up her production process, which means she could earn y^H, but only once the sewing machine is powered up, which may take some time (she may need to order the sewing machine, which could arrive only after some weeks, and she has then to learn how use it). Therefore, the flexible repayment schedule is more suitable for her more entrepreneurial activity.

2.2 Borrowers's utility

Let borrowers' utility function be defined as:

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

where $u_t \geq 0$, $\delta \in [0, \infty)$ being the discount factor which is common among the borrowers and the lender, and $\beta_i \in (0; 1]$, i=$\{B, G\}$. I model borrowers' time inconsistency with quasi-hyperbolic discounting. To

[6]This is expressed through the continuation value V.

this end, I assume that β_G=1, e.g. good borrowers are time-consistent. Bad borrowers, instead, are present-biased, with $\beta_B \in (0;1)$. Therefore, the difference between good and bad borrowers lies in their degree of impatience: while good borrowers discount the present and the future in the same way, bad borrowers discount future payoffs more heavily than present ones. It follows that, in the case of repayment flexibility, this could potentially represent a big threat to a good repayment performance. Suppose, indeed, that the blouse tailor chooses the grace-period contract and decides to buy a sewing machine. Plausibly, the cash flow generated by the new production technology will be low immediately after the investment has been done, but will then reach a higher income level y^H, at time 2. This means that the borrower would not earn enough to pay back the repayment required by the rigid repayment schedule at time 1, if she wishes to undertake the long-term activity.

The lender knows that borrowers have different degrees of self-control, which are embedded in the β_i parameter, $i = \{B; G\}$. However, he cannot distinguish among good and bad types. As β_i is unknown to the lender, he can successfully screen borrowers' types only by designing an appropriate set of contracts.

2.3 The contracts

In this section, I present and analyse three contracts: first, the traditional, rigid microfinance contract; second, a "fully flexible" contract, where the grace-period is always provided to all borrowers. Last, I analyse a "mixed" contract where the grace-period is provided as a contract option.

2.3.1 First Best

If information upon borrowers' type was perfectly observable, both in terms of present-bias and entrepreneurial activities they wished to undertake, repayments in the flexible and the rigid repayment schedule would be chosen as to maximize the joint surplus of the borrowers and the lender. In particular, the lender would offer the flexible schedule to all good borrowers, as they are time-consistent. Conversely, he would offer the rigid repayment schedule to bad borrowers if they are very present-biased, while he would offer them the flexible repayment schedule if they are relatively time-consistent. Let's call β^* the value of β_B below (above) which bad borrowers will be offered the rigid (flexible) repayment schedule.

Let the lender's payoff be:

$$\begin{cases} \phi(\delta P^f - 1) + (1-\phi)[(1+\delta)P^r - 1] & \text{if } \beta_B < \beta^* \\ \delta P^f - 1 \quad \text{if } \beta_B \geq \beta^* \end{cases}$$

and the payoff of good and bad borrowers be, respectively:

$$\delta(y^H - P^f)$$

and:

$$\begin{cases} (y^L - P^r)(1+\beta_B\delta) & \text{if } \beta_B < \beta^* \\ \beta_B\delta(y^H - P^f) & \text{if } \beta_B \geq \beta^* \end{cases}$$

The first-best surplus can be written as:

$$S^* = \begin{cases} \phi\delta y^H + (1-\phi)(1+\beta\delta)y^L + \delta P^r(1-\phi)(1-\beta) - 1 & \text{if } \beta_B < \beta^* \\ \delta y^H(\phi + \beta(1-\phi)) + P^f(1-\phi)\delta(1-\beta) - 1 & \text{if } \beta_B \geq \beta^* \end{cases}$$

Note that when $\beta_B < \beta^* \Rightarrow \frac{dS}{dP^r} > 0$. This implies that the surplus is increasing in P^r. Therefore, the lender will set the highest possible value for P^r such that it maximizes his profit. Similarly, when $\beta_B \geq \beta^* \Rightarrow \frac{dS}{dP^f} > 0$, the lender will set the highest value of P^f that maximizes his profit.

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

I first analyse the standard case in which the lender only offers the traditional microfinance contract, which requires to repay P_1 at time 1 and P_2 at time 2. I assume that there is no strategic default: therefore borrowers will repay in every period if their participation constraint is satisfied. For ease of computation, $P_1 = P_2 = P^r$, where "r" stands for the rigid contract. In reality, these are computed using a declining balance interest rate. I first look at the borrowers' utility in this repayment schedule.

- If they opt for the "short-term" business activity, their utility will be:

$$U^t_{ST} = y^L - P^r + \beta_i\delta(y^L - P^r) + \beta\delta^2 V$$

- If they opt for the "long-term" business activity instead, their utility will be:

$$U^t_{LT} = -P^r + \beta_i\delta(y^H - P^r)$$

Note that, because borrowers fail to repay in period 1 if they opt for the long-term business activity in the rigid repayment contract, they will not receive any future credit from the lender. This is why the continuation value $\delta^2 V$ does not appear in the U^t_{LT} expression. I make the following assumption on $\delta^2 V$:

$$\delta^2 V \geq \delta(y^H - y^L) \tag{2}$$

Because $\delta(y^H - y^L) > y^L$ (for Condition (1)), assuming $\delta^2 V \geq \delta(y^H - y^L) \Rightarrow \delta^2 V > y^L$. That is, having a continued access to credit implies that the borrower will be able to invest in the future and receive at least y^L at time 3.

Since the Limited Liability Constraint applies, borrowers' utility will be zero instead of negative when they are not able to repay. This implies that U^t_{LT} can be written as:

$$U^t_{LT} = 0 + \beta\delta^2(y^H - P^r)$$

In the rigid contract, the lender requires regular repayments to be performed by borrowers. This implies that borrowers should opt for the short-term business activity, which also ensures future credit.

Therefore, the lender must set a repayment that satisfies the following Incentive Compatibility Constraint (borrowers will receive V at time 3 only for the short-term business activity, as they would miss a repayment in the first period if they undertake the long-term business activity):

$$y^L - P^r + \beta_i \delta(y^L - P^r) + \beta\delta^2 V \geq 0 + \beta\delta(y^H - P^r) \qquad \textbf{(ICC)}$$

For good borrowers, the maximum incentive-compatible repayment will be:

$$P^r \leq \delta^2 V - [\delta y^H - (1+\delta)y^L] = \overline{P^r_G}$$

For bad borrowers, instead, it will be:

$$P^r \leq \beta\delta^2 V - [\beta\delta y^H - (1+\delta)y^L] = \overline{P^r_B}$$

Both $\overline{P^r_B}$ and $\overline{P^r_G}$ must be ≥ 0. This is ensured by (2).

Let us now turn to the lender's problem. The rigid contract is defined both in terms of repayments and the probability to enter the contract. Specifically, let $(x_t; P^r)$ be a contract that offers repayment P^r and attracts borrowers with probability x_i, i=G, B. The lender sets this contract to maximize the following profit function:

$$\max_{P^r} \quad x_G \phi(P^r + \delta P^r - 1) + x_B(1-\phi)(P^r + \delta P^r - 1) \tag{3}$$

$$s.t.$$

$$P^r \leq y^L \qquad \textbf{(FCST)}$$

$$P^r \leq y^H \qquad \textbf{(FCLT)}$$

$$P^r \leq \frac{\beta\delta^2 V}{1+\beta\delta} + y^L \qquad \textbf{(PCSTB)}$$

$$P^r \leq \frac{\delta^2 V}{1+\delta} + y^L \qquad \textbf{(PCSTG)}$$

$$P^r \leq \overline{P^r_G} \qquad \textbf{(ICG)}$$

$$P^r \leq \overline{P^r_B} \qquad \textbf{(ICB)}$$

$$x_i = 1 \qquad \text{for all } i = G, B$$

The lender's profit can therefore be written as:[7]

$$\Pi^r = \begin{cases} (1+\delta)P^r - 1 & \text{if } P^r \leq \overline{P^r_B} \\ \phi[(1+\delta)P^r - 1] + (1-\phi)[(\delta P^r - 1] & \text{if } P^r \in (\overline{P^r_B}; \overline{P^r_G}] \\ \delta P^r - 1 & \text{if } P^r \in (\overline{P^r_G}; y^H] \\ 0 & \text{if } P^r > y^H \end{cases}$$

[7]see also in the Appendix.

In order to receive regular repayments in each period, the binding IC is: $P_r \leq \overline{P_B^r}$. Thus, the lender will set $P^r = y^L < \overline{P_B^r}$.[8] Therefore, the profit that satisfies the lender's constrained maximization problem is:

$$\Pi^r = (1+\delta)y^L - 1 \tag{4}$$

Results are summarised by the following propositions:

Proposition 1 *The traditional microfinance contract prevents clients from undertaking long-term business activities.*

Proposition 2 *Both good and bad borrowers will be able to repay in the rigid repayment contract, irrespectively of their degree of impatience.*

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

I now study the case where, by default, the grace-period is always provided. From now on, I refer to this contract as the "fully flexible" contract. In this contract, repayments only start in period 2. Call P^f the repayment the lender demands under the flexible repayment schedule. Borrowers' utility will be as follows:

- If they opt for the "short-term" business activity:

$$U^t_{ST} = y^L + \beta_i \delta (y^L - P^f) + \delta^2 V$$

- If they opt for the "long-term" business activity:

$$U^t_{LT} = 0 + \beta_i \delta (y^H - P^f) + \delta^2 V$$

Whether borrowers will opt for the short-term or the long-term business activity will depend on which condition satisfies the following Incentive Compatibility Constraint:

$$y^L + \beta_i \delta (y^L - P^f) + \beta \delta^2 V > 0 + \beta \delta (y^H - P^f) + \beta \delta^2 V \qquad \textbf{(ICC)}$$

Note that, for $\beta_i = 1$, the above ICC is never satisfied, $\forall\ P^f$, $\forall\ V$. This implies that good borrowers will always choose the long-term business activity. Bad borrowers, instead, will prefer the short-term business activity, $\forall\ P^f$, $\forall\ V$, as long as:

$$\beta_B < \tfrac{y^L}{\delta(y^H - y^L)} = \underline{\beta_B}^{f\,9}$$

[8] This condition holds because of (2).

[9] With thr parametrisation: $y^H = 30$; $y^L = 14$; $V = 17$; $\delta = 0.967 \Rightarrow \underline{\beta^f_B} = 0.905$. This is a plausible threshold for present-bias.

The lender maximizes the following profit function:

$$\max_{P^f} \quad x_G\phi(\delta P^f - 1) + x_B(1-\phi)(\delta P^f - 1) \tag{5}$$

$s.t.$

$$P^f \leq y^L + \frac{y^L}{\beta\delta} + \delta V \tag{PCST}$$

$$P^f \leq y^H + \delta V \tag{PCLT}$$

$$y^L + \beta_i \delta y^L + \beta\delta^2(y^L - P_f) > 0 + \beta_i \delta y^H + \beta\delta^2(y^H - P_f) \tag{ICC}$$

$$P^f \leq y^L \tag{FCST}$$

$$P^f \leq y^H \tag{FCLT}$$

$$w_i \geq 0 \tag{LL}$$

The solution to (5), as shown in the Appendix, depends on β_B. I thus distinguish between two cases:

Case 1:

If $\beta_B \geq \underline{\beta_B}^f$, it is optimal for the lender to set $P^f = y^H$. He will thus achieve a profit of:

$$\Pi^f = \delta y^H - 1$$

Case 2:

If $\beta_B < \underline{\beta_B}^f$, then the lender's profit will depend on ϕ, the share of good borrowers in the pool. In particular,

$$\Pi^f = \begin{cases} \phi(\delta y^H) - 1 & \text{if } \phi \geq \underline{\phi} \\ \delta y^L - 1 & \text{if } \phi < \underline{\phi} \end{cases}$$

Proposition 3 *If all borrowers are sufficiently time-consistent, a pooling equilibrium exists when the "fully-flexible" contract is offered, which maximizes the lender's profit. If, instead, a fraction* $1-\phi$ *of borrowers is present-biased, whether the lender ia able to achieve a higher profit through a separating or a pooling contract will depend on the share of good borrowers in the pool,* ϕ.

2.3.4 The lender offers a mixed contract, where the grace-period is provided as a contract option

Let $(x_i; P^j)$ be a mixed contract that includes two repayments P^j, $j = r; f$, with a rigid and a flexible repayment schedule, respectively, and which attracts borrowers with probability x_i, i=G, B. I first study whether a "separating" contract exists. The "separating" contract is a contract where bad borrowers stick to the rigid debt structure if they are very impatient, whereas good borrowers repay under the flexible schedule, being these two repayment schedules provided simultaneously by the lender. Borrowers' utility will be now different as it would depend on the two different repayments set by the lender. In particular:

- If they opt for the **"short-term" business activity** in the **rigid repayment contract**, their utility will be:

$$U^t_{ST} = y^L - P_r + \beta_i \delta(y^L - P_r) + \delta^2 V$$

- If they opt for the **"short-term" business activity** in the **flexible repayment contract**, their utility will be:

$$U^t_{ST} = y^L + \beta\delta(y^L - P_f) + \delta^2 V$$

- If they opt for the **"long-term" business activity** in the **rigid repayment contract**, their utility will be:

$$U^t_{LT} = -P_r + \beta_i \delta(y^H - P_r)$$

- If they opt for the **"long-term" business activity** in the **flexible repayment contract**, their utility will be:

$$U^t_{LT} = 0 + \beta_i \delta y^H + \delta^2 V$$

I first look at bad borrowers' behavior. I assume that bad borrowers have $\beta_B < \underline{\beta_B}^f$. From the previous analysis, these borrowers always prefer the short-term activity in the flexible repayment schedule, $\forall\ P_f$, V. At the same time, bad borrowers will opt for the short-term business activity in the rigid repayment schedule if $P^r \leq \beta\delta^2 V - [\beta\delta y^H - (1+\delta)y^L] = \overline{P^r_B}$. Thus, the lender needs to satisfy this condition when setting the repayment for the rigid contract. The ICC for bad borrowers with $\beta_B < \underline{\beta_B}^f$ becomes:

$$y^L - P^r + \beta_B \delta(y^L - P^r) \geq y^L + \beta_B \delta(y^L - P^f) \qquad \textbf{(ICB1)}$$

Suppose first that the two contracts were offered at the same price $P^r = P^f = P^0$. Borrowers would then face the following ICC:

$$y^L - P^0 + \beta_B \delta(y^L - P^0) \geq y^L + \beta_B \delta^2(y^L - P^0) \qquad \textbf{(ICB0)}$$

It is easy to see that the above **ICB0** is never satisfied. It follows:

Proposition 4 *When the price of the two repayment contract is equalised, borrowers will always opt for the flexible repayment schedule.*

Suppose the lender sets two different repayment schedules, P^r and P^f, as shown in **ICB1**. This inequality is satisfied for:

$$P^r \leq \tfrac{\beta_B \delta}{1+\beta_B \delta} P^f = \overline{\overline{P^r}}$$

Because $\frac{\beta_B \delta}{1+\beta_B \delta}$ is always < 1, this ensures that the maximum incentive compatible repayment in the rigid contract for bad borrowers must always be smaller than the repayment in the flexible repayment schedule, thus confirming Proposition 4.

Let us now turn to the case of bad borrowers with $\beta_B \geq \underline{\beta_B}^f$. These borrowers always prefer the long-term activity in the flexible repayment schedule, $\forall P^f$, V. At the same time, they will opt for the short-term business activity in the rigid repayment schedule if $P \leq \overline{P_B^r}$. Their ICC thus becomes:

$$\beta_B \delta(y^H - P^f) + \beta_B \delta^2 V \geq y^L - P^r + \beta_B \delta(y^L - P^r) + \beta_B \delta^2 V \qquad \textbf{(ICB2)}$$

The above inequality is satisfied for:

$$P^r \geq y^L - \tfrac{\beta\delta}{1+\beta\delta}(y^H - P^f) = \underline{P_B^r}$$

where $\underline{P_B^r}$ is the minimum incentive compatible repayment that satisfies bad borrowers' (with $\beta_B \geq \underline{\beta_B}^f$) incentive-compatibility constraint.

Let us consider good borrowers. From the previous analysis, these borrowers always prefer the long-term to the short-term business activity in the flexible repayment schedule, $\forall\ P^f$. On the contrary, they will prefer the short-term business activity to the long-term business activity in the rigid repayment schedule $\iff$ $P^r \leq \overline{P_G^r}$. At the same time, $\overline{P_G^r} \geq \overline{P_B^r}$. Assuming that the lender will set $P^r \leq \overline{P_B^r}$, this ensures that good borrowers will always opt for the short-term business activity in the rigid repayment schedule. Therefore, good borrowers will prefer the flexible schedule to the rigid schedule as long as:

$$\delta^2(y^H - P^f) + \delta^2 V \geq (y^L - P^r) + \delta(y^L - P^r) + \delta^2 V \qquad \textbf{(ICG)}$$

This is satisfied for:

$$P^r \geq y^L - \tfrac{\delta}{1+\delta}(y^H - P^f) = \underline{P_G^r}$$

where $\underline{P_G^r}$ is the minimum incentive compatible repayment that satisfies good borrowers' incentive-compatibility constraint.

The lender maximizes the following profit function:

$$\max_{P^r, P^f} \quad x_G\phi(\delta^2 P_f - 1) + x_B(1-\phi)((1+\delta+\delta^2)P_r - 1) \tag{6}$$

$$s.t.$$

$$P^r \leq \beta\delta^2 V - [\beta\delta y^H - (1+\delta)y^L] = \overline{P^r_B} \tag{PC}$$

$$P^r \leq \frac{\beta_B\delta}{1+\beta_B\delta}P^f = \overline{\overline{P^r}} \tag{ICB1}$$

$$P^r \geq y^L - \frac{\beta\delta}{1+\beta\delta}(y^H - P^f) = \underline{P^r_B} \tag{ICB2}$$

$$P^r \geq y^L - \frac{\delta}{1+\delta}(y^H - P^f) = \underline{P^r_G} \tag{ICG}$$

$$P_r \leq y^L \tag{FCST}$$

$$P_f \leq y^H \tag{FCLT}$$

$$w_i \geq 0 \tag{LL}$$

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

As shown in the Appendix, if ICG is the binding incentive-compatibility constraint, the lender's profit will be as follows:

$$\Pi^0_{mixed} = \begin{cases} \phi\delta y^H - 1 & \text{if } \beta_B < \underline{\beta^f_B} \\ \delta y^L - 1 & \text{if } \beta_B \geq \underline{\beta^f_B} \end{cases}$$

Not surprisingly, Π^0_{mixed} equals the lender's profit in the "fully flexible" contract: if all borrowers are sufficiently time consistent, the lender would get a higher profit than in the rigid contract. Instead, if there's a sufficient share of bad, impatient borrowers in the pool, he would be better off by offering the rigid contract instead of this mixed contract.

If the lender wants to keep the repayment in the flexible schedule at $P^f = y^H$, the only way to attract bad borrowers with $\beta_B < \underline{\beta_B}^f$ in the rigid repayment schedule is to set $P^r = \frac{\beta_B\delta}{1+\beta_B\delta}y^H$. In this case, P^r will be computed based on the assumption the lender makes about how present-biased bad borrowers with $\beta_B < \underline{\beta_B}^f$ might be. In doing so, he faces a trade-off, as $\frac{dP^r}{d\beta} > 0$. Assume the lender thinks that a certain value of β_B, $\hat{\beta}_B$, could be a good proxy for the true value of β_B, with $\hat{\beta}_B < \underline{\beta_B}^f$.

Therefore, the repayment for the rigid repayment schedule will be:

$$P^r = \frac{\hat{\beta}_B\delta}{1+\hat{\beta}_B\delta}y^H = \hat{P}^r$$

with $\hat{P}^r < \overline{\overline{P^r}}$. However, in doing so, neither ICG or ICB2 will be satisfied. This implies that also all good borrowers and bad borrowers with $\beta_B \geq \underline{\beta_B}^f$ will opt for the rigid repayment schedule. As a consequence, the lender will achieve a lower profit than with the rigid repayment contract.

Another potential strategy is for the lender to set $P^r = y^L$ and then set P^f in order to satisfy both bad and good borrower's ICC. If the repayment for the rigid schedule is set at y^L, the following relationship must be satisfied:

$$y^L \leq \frac{\beta_B \delta}{1+\beta_B \delta} P^f = \overline{\overline{P^r}}$$

that is,

$$P^f \geq \frac{1+\beta_B \delta}{\beta_B \delta} y^L = \underline{P^f}.$$

Note that, because of (1), $\underline{P^f} < y^H$ for $\beta_B \geq \underline{\beta_B}^f$. However, $\frac{dP^f}{d\beta} < 0$. The lender's payoff in the flexible repayment schedule is a decreasing function of borrower's time inconsistency. Let's assume that $\hat{\hat{\beta}}_B$ is the average present-bias for bad borrowers with $\beta_B \geq \underline{\beta_B}^f$, i.e. $\hat{\hat{\beta}}_B \in [\underline{\beta_B}^f; 1]$. The lender will thus set the price for the flexible schedule as:

$$P^f \in [\frac{1+\delta}{\delta} y^L; y^H).$$

In this case, the lender will end up with a profit of:

$$\Pi^*_{mixed} = \begin{cases} \phi\delta \frac{1+\delta\hat{\hat{\beta}}_B}{\delta\hat{\hat{\beta}}_B} y^L + (1-\phi)(1+\delta)y^L - 1 & \text{if } \beta_B < \underline{\beta_B^f} \\ \delta \frac{1+\delta\hat{\hat{\beta}}_B}{\delta\hat{\hat{\beta}}_B} y^L - 1 & \text{if } \beta_B \geq \underline{\beta_B^f} \end{cases}$$

2.4 Contracts comparison

I now compare the three contracts analysed in the previous paragraphs to study differences in the lender's profit. To this end, Figure 1 below shows a comparison between the profit the lender achieves in the rigid contract and the mixed contract (Π^*_{mixed}), the latter computed for β_B either below or above $\underline{\beta_B^f}$.[10] In particular, it shows how the lender's profit varies for different values of ϕ. When $\phi = 0$, the profit the lender achieves in the rigid contract equals the profit in the mixed contract (Π^*_{mixed}) when bad borrowers have $\beta_B < \underline{\beta_B^f}$. If, instead, $\beta_B \geq \underline{\beta_B^f}$, this contract always dominates both the mixed contract with impatient bad borrowers and the rigid contract, up to a point ($\phi = 1$) where the mixed contract takes a unique value, irrespectively of β_B.

Figure 2 shows how the lender's profit varies across the rigid, the fully flexible and the mixed contract.[11] On the y axis, different levels of β_B are reported. The "jump" for both the fully flexible and the mixed contract occurs in correspondence of $\underline{\beta_B^f}$. For $\beta_B < \underline{\beta_B^f}$, the mixed contract dominates any other contract. Conversely, when $\beta_B \geq \underline{\beta_B^f}$, the fully flexible contract leads to the highest profit for the lender.

[10] We use the following parametrisation: $y^H = 30$; $y^L = 14$; $V = 17$; $\delta = 0.967$ and $\underline{\beta_B^f} = 0.905$.

[11] We use the following parametrisation: $y^H = 30$; $y^L = 14$; $V = 17$; $\delta = 0.967$, $\phi = 0.6$ and $\underline{\beta_B^f} = 0.905$.

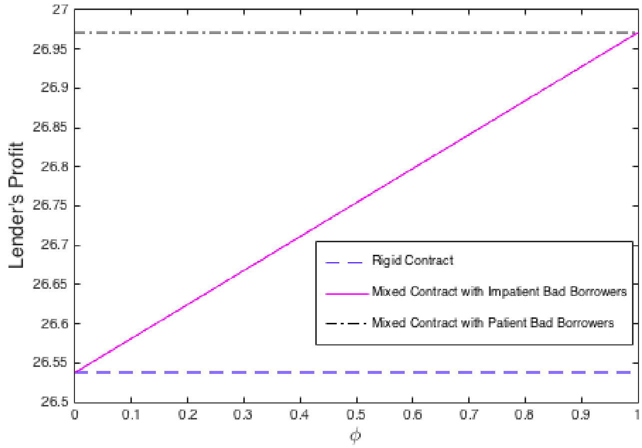

Figure 1: Mixed contract *versus* rigid contract

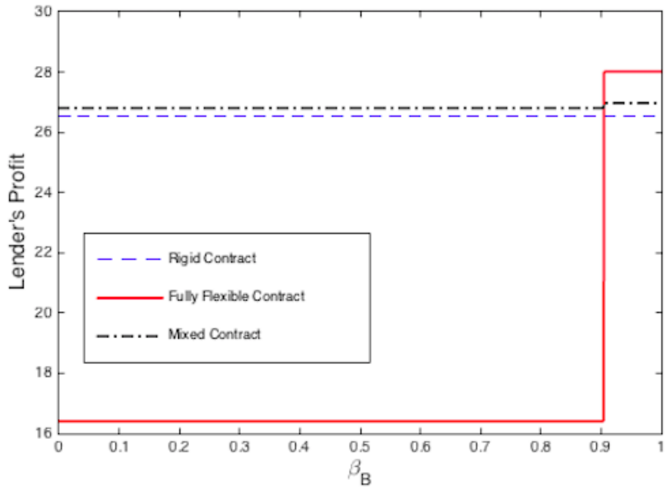

Figure 2: Contracts comparison

Finally, based on the model predictions, I study how lender's profit changes for different prices of the flexible schedule. Figure 3 shows that, when borrowers have $\beta_B < \underline{\beta_B^f}$, the lender can set the rigid repayment schedule to an arbitrary value $y^L = \overline{y^L}$ and, for $P^f \in [\frac{1+\delta}{\delta}\overline{y^L}; y^H)$, he will be able to achieve a separating equilibrium that dominates any other contract. Note that, for $P^f > y^H$, all borrowers including the good ones will opt for the rigid repayment schedule, which is represented by a flat line, as the lender's profit won't depend on the price of the flexible schedule. Figure 3 also shows that for $P^f \leq y^L$ all borrowers opt for the flexible repayment schedule and are able to repay, because the required repayment is lower than their expected return. This will generate however a limited profit for the lender. For $P^f \in (\overline{y^L}; \frac{1+\delta}{\delta}\overline{y^L})$, all borrowers will still opt for the flexible schedule. However bad borrowers with $\beta_B < \underline{\beta_B^f}$ will default this time and the lender will be able to recover the loss from these borrowers only by further increasing the price of the flexible schedule.

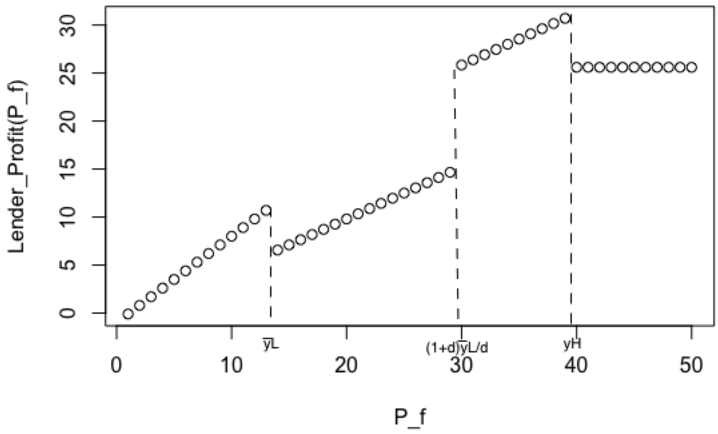

Figure 3: Lender's profit as a function of P_f, when $\beta_B < \underline{\beta_B^f}$ and $P_f = \overline{y^L}$

Figure 4 shows the lender's profit when bad borrowers' present-bias is very mild ($\beta_B \geq \underline{\beta_B^f}$). In this case, the profit is a continuous function, increasing in P^f until it takes the value of y^H. All borrowers in this case will always opt for the flexible schedule and never default. This condition does not hold anymore when $P^f > y^H$: in this case, borrowers' participation constraint will not be satisfied and they will all opt for the rigid repayment schedule.

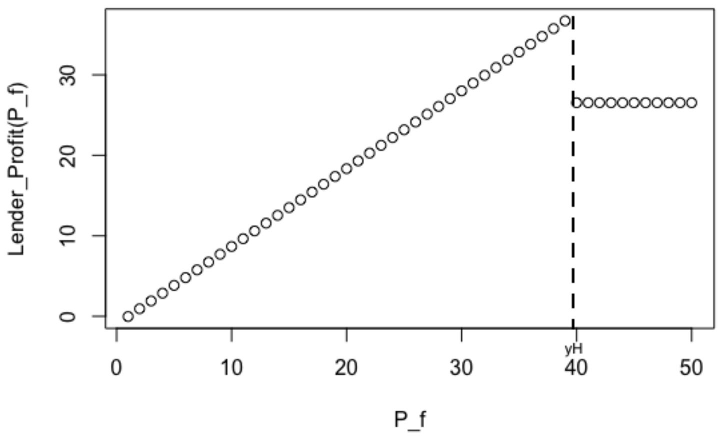

Figure 4: Lender's profit as a function of P_f, when $\beta_B \geq \underline{\beta_B^f}$ and $P_f = \overline{y^L}$

Theoretical results shown in Figure 3 and 4 move from the assumption that borrowers are fully rational and that they will take-up the flexible repayment schedule when both their Incentive Compatibility and Participation Constraint are satisfied. In reality, this might not be the case as these individuals may opt for the rigid repayment schedule over the flexible schedule for a number of reasons that we have not modelised, like lack of trust towards the lender and the new products, a sudden shock, or simply the inability to understand the inherent advantages of the flexible repayment schedule. Thus, the average probability that microfinance customers take-up the flexible repayment schedule can be described in a more generalised form as follows:

$$p(take\,up\,flexible) = \begin{cases} (0;1] & \text{if } P^f < \frac{1+\delta}{\delta} y^L \wedge \forall \beta_B \\ 0 & \text{if } P^f > \frac{1+\delta}{\delta} y^L \wedge \beta_B < \underline{\beta_B^f} \\ (0;1] & \text{if } P^f \in (\frac{1+\delta}{\delta} y^L; y^H] \wedge \beta_B \geq \underline{\beta_B^f} \\ 0 & \text{if } P^f > y^H \wedge \forall \beta_B \end{cases}$$

All in all, the theoretical model allows me to formulate three testable predictions:

Prediction 1: *As the difference in price between the flexible and the rigid contract widens, borrowers are more likely to opt for the rigid repayment schedule, irrespectively of their present-bias.*

Prediction 2: *As the price of the flexible contract increases, present-biased borrowers are more likely to opt for the rigid repayment schedule than non present-biased borrowers.*

Prediction 3: *Borrowers displaying a lower degree of entrepreneurship are more likely to prefer the rigid repayment schedule than entrepreneurial borrowers, as the price of the flexible contract increases.*

3 Lab-in-the-field experiments

In this section, I provide an empirical test of the model set up in section 2, via a series of lab-in-the-field experiments conducted in October 2015 with a sample of 150 randomly selected microentrepreneurs living and working in Kolkata, India. The scope of these games was to estimate differences in the take-up rates of the flexible repayment contract among borrowers, based on their individual characteristics and on the price of the flexible schedule. Thus, an additional questionnaire was used to gather information on subjects' socio-economic characteristics.[12] Sections of the survey instrument included household composition, details on business activities, as well as aspirations and entrepreneurship.

All subjects involved in the games were microfinance customers at the time of the experiment and had successfully repaid a few loans as group-lending borrowers. This made them eligible for individual loans, which are specifically targeted for business purposes.[13] However, they were not individual-lending

[12] A copy of the questionnaire is available upon request.

[13] Most MFIs, particularly in India, have now started offering individual loans. However, in order to "screen" among borrowers, they require their customers to first borrow in group lending schemes. Conditional upon a successful repayment behavior in group loans, these borrowers are then "upgraded" to individual loans, which normally are more expensive, have larger loan size, and are specifically targeted for business purposes.

borrowers, yet. This made this sample of borrowers particularly suitable for my experiment, for at least two reasons: first, subjects were entrepreneurs with business growth potential and, as such, had borrowing needs to invest in riskier projects. Second, these individuals had never taken individual loans before, nor benefited from repayment flexibility. Therefore, their preferences for repayment flexibility are solely driven by their type, and not by any learning from previous flexible loans.

3.1 Willingness-To-Pay, Risk Aversion and Time Lotteries

The main lab-in-the-field game I implement is a Willingness-To-Pay lottery. In this game, respondents faced a set of 15 hypothetical choices. In each choice, they had to decide between a flexible and a rigid microfinance contract. The price of the rigid contract was always set at an interest rate of 28%,[14] while the flexible repayment contract was offered at different interest rates, ranging from 26% (i.e. below the price of the rigid contract), to 40% (well above the price of the rigid contract). By letting the price of the flexible repayment schedule exogenously vary, I can observe borrowers' preferences for repayment flexibility either when the price of the flexible schedule is lower or equal than the rigid contract, or when the price of the flexible contract is larger than the rigid contract. This mirrors a pooling and a separating contract, respectively. If any differences in take-up rates between the two different contracts are detected, I can then link borrowers' types to their take-up decisions and study whether the separating contract is more effective at screening out bad borrowers than the pooling contract.

It must be noticed that the WTP lottery I use is based on respondents' stated preferences. As other choice experiments, the most straightforward limitation of this approach is that while subjects state their preferences (in this case, over repayment flexibility), these may differ from what they would do if they were *actually* offered a flexible contract. This is why, in principle, it would be preferred to gather subjects' stated preferences along with their revealed preferences (see for instance Mobarak et al., 2012 who study the determinants of efficient cookstoves take-up rates). However, it is not always feasible, particularly for costs and logistics, to test respondents' behavior over a certain product or service. In my context, it would have required a Microfinance Institution to offer the same flexible financial contract at very different interest rates, an almost impossible experiment to implement. This is why I use a set of framed-field experiments (Harrison and List, 2004; Levitt and List, 2007), which allow me to overcome the above-mentioned problems. The subjects in my experiment are real microfinance borrowers who carry out entrepreneurial activities and might be potentially interested in the flexible repayment schedule. Most importantly, they have never been offered such a product, which implies their stated preferences are not influenced by any past experience.[15]

I measured borrowers' attitude towards risk with a standard Multiple Price List (MPL), used for instance by Cassar et al. (2016). This game consisted of a set of six choices between two lotteries. The

[14]This is the interest rate on standard individual lending charged by most Indian MFIs.

[15]Additionally, I currently running a Randomized Controlled Trial where I am testing real take-up rates for a flexible contract that has become a product offered by the partner MFI (at a unique price).

first lottery, Option A, was a risky gamble that involved tossing a coin: if the coin landed on heads, the subject won Rs. 300; if it landed on tails, the subject won Rs. 0. The second lottery, Option B, consisted of receiving a guaranteed amount of cash. This amount ranged from Rs. 30 (in the first choice) to Rs. 230 (in the last choice). Intuitevely, a subject who is very risk-averse will either opt for Option B from the first choice or will switch from Option B at an earlier stage than risk-loving individuals. Conversely, risk-loving subjects will prefer Option A to Option B to a higher extent, up to an extreme case where they will always prefer the gamble to the safe option. Based on subjects' "switching point" between the risky and the safe lottery, I was able to compute individual risk aversion intervals.[16]

In addition, I included two lotteries to assess subjects' intertemporal preferences. In the first one, the respondent had to choose between a Rs. 200 sum to be paid the day after the interview and an equal or larger sum (Rs. 200, 240, 260, 280, 300) to be paid one month later. The second lottery "shifted" the time horizon of the first lottery by three months. Combining the two lotteries not only allows one to estimate subjects' discount rate, but also to detect any time inconsistency. If a subject preferred Rs. 260 one month later to Rs. 200 paid tomorrow, she should have also preferred Rs. 260 paid four months in the future to Rs. 200 paid three months in the future. This behavior is defined as "time consistent". Still, preference "reversals" may emerge. For example, when a subject prefers Rs. 260 one month later to Rs. 200 paid tomorrow, but the choice is reverted for the later rewards, the subject is said to display hyperbolic discounting as shown by Mahajan and Tarozzi (2011). Conversely, when a subject prefers Rs. 260 one month later to Rs. 200 paid tomorrow, but this choice is reverted for the earlier rewards, the subject is showing anti-hyperbolic discounting. Although less documented in the behavioral economics literature, anti-hyperbolic discounting has been reported in a number of contexts (see Read et al., 2013).

3.2 Data and Descriptive Statistics

Table 1 displays descriptive statistics for the main socio-demographic variables elicited through the survey instrument. Panel A of Table 1 shows that 93% of the sample consists of women, aged on average 38 years old and predominantly married. One of the eligibility criteria to take part to the study was to have at least one oustanding debt at a local MFI: the average number of loans in the sample is 1.17, with average loan size 24,633 Indian Rupees (which correspond to about 370$). Finally, the average monthly sales from subjects' business activity is about 29,139 Indian Rupees (about 436$). This variable will be used as a proxy for entrepreneurship in the main analysis. Panel B of table 1 displays descriptive statistics for the main individual characteristics elicited through the lab-in-the-field experiments. From the WTP lottery, I find that the share of subjects that are willing to take-up the flexible contract, at least once, is 47%. Also, results from the risk aversion lottery reveal that subjects are relatively risk averse, with an average level of risk-aversion equal to 4. I also measured subjects' level of financial literacy by means of

[16] Although there were only six choices, I denoted as "7" the behavior of those individuals who never switched from the risky to the safe lottery but opted for the gamble in all six decisions.

three questions that assessed their ability to distinguish between a more expensive and a less expensive loan. I then created an index of their level of financial literacy. This ranged from 0 to 3, depending on the number of correct answers subjects provided.[17] The median number of correct answers is 2, suggesting that subjects had a good level of financial literacy. In terms of occupation, all subjects involved in the experiments were self-employed.[18] The main business activities they were engaged in is shopkeeping and sale of electronic items, clothes and food (22.67%). Another 21% were tailors and small garment manufacturers, while 7.33% held a petty shop. Finally, another 7.33% and 5.33% were contractors and artisans, respectively.

Table 1: Descriptive Statistics

Panel A			
Variable	mean	median	sd
gender	0.07	0	0.25
age	38.05	38	8.77
marital status	0.95	1	0.21
income	214,460	120,000	287,592
household size	3.79	4	1.20
n. loans	1.17	1	0.37
average loan size	24633.33	20000	20047.4
monthly sales	29,138.93	12,500	56,823.07
Panel B			
Variable	mean	median	sd
take-up rate	0.47	0	0.50
risk tolerance	4.1	4	1.76
time consistent	0.69	1	0.46
financially literate	1.75	2	0.73
Number of subjects		150	

Panel B of Table 1 shows that 69% of the subjects involved in the experiments do not display time preference reversals and are, therefore, time-consistent. At the same time, somewhat surprisingly, I do not detect any evidence of present-bias. Conversely, all time-inconsistent subjects I identify display a "anti-hyperbolic" behavior: that is, they prefer the larger reward at t+s instead of t and, when the time horizon is shifted, they prefer the earlier reward. This form of time inconsistency is less discussed in the literature. Yet, a few studies confirm that this behavior can be detected among low-income populations (see for instance the study of Read et al., 2013 in Pakistan). Although the theoretical model presented earlier makes predictions about the behavior of present-biased versus time-consistent borrowers, it can still be extended including future-biased borrowers. Future-biased borrowers' β is greater than 1. As such, we can think of these borrowers as customers that would benefit from the flexible schedule to an even greater extent than time-consistent borrowers, as they are not affected by self-control problems

[17]The maximum number of correct answers subjects could provide was indeed three.
[18]Results are not shown in Table 1.

in the present time. It follows, from a theoretical perspective, that the maximum incentive-compatible interest rate for future-biased borrowers is larger than for time-consistent borrowers. In line with this hypothesis, I should observe that future-biased borrowers are willing to take-up the flexible repayment schedule also at higher prices, compard to time-consistent borrowers. Thus, a slightly modified version of Prediction 2 can be formulated:[19]

Prediction 2b: *As the difference in price between the flexible and the rigid contract widens, the willingness to take-up the flexible contract increases as borrowers' β increases.*

4 Results

4.1 Demand for repayment flexibility

In this section I analyze graphically the results from the WTP lottery. Figure 5 shows the share of respondents that are willing to take-up the flexible repayment contract at a given price (displayed in brackets under each bin), provided that the standard, rigid contract is offered at a fixed price ($\overline{y^L} =$ 28%).

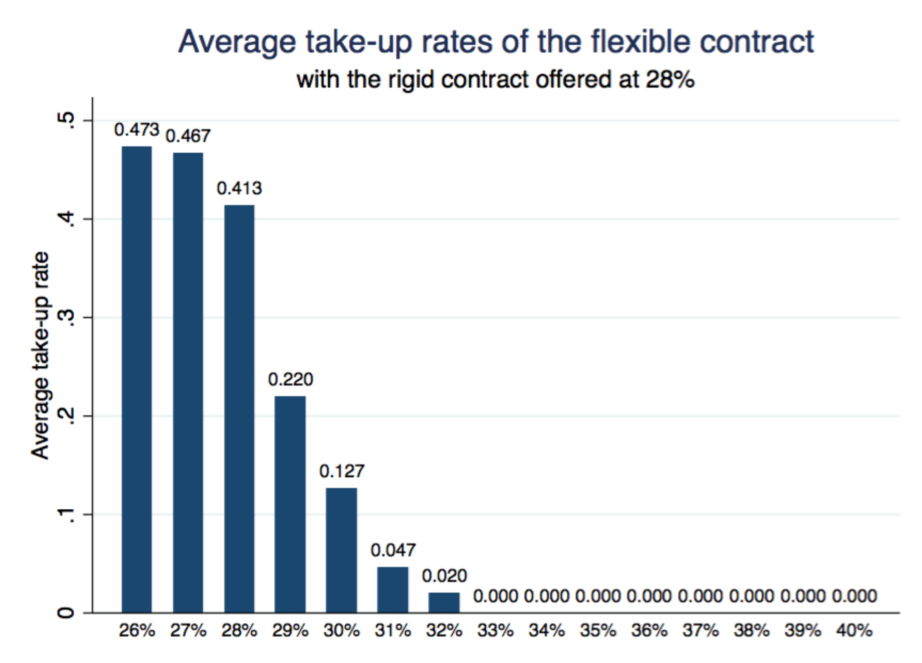

Figure 5: Take-up rate of the flexible repayment schedule

As expected, the demand for repayment flexibility is decreasing in the price of the flexible contract.

[19]Note that both time-consistent and future-biased borrowers are "good" borrowers. This because neither of them would heavily discount their future utility. Therefore, in an ideal separating contract, the lender might want to keep both of them in the flexible repayment schedule.

In particular, Figure 5 shows that when the price of the flexible contract increases from 26% to 27%, the average take-up rate of the flexible schedule decreases by less than 1%, moving from 47.53% to 46.67%. When the price goes from 27% to 28%, the average take-up rate decreases by more than 5% (from 46.67% to 41.33%). Instead, when the flexible contract becomes more expensive than the rigid contract (i.e. when the separating contract is offered), with its price rising from 28% to 29%, the average take-up rate drops by more than 20%. Finally, the average take-up rate decreases at a slower pace for interest rates higher than 29%, until it becomes zero if the flexible schedule is offered at any interest rate larger than 32%.

Based on the model's predictions, all borrowers should have preferred the flexible repayment schedule to the rigid repayment schedule for at least any value of $P^f \leq \overline{y^L}$ (which in the experiment is set at 28%). For values of P^f in this interval, all borrowers would also be able to repay. This nicely maps into the results of Figure 5, which shows a larger share of borrowers taking-up the flexible schedule in the pooling than in the separating contract. The model also predicts that for values of $P^f \in (\overline{y^L}; \frac{1+\delta}{\delta}\overline{y^L}]$, subjects would still opt for the flexible contract, but bad borrowers would default. The large drop in take-up rates for $P^f > \overline{y^L}$ may then reflect the behavior of sophisticated (bad) borrowers who anticipate their potential default, and therefore do not choose the flexible schedule when this becomes too expensive, as they do not want to lose access to future credit.

Figure 5 also reveals that less than half of the subjects opted for the flexible contract at least once. In fact, even when the flexible contract was offered at 26% interest rate *versus* 28% of the rigid contract, the take-up rate was 47% (71 subjects). In the previous section, I already argued that the compliance to the flexible schedule might not be perfect. There could be several explanations driving these results. First, these subjects were (hypothetically) offered repayment flexibility for the first time. Therefore, they might have underestimated (or been completely unaware of) the benefits of repayment flexibility. Second, they might have been too risk-averse to opt for the flexible contract. Third, they might have faced other psychological constraints that prevented them from taking the flexible repayment schedule. All in all, one must observe that these subjects did not value repayment flexibility as much as expected.

Finally, no borrowers preferred the flexible contract if it was offered at an interest rate of 33% or above. This interest rate thus represents the y^H threshold derived from the model. This result is particularly important as one of the objectives of this experiment was to provide guidance to microfinance institutions about what is the optimal interest rate to charge for flexible contracts.

All in all, despite elicited take-up rates were far from being perfect, the experimental results are consistent with the model, and support **Prediction 1**: not only there is a clear inverse relationship between the price of the flexible contract and take-up rates, but as the price of the flexible schedule becomes more expensive, take-up rates sharply drop.

4.2 Empirical Strategy

This section tests the model predictions more formally. The theory developed in the first part of the paper hypothesizes that as the price of the flexible contract increases, take-up rates will decrease (**Prediction 1**). Moreover, subjects' individual characteristics should predict take-up rates. In particular, as the difference in price between the flexible and the rigid product widens, mirroring the separating contract where the flexible schedule is more expensive, good borrowers should be more likely to take-up the flexible contract, while bad borrowers should prefer the rigid repayment schedule. In terms of time preferences, this means that take-up rates should be positively related with borrowers' β (**Prediction 2b**). Moreover, more entrepreneurial borrowers should opt for the flexible repayment schedule, even when this contract is significantly more expensive than the rigid one (**Prediction 3**).

I first test **Prediction 1** more formally. In order to study the sensitivity of the demand for repayment flexibility to different price of the flexible contract, I estimate the following regression equation where the unit of observation is entrepreneur i's decision in choice j:

$$take\ up_{i,j} = \alpha_0 + \sum_{j=1}^{J} \alpha_j choice_j + \epsilon_{ij} \tag{7}$$

where $choice_j$, with j=1,...,15, is a set of 15 dummies corresponding to the 15 experimental choices each subject i exogenously faced in the WTP lottery. In each choice, subjects were asked to decide whether they preferred a rigid contract at 28% or a flexible contract whose price ranged from 26% (j = 1) to 40% (j = 15). Therefore, the dependent variable $take\ up_{i,j}$ is a dummy that equals one if the respondent prefers the flexible contract or 0 if she prefers the rigid contract, at choice j. Since I observe each borrower's willingness to take-up the flexible schedule across 15 choices, my final dataset contains 2250 subject-choice observations. However, as also shown in Figure 5, none of the subjects took up the flexible contract when the interest rate was larger than 32% (and even when the interest rate of the flexible contract is 32%, take-up is 2%). Because of the lack of variability in the outcome of interest, I drop all the observations for which j is larger than or equal to 7. I therefore end up with 900 observations.

In order to confirm **Prediction 1**, α_j should be negative, and with magnitude increasing in j. Results from (7) are shown in table 2 in the Appendix. The dependent variable in both column (1) and column (2) is the subject's stated willigness to take-up the flexible contract. The omitted variable for $choice_j$ is a dummy that equals one when the flexible contract is offered at 26% (j = 1), so the coefficients of all the other dummies must be interpreted in relation to this omitted term. In line with Figure 5, results from Table 2 show that take-up rates are decreasing in the price of the flexible schedule. However, compared to when the flexible schedule is offered at 26%, there are no significant differences in take-up rates when the flexible product is offered either at 27% of 28% (j = 2 or j = 3). That is, as long as a pooling contract is offered, no sharp differences in the share of borrowers taking-up the flexible contract are observed. Conversely, when the flexible repayment contract is offered at a more expensive rate than the rigid contract ($j \geq 4$), i.e., when the lender offers a separating contract, take-up rates significantly drop, with a negative coefficient of $choice_j$ that increases in magnitude as the price of the flexible schedule increases. Results from column (1) of table 2 thus confirm **Prediction 1**, showing that as the gap in price between the two contracts widens, lesser and less people are willing to opt for the flexible schedule. Column (2) adds borrowers' characteristics as covariates. I include subjects' degree of risk aversion (with a dummy that takes the value of 1 if subjects' switch from the risky to the safe lottery either in the fourth or in earlier decisions, and zero otherwise); time preferences (expressed as a dummy that equals to one if the subject is time consistent); subjects' degree of financial literacy. I also add (the log of) monthly sales from borrowers' business activity, which I use as a proxy for entrepreneurship. Finally, I control for subjects' age and gender. Results in column (2) show that neither risk aversion nor time consistency predict take-up rates. However, subjects who report higher business sales are more likely to take-up the flexible contract than subjects who report lower business sales, all else equal. Thus, repayment flexibility seems to attract more entrepreneurial borrowers. On the contrary, financial literacy negatively influences take-up rates. A potential explanation for this result is that the way subjects are classified into more or less financial literate specifically focused on their ability to recognise which option was more expensive between different loans. It is therefore possible that more financial literate individuals overall value the flexible repayment schedule as more expensive (which is by the way correct), and therefore are less likely to take-up this product. Finally, women are less likely to opt for the flexible contract (possibly because they are more risk-averse), as well as older people. A potential explanation for this latter result is that older people are more used to the rigid repayment schedule as they are more experienced customers. As such, they are more reluctant to adopt the novel repayment scheme represented by the flexible schedule. All in all, results from column (2) of Table 2 support **Prediction 3**, by showing that more entrepreneurial borrowers are, on average, more likely to take-up the flexible contract. However, no evidence of the impact of time inconsistency on take-up rates is detected, as **Prediction 2b** would instead suggest.

The findings from Table 2 suggest that as the difference in price between the flexible and the rigid schedule increase, less people are likely to take-up the flexible contract. This implies that some sort of "screening mechanism" is in place. However, the analysis has not yet shown which borrowers are more likely to prefer the rigid and the flexible contract, respectively, as the price gap between the two schedules widens. This is a crucial aspect of this paper, as I argue that the separating contract makes a better job at screening out bad borrowers from the flexible repayment schedule. Therefore, in what follows, I look more in detail at how borrowers' characteristics predict take-up rates of the flexible repayment schedule, at different interest rates. In doing so, I interact the set of dummies $choice_j$ with borrowers' characteristics (risk aversion, time consistency, entrepreneurship, financial literacy). The main objective of this analysis is to study whether, by charging different prices for the rigid and flexible contract, the lender is able to attract good borrowers into the flexible schedule, and to retain bad ones under the rigid repayment schedule. I thus estimate the following regression equation:

$$take\,up_{i,j} = \gamma_0 + X_i + \sum_{j=1}^{J} \gamma_j choice_j + \sum_{j=1}^{J} \theta_j X_i \times choice_j + \epsilon_{ij} \tag{8}$$

where X_i is a vector of borrowers' characteristics. I observe each borrower i's willingness to take-up the flexible schedule across 15 choices j they had to make, where the price of the flexible schedule ranges from 26% to 40% and the price of the rigid contract is fixed at 28%. Similar to the previous analysis, I drop all observations corresponding to choices larger or equal than 7, as no borrowers chose the flexible contract if this was offered at an interest higher than 32%. Thus, I end up with 900 observations out of the initial 2250 observations. My main coefficient of interest in (8) is θ_j. The coefficient of the interaction term allows me to study whether, as the lender offers a separating contract where the flexible product is offered at a more expensive rate, bad borrowers are more likely to opt for the rigid contract while good borrowers stick to the flexible repayment schedule. This allows me to test **Prediction 2b** and **Prediction 3** directly, by looking at whether time consistency and entrepreneurship predict take-up rates differently, as the price of the flexible contract increases. Logit estimates of (8) are shown in table 3 in the Appendix. I first look at borrowers' risk-aversion. Risk-averse borrowers are not per se "bad" borrowers. Yet, their type suggests that they might be more likely to invest in "low-risk/low-return" investment opportunities, for which the flexible repayment schedule might not be suitable. Thus, when a separating contract is offered, they should be less likely to take-up the flexible contract. We thus expect θ_j to be negative and significant, for $j \geq 4$. In line with this hypothesis, the coefficient of the interaction term $risk\,averse \times choice_j$, reported in Column (2), is indeed negative when the borrower is offered the flexible schedule at an interest rater larger than or equal to 29%. In particular, when a separating contract is offered, with the flexible contract priced at 30%, risk-averse borrowers are significantly more likely to take-up the rigid contract than the flexible contract. This suggests that the separating contract succeeds in retaining more risk-loving borrowers under the flexible option, as they would benefit from a grace-period to a larger extent.

I then look at the behavior of borrowers based on their time preferences. Results are shown in Column (3). The coefficient of $time\,consistent \times choice_j$ is negative for $j \geq 4$, but never significant. Recall that the theoretical analysis had showed that the separating contract should refrain neither time-consistent nor future-biased borrowers from choosing the flexible contract. Therefore, the non-significance of the coefficient of θ in column (3) is encouraging, as it implies that the separating contract is not more likely to screen out either types.

Column (4) of Table 3 looks at whether the there is a differential impact of financial literacy on take-up rates. The coefficient of $financial\,literate \times choice_j$ is negative for $j \geq 4$ but not significant. This suggests that subjects' financial literacy does not play a role in determining take-up rates when a separating contract is offered by the MFI.

Finally, I look at whether business performance (measured as log of monthly sales) predicts the take-up rate of the flexible contract, particularly in the separating contract. This is shown in Column (5). The coefficient of $log(sales) \times choice_j$ is positive, and significant when the flexible contract is offered at 31%. This suggests that the separating contract successfully attracts more entrepreneurial borrowers into the flexible schedule. This result thus confirms **Prediction 3**: as the difference between the price of the flexible and the rigid repayment schedule increases, more entrepreneurial borrowers are more likely to take-up the flexible contract than less entrepreneurial ones.

All in all, results from the empirical analysis confirm that when the lender offers a separating contract, it succeeds in screening out less entrepreneurial and more risk-averse types, who are instead more likely to take-up the rigid contract than the flexible one. At the same time, the separating contract does not attract time-consistent and future-biased borrowers to a different extent. This can be seen as a further proof that the separating contract is effective, as both types of borrowers would benefit from repayment flexibility (and would also be able to repay, as the model has shown).

5 Estimating the lender's profit

From a policy perspective, this analysis ultimately aims at providing lenders with guidance about what is the most appropriate repayment schedule to offer their customers. Both the theory and the experiments have shown that a contract where the flexible repayment schedule is offered at a higher price than the rigid one successfully separates good borrowers and bad borrowers into the flexible and rigid schedule, respectively. Borrowers' quality can of course measured in many ways: risk-aversion, time preferences, financial literacy and business performance are only some of many indicators lenders can use to predict borrowers' preference for repayment flexibility. These individual characteristics can in turn be used to estimate repayment rates in each repayment scheme. In this section, I use experimental data to make back-of-the-envelope calculations of the lender's profit in the rigid and the the mixed contract. For each price at which the lender can potentially offer the flexible contract, I know exactly what is the take-up rate. This allows me to estimate how the lender's profit changes as the price of the flexible schedule changes, provided that the price of the rigid contract remains the same.

An important assumption in doing this exercise is that borrowers do not strategically default, i.e. they will always repay within the chosen repayment scheme. Table 4 in the Appendix shows the comparison between the profits the lender would achieve with the mixed and the standard rigid contract, respectively. The numbers shown in the table are based on the assumption that the lender offers a loan of size 65,000Rs and maturity 18 months. He can either offer a standard rigid contract at 28%, or a mixed contract. In particular, for the mixed contract, I assume that the rigid schedule is still offered at 28%. I then study how the overall profit of this contract changes for different interest rates and take-up rates.

If the lender only offers a standard rigid contract at 28%, the borrower will have to repay a monthly installment of 4,463.74 Rs (declining balance), for a total of 80,347.24 Rs over the two years. Assuming that the lender has a pool of 150 customers, his total profit will be 12,052,085.81 Rs (as shown in column (4) of Table 4), under the hypothesis that borrowers will never default.[20]

What happens instead if the lender offers the mixed contract? Column (1) and (2) of Table 4 show the profit the lender would achieve with the flexible and the rigid schedules, respectively, when these are offered simultaneously in a mixed contract (and for different take-up rates). The lender's total profit from this contract, which is the sum of the profits the lender makes from both schedules, is displayed in column (3).

Figure 6 compares results displayed in Column (3) and (4) of Table 4. It shows how the lender's profit changes assuming different take-up rates for the flexible schedules (on the x axis). Interestingly, given the observed take-up rates, the lender would always be better off by offering the mixed contract rather than the standard rigid contract, as long as the price of the former is lower than 33%. Of course, the difference in profit between the mixed and the rigid contract strongly depends on the elasticity of take-up rates on price. As shown already in the paper (see Figure 5), the relationship between the price of the flexible schedule and the take-up rate is not linear.

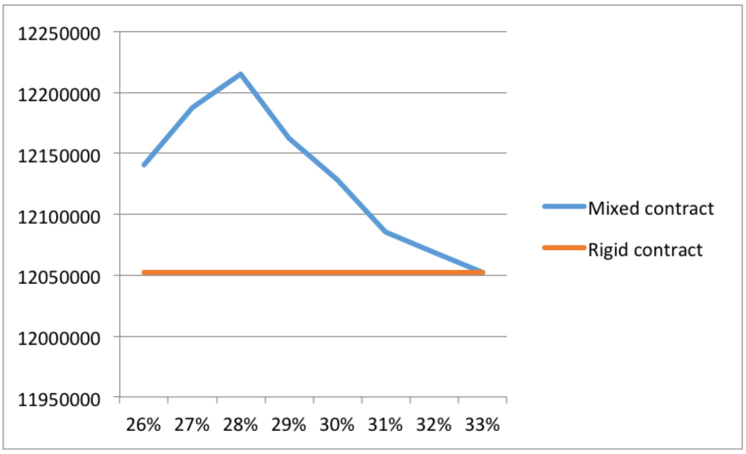

Figure 6: Contracts comparison

6 Conclusions

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. Therefore, a possible solution is to introduce more flexibility in the repayment mechanism. In this paper, I study the main drivers of

[20] Because they will invest in a short-term, risky-free business activities that yields a sure payoff in each period.

borrowers' contract choice when a microfinance lender provides a flexible repayment schedule along with the standard, rigid one. I build an adverse selection model where the lender faces both time-consistent and present-biased borrowers. The model shows that offering a menu of contracts which attract bad and good borrowers at different prices dominates any other contract, when a significant share of borrowers are time-inconsistent. If, instead, borrowers are all time-consistent, the optimal strategy would be to offer them a contract with a grace-period. Not surprisingly, this type of contract performs very poorly in presence of present-biased borrowers.

In the second part of the paper, I test the theoretical predictions of the model with a sample of 150 Indian microentrepreneurs, through a series of lab-in-the-field games. The main objective of this analysis is to study whether, by charging different prices for the rigid and flexible contract, the lender is able to attract good borrowers into the flexible schedule, and to retain bad ones under the rigid repayment schedule. I use a Willingness-To-Pay (WTP) lottery to estimate take-up rates of the flexible contract, when it is offered at different prices. I also elicit individual time and risk preferences, along with entrepreneurial ability, and collect socio-demographic characteristics.

The experiment confirms the model's predictions. I find that more entrepreneurial borrowers are more likely to take-up the flexible schedule than less entrepreneurial ones, and even more so when the flexible schedule is more expensive than the rigid one. Risk-averse borrowers, on the contrary, are more likely to stick to the rigid contract when this is cheaper than the flexible contract.

From a policy perspective, my paper thus shows that borrowers' characteristics can be predictive of flexible contracts' take-up rates. If the lender can collect this information and create a "screening algorithm", this can ultimately be used to design more profitable menus of microfinance contracts. However, findings from my paper also suggest that, even when the lender can screen across borrowers, take-up rates of the flexible contract might still be far from perfect, suggesting that repayment flexibility may not be as attractive as commonly thought. Therefore, a potential solution to boost take-up rates would be to provide more financial and business trainings, in order to allow microentrepreneurs to have the the skills to correctly evaluate their future profits and thus choose the repayment schedule that best suits their entrepreneurial activity. Finally, my paper indicates that further research is needed, also by means of a Randomized Controlled Trial, to study the impact of more sophisticated contracts that could fit borrowers' characteristics (risk-aversion, time preferences) and their type of business activity.

References

Angelucci, M., Karlan, D., and J. Zinman. (2015). "Microcredit Impacts: Evidence from a Randomized Microcredit Program Placement Experiment by Compartamos Banco." *American Economic Journal: Applied Economics*, 7(1): 151-82.

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

Banerjee, A. V., and E. Duflo (2014). "Do firms want to borrow more? Testing credit constraints using a directed lending program." *The Review of Economic Studies*, 81(2), 572607.

Banerjee, A. V., Duflo, E., Glennerster, R., and C. Kinnan (2015). "The Miracle of Microfinance? Evidence from a Randomized Evaluation." *American Economic Journal: Applied Economics*, 7(1): 22-53.

Bauer, M., Chytilov, J. and J. Morduch (2012). "Behavioral foundations of microcredit: Experimental and survey evidence from rural India." *The American Economic Review*, 102(2), pp.1118-1139.

Beck, T. (2007). "Financing constraints of SMEs in developing countries: Evidence, determinants and solutions." *The World Bank. Washington DC.*

Cassar, A., Wordofa, F., and Y.J. Zhang (2016). "Competing for the benefit of offspring eliminates the gender gap in competitiveness." *Proceedings of the National Academy of Sciences*,113(19), pp.5201-5205.

Crépon, B., Devoto, F., Duflo, E., and W. Parienté "Estimating the impact of microcredit on those who take it up: Evidence from a randomized experiment in Morocco", *American Economic Journal: Applied Economics*, 7(1): 123-50

Czura, K. (2015). Do flexible repayment schedules improve the impact of microcredit? Evidence from a randomized evaluation in rural India, Munich Discussion Paper No. 2015-20. Munich: University of Munich (LMU).

De Mel, S., McKenzie, D., and C. Woodruff (2008). "Returns to capital in microenterprises: evidence from a field experiment". *The Quarterly Journal of Economics*, 123(4), 13291372.

Feigenberg, B., Field, E., and R. Pande (2013). "The economic returns to social interaction: Experimental evidence from microfinance". *The Review of Economic Studies 80*(4), 1459-1483.

Field, E. and R. Pande (2008). "Repayment Frequency and Default in Microfinance: Evidence from India". *Journal of European Economic Association Papers and Proceedings*, *6* (2-3), 501-550.

Field, E., Pande, R., Papp, J. and N. Rigol (2013). "Does the classic microfinance model discourage entrepreneurship among the poor? Experimental evidence from India". *The American Economic Review 103*(6), 2196-2226.

Fischer, G. (2013). "Contract Structure, Risk Sharing and Investment Choice". *Econometrica 81*(3), 883-939.

Fischer, G., and M. Ghatak (2010). "Repayment Frequency in Microfinance Contracts with Present-Biased Borrowers". Working Paper, London School of Economics.

Gulesci, S., Madestam, A., and M. Stryjan, (2014). "Contractual Structure, Borrower Selection, and Hypothetical Loan Demand: Survey Evidence from Uganda". *PEDL Research Note.*

Hail, L. and C. Leuz (2006). "International differences in the cost of equity capital: Do legal institutions and securities regulation matter?." *Journal of accounting research*, 44(3), pp.485-531.

Harrison, G. W., and J. A. List (2004). "Field experiments." *Journal of Economic Literature*, 42(4), pp. 1009-1055.

Levitt, S.D. and J.A. List (2007). "What do laboratory experiments measuring social preferences reveal about the real world?. " *The Journal of Economic Perspectives*, 21(2), pp.153-174.

Mahajan, A., and A. Tarozzi (2011). "Time inconsistency, expectations and technology adoption: The case of insecticide treated nets." *Economic Research Initiatives at Duke (ERID) Working Paper 105.*

McIntosh, C. (2008). "Estimating Treatment Effects from Spatial Policy Experiments: An Application to Ugandan Microfinance". *Review of Economics and Statistics 90*(1), 15-28.

McKenzie, D. J., and C. Woodruff (2006). "Do entry costs provide an empirical basis for poverty traps? Evidence from Mexican microenterprises." *Economic Development and Cultural Change*, 55(1), 342.

Mobarak, A. M., Dwivedi, P., Bailis, R., Hildemann, L., and G. Miller (2012). "Low demand for nontraditional cookstove technologies." *Proceedings of the National Academy of Sciences*, 109(27), 10815-10820.

Prina, S. (2015), Banking the poor via savings accounts: Evidence from a field experiment. *Journal of Development Economics*, 115, 1631.

Read, D., Frederick, S., and Scholten, M. (2013). "DRIFT: An Analysis of Outcome Framing in Intertemporal Choice." *Journal of Experimental Psychology: Learning, Memory, and Cognition.* 39 (2), 573.

Yunus, M. (2003). *Banker to the Poor: Micro-Lending and the Battle Against World Poverty*, Public Affairs

A Empirical Results

Table 2: Probability of taking-up the flexible repayment schedule, provided that the rigid repayment schedule is offered at a fixed rate

This table reports logit estimates of the borrower i's probability of taking-up the flexible repayment schedule over the rigid contract at each choice. Marginal effects are displayed.

VARIABLES	(1) take-up	(2) take-up
flexible at 27%	-0.005	-0.005
	(0.041)	(0.040)
flexible at 28%	-0.043	-0.044
	(0.041)	(0.040)
flexible at 29%	-0.206***	-0.207***
	(0.043)	(0.041)
flexible at 30%	-0.324***	-0.322***
	(0.049)	(0.046)
flexible at 31%	-0.518***	-0.504***
	(0.070)	(0.064)
risk averse		-0.018
		(0.029)
time consistent		-0.025
		(0.031)
financial literate		-0.045**
		(0.019)
log(sales)		0.053***
		(0.012)
gender		-0.184***
		(0.060)
age		-0.008***
		(0.002)
Observations	900	900

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3: Probability of taking-up the flexible repayment schedule, provided that the rigid repayment schedule is offered at a fixed rate

This table reports logit estimates of the borrower i's probability of choosing the flexible repayment schedule over the rigid one when the former is offered at a price j, with j = 26%,..., 40%, and the latter is offered at 28%.

VARIABLES	(1) take-up	(2) take-up	(3) take-up	(4) take-up
flexible at 27%	-0.013	-0.000	-0.017	-0.050
	(0.066)	(0.074)	(0.108)	(0.316)
flexible at 28%	-0.053	-0.064	-0.052	-0.250
	(0.065)	(0.074)	(0.108)	(0.317)
flexible at 29%	-0.139**	-0.115	-0.063	-0.553
	(0.068)	(0.074)	(0.106)	(0.360)
flexible at 30%	-0.207***	-0.235***	-0.251**	-0.688
	(0.072)	(0.081)	(0.121)	(0.431)
flexible at 31%	-0.423***	-0.394***	-0.394**	-2.033***
	(0.093)	(0.098)	(0.161)	(0.773)
risk averse	0.024	-0.018	-0.018	-0.016
	(0.059)	(0.029)	(0.029)	(0.029)
risk averse × flexible at 27%	0.013			
	(0.083)			
risk averse × flexible at 28%	0.015			
	(0.082)			
risk averse × flexible at 29%	-0.110			
	(0.088)			
risk averse × flexible at 30%	-0.212**			
	(0.103)			
risk averse × flexible at 31%	-0.143			
	(0.138)			
time consistent	-0.024	0.019	-0.025	-0.026
	(0.031)	(0.063)	(0.031)	(0.031)
time consistent × flexible at 27%		-0.007		
		(0.088)		
time consistent × flexible at 28%		0.029		
		(0.088)		
time consistent × flexible at 29%		-0.140		
		(0.091)		
time consistent × flexible at 30%		-0.135		
		(0.104)		
time consistent × flexible at 31%		-0.187		
		(0.141)		
financial literate	-0.044**	-0.045**	-0.027	-0.046**
	(0.019)	(0.019)	(0.041)	(0.020)
financial literate × flexible at 27%			0.007	
			(0.057)	
financial literate × flexible at 28%			0.005	
			(0.057)	
financial literate × flexible at 29%			-0.089	
			(0.059)	
financial literate × flexible at 30%			-0.043	
			(0.068)	
financial literate × flexible at 31%			-0.070	
			(0.099)	
log(sales)	0.052***	0.053***	0.053***	0.030
	(0.012)	(0.012)	(0.012)	(0.023)
log(sales) × flexible at 27%				0.005
				(0.033)
log(sales) × flexible at 28%				0.022
				(0.033)
log(sales) × flexible at 29%				0.036
				(0.037)
log(sales) × flexible at 30%				0.038
				(0.044)
log(sales) × flexible at 31%				0.149**
				(0.072)
Observations	900	900	900	900

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Take-up rates flexible schedule and corresponding profit for the lender

	(1) Profit from flexible	(2) Profit from rigid	(3) Profit Mixed Contract (1) + (2)	(4) Profit Rigid Contract
Flexible at 26%	5,793,006.34 Rs	6,347,431.86 Rs	12,140,438.2 Rs	12,052,085.81 Rs
Flexible at 27%	5,759,904.40 Rs	6,427,779.098 Rs	12,187,683.5	12,052,085.81 Rs
Flexible at 28%	5,144,833.94 Rs	7,070,557.007 Rs	12,215,390.95	12,052,085.81 Rs
Flexible at 29%	2,761,511.94 Rs	9,400,626.93 Rs	12,162,138.87	12,052,085.81 Rs
Flexible at 30%	1,603,359.07 Rs	10,525,488.27 Rs	12,128,847.34	12,052,085.81 Rs
Flexible at 31%	595,676.35 Rs	11,489,655.14 Rs	12,085,331.49	12,052,085.81 Rs
Flexible at 32%	257,430.28 Rs	11,811,044.09 Rs	12,068,474.37	12,052,085.81 Rs
Flexible $\geq$ 33%	-	12,052,085.81 Rs	12,052,085.81Rs	12,052,085.81 Rs

B Rigid Contract

The bank sets this contract to solve the following problem:

$$\max_{P^r} \quad x_G\phi(P^r + \delta P^r - 1) + x_B(1-\phi)(P^r + \delta P^r - 1) \tag{3}$$

$$s.t.$$

$$P^r \leq y^L \tag{FCST}$$

$$P^r \leq y^H \tag{FCLT}$$

$$P^r \leq \frac{\beta\delta^2 V}{1+\beta\delta} + y^L \tag{PCSTB}$$

$$P^r \leq \frac{\delta^2 V}{1+\delta} + y^L \tag{PCSTG}$$

$$P^r \leq \overline{P^r_G} \tag{ICG}$$

$$P^r \leq \overline{P^r_B} \tag{ICB}$$

$$x_i = 1 \qquad \text{for all } i = G, B$$

The lender's profit will depend on which Incentive Compatibility Constraint is binding. By comparing $\overline{P^r_G}$ and $\overline{P^r_B}$, we see that, given (2), $\overline{P^r_G} \geq \overline{P^r_B}$, $\forall\ \beta$. This condition implies that if the value of future credit is high enough, good borrowers are willing to pay a higher loan size than bad borrowers to enter the rigid contract and get their loan renewed.

C Flexible contract only

The lender's maximisation problem, in case only the grace-period contract is offered, will be as follows:

$$\max_{P^f} \quad x_G\phi(\delta P^f - 1) + x_B(1-\phi)(\delta P^f - 1) \tag{4}$$

$$s.t.$$

$$P^f \leq y^L + \frac{y^L}{\beta\delta} + \delta V \tag{\textbf{PCST}}$$

$$P^f \leq y^H + \delta V \tag{\textbf{PCLT}}$$

$$y^L + \beta_i\delta y^L + \beta\delta^2(y^L - P_f) > 0 + \beta_i\delta y^H + \beta\delta^2(y^H - P_f) \tag{\textbf{ICC}}$$

$$P^f \leq y^L \tag{\textbf{FCST}}$$

$$P^f \leq y^H \tag{\textbf{FCLT}}$$

$$w_i \geq 0 \tag{\textbf{LL}}$$

Because the flexible repayment schedule is designed to allow borrowers for more illiquid investment activities, the binding participation constraint is **PCLT**. Moreover, given that good borrowers' **ICC** is satisfied for every P_f, we call $\overline{P^f} = y^H$ the highest repayment which satisfies the **PCLT**, the **ICC** and the feasibility condition of both good borrowers and bad borrowers with $\beta_B \geq \underline{\beta_B^f}$.

The lender thus faces a trade-off when deciding which interest rate should be set for the flexible contract. If he offers the contract at y^L, he will achieve a profit of:

$$\Pi^{f,L} = \delta y^L - 1 \tag{6}$$

$\forall\ \beta_B$. If, instead, he decides to set the repayment at y^H, borrowers with $\beta_B < \underline{\beta_B^f}$ will enter the contract and will opt for the short-term activity in the flexible repayment schedule. However, they will end up defaulting as they will have no cash-in-hand to repay their debt at time 2 (as they will only earn y each period). The lender's profit will thus depend upon β_B and will be:

$$\Pi^{f,H} = \begin{cases} \phi(\delta y^H) - 1 & \text{if } \beta_B < \underline{\beta_B^f} \\ \delta y^H - 1 & \text{if } \beta_B \geq \underline{\beta_B^f} \end{cases}$$

Note that if $\beta_B \geq \underline{\beta_B^f}$, $\Pi^{f,H} > \Pi^{f,L}$, $\forall\phi$. However, when $\beta_B < \underline{\beta_B^f}$, $\Pi^{f,H} > \Pi^{f,L}$ if $\phi > \frac{y^L}{y^H} = \underline{\phi}$.

D Mixed Contract

The lender's profit will be follows:

$$\max_{P^r, P^f} \quad x_G\phi(\delta P_f - 1) + x_B(1-\phi)((1+\delta)P_r - 1) \tag{5}$$

$$s.t.$$

$$P^r \leq \beta\delta^2 V - [\beta\delta y^H - (1+\delta)y^L] = \overline{P^r_B} \tag{PC}$$

$$P^r \leq \frac{\beta_B\delta}{1+\beta_B\delta}P^f = \overline{\overline{P^r}} \tag{ICB1}$$

$$P^r \geq y^L - \frac{\beta\delta}{1+\beta\delta}(y^H - P^f) = \underline{P^r_B} \tag{ICB2}$$

$$P^r \geq y^L - \frac{\delta}{1+\delta}(y^H - P^f) = \underline{P^r_G} \tag{ICG}$$

$$P_r \leq y^L \tag{FCST}$$

$$P_f \leq y^H \tag{FCLT}$$

$$w_i \geq 0 \tag{LL}$$

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

What value for P^r and P^f will the lender set for the two contracts? For the flexible contract, the required repayment must satisfy the following binding condition:

$$P^f \leq y^H$$

If the lender wants all good borrowers to repay in the flexible repayment schedule, he must also ensure that ICG is satisfied. This is for $P^r \geq \underline{P^r_G}$. He will therefore choose the highest payment that is incentive-compatible for good borrowers. This is for $P^f = y^H$. The corresponding value of $\underline{P^r_G}$ is computed by substituting P^f with y^H in ICG. We thus obtain:

$$P^r \geq y^L = \underline{P^r_G}$$

Now, let's turn to bad borrowers. Bad borrowers with $\beta_B < \underline{\beta_B}^f$ will enter and repay in the rigid contract if ICB1 is satisfied. This implies for:

$$P^r \leq \tfrac{\beta_B\delta}{1+\beta_B\delta}y^H$$

On the contrary, bad borrowers with $\beta_B \geq \underline{\beta_B}^f$ will enter and repay in the flexible contract if ICB2 is satisfied. This is for:

$$P^r \geq y^L$$

The question is therefore which payments the lender will set, for the rigid and flexible repayment. Let's first assume the lender sets $P^f = y^H$. Good borrowers will opt for the flexible schedule if the price for the rigid schedule is set sufficiently high by the lender, that is $P^r \geq \underline{P_G^r}$. Similarly, bad borrowers with $\beta_B \geq \underline{\beta_B}^f$ will enter the flexible schedule if $P^r \geq \underline{P_G^r}$. A good "candidate" to be a repayment for the rigid schedule is y^L, which is the price of the standard rigid microfinance contract. If the lender sets $P^r = y^L$, both good borrowers and bad borrowers with $\beta_B \geq \underline{\beta_B}^f$ will opt for the flexible repayment schedule. How about bad borrowers with $\beta_B < \underline{\beta_B}^f$?

Their ICC (ICB1) is satisfied $\iff$

$$y^L \leq \tfrac{\beta_B \delta}{1+\beta_B \delta} y^H = \overline{\overline{P^r}}$$

However, the above inequality is never satisfied for $\beta_B < \underline{\beta_B}^f$. This implies that bad borrowers with $\beta_B < \underline{\beta_B}^f$ will choose the flexible schedule and will undertake the short-term business activity if $P^r = y^L$ and $P^f = y^H$. As consequence, because the required repayment for the flexible schedule, y^H, is greater than the income generated by the short-term business activity, they will default.

E Contract Installments Computations

RIGID REPAYMENT CONTRACT

Loan Principal	$ 65.000,00
Interest Rate	28%
Loan Term	18
EMI	$ 4.463,74

Period#	Month	Installment Paid	Interest Paid	Principal Paid	Loan Outstanding
0	May	-	-	-	$ 65.000,00
1	June	$ 4.463,74	$ 1.516,67	$ 2.947,07	$ 62.052,93
2	July	$ 4.463,74	$ 1.447,90	$ 3.015,83	$ 59.037,10
3	August	$ 4.463,74	$ 1.377,53	$ 3.086,20	$ 55.950,89
4	September	$ 4.463,74	$ 1.305,52	$ 3.158,21	$ 52.792,68
5	October	$ 4.463,74	$ 1.231,83	$ 3.231,91	$ 49.560,77
6	November	$ 4.463,74	$ 1.156,42	$ 3.307,32	$ 46.253,46
7	December	$ 4.463,74	$ 1.079,25	$ 3.384,49	$ 42.868,97
8	January	$ 4.463,74	$ 1.000,28	$ 3.463,46	$ 39.405,51
9	February	$ 4.463,74	$ 919,46	$ 3.544,27	$ 35.861,23
10	March	$ 4.463,74	$ 836,76	$ 3.626,97	$ 32.234,26
11	April	$ 4.463,74	$ 752,13	$ 3.711,60	$ 28.522,66
12	May	$ 4.463,74	$ 665,53	$ 3.798,21	$ 24.724,45
13	June	$ 4.463,74	$ 576,90	$ 3.886,83	$ 20.837,62
14	July	$ 4.463,74	$ 486,21	$ 3.977,52	$ 16.860,10
15	August	$ 4.463,74	$ 393,40	$ 4.070,33	$ 12.789,76
16	September	$ 4.463,74	$ 298,43	$ 4.165,31	$ 8.624,45
17	October	$ 4.463,74	$ 201,24	$ 4.262,50	$ 4.361,96
18	November	$ 4.463,74	$ 101,78	$ 4.361,96	$ -0,00
		$ 80.347,24			

Figure 7: Installment computation for the rigid contract

FLEXIBLE REPAYMENT CONTRACT

Loan Principal	$ 69.342,10
Interest Rate	28%
Loan Term	15
EMI	$ 5.532,08

Period#	Month	Installment Paid	Interest Paid	Principal Paid	Loan Outstanding
0	May	-	-	-	$ 65.000,00
1	June		$ 1.516,67		$ 66.516,67
2	July		$ 1.447,90		$ 67.964,57
3	August		$ 1.377,53		$ 69.342,10
4	September	$ 5.532,08	$ 1.305,52	$ 3.914,10	$ 65.428,00
5	October	$ 5.532,08	$ 1.231,83	$ 4.005,43	$ 61.422,58
6	November	$ 5.532,08	$ 1.156,42	$ 4.098,89	$ 57.323,69
7	December	$ 5.532,08	$ 1.079,25	$ 4.194,53	$ 53.129,16
8	January	$ 5.532,08	$ 1.000,28	$ 4.292,40	$ 48.836,77
9	February	$ 5.532,08	$ 919,46	$ 4.392,55	$ 44.444,21
10	March	$ 5.532,08	$ 836,76	$ 4.495,05	$ 39.949,16
11	April	$ 5.532,08	$ 752,13	$ 4.599,93	$ 35.349,23
12	May	$ 5.532,08	$ 665,53	$ 4.707,26	$ 30.641,97
13	June	$ 5.532,08	$ 576,90	$ 4.817,10	$ 25.824,87
14	July	$ 5.532,08	$ 486,21	$ 4.929,50	$ 20.895,37
15	August	$ 5.532,08	$ 393,40	$ 5.044,52	$ 15.850,85
16	September	$ 5.532,08	$ 298,43	$ 5.162,23	$ 10.688,62
17	October	$ 5.532,08	$ 201,24	$ 5.282,68	$ 5.405,94
18	November	$ 5.532,08	$ 101,78	$ 5.405,94	$ -
		$ 82.981,19			

Figure 8: Installment computation for the flexible contract