

Competitive Microcredit Markets: Differentiation and ex-ante Incentives for Multiple Borrowing

Paolo Casini*

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Abstract

We analyze an oligopolistic microcredit market characterized by asymmetric information and institutions that can offer only one type of contract. We study the effects of competition on contract choice taking into account the case in which, due to the absence of credit bureaus, small entrepreneurs can borrow from more than one institution. Modelling different behavioral assumptions, we show that appropriate contract design can eliminate the ex-ante incentives for multiple borrowing. Moreover, the presence of an altruistic MicroFinance Institution (MFI) in the market mitigates the negative effects of asymmetric information allowing MFIs to screen borrowers even when they cannot share information and contracts are not committing.

Keywords: Microfinance, Competition, Altruism, Credit Bureaus, Multiple Borrowing, Credit Rationing

JEL Classification: G21, L13, L31, O16

PRELIMINARY DRAFT

1 Introduction

Competition is increasingly a cause for concern in microcredit markets. A growing number of institutions enters the market, motivated by goals spanning from poverty reduction to profit maximization. Economists generally

*ECARES (Université Libre de Bruxelles) and Università “G. d’Annunzio”, Chieti.
E-mail: pcasini@ulb.ac.be

welcome competition as a positive phenomenon, especially in terms of consumer welfare, but some of the special features of microcredit raise some doubts regarding this conventional wisdom.

Whenever borrowers and lenders are tied in a reciprocal relationship, it is possible to lend money without incurring important financial losses. Lenders need borrowers to repay their loans in order to avoid losses. Borrowers need lenders to finance their businesses and their daily activities. When microcredit was still at its origin, this relation was quite balanced since the supply of credit was largely insufficient, and the demand side was still limited, mainly because of distrust toward microfinance institutions. This was enough to discipline the involved parties. But the increase of competition is destabilizing the relation in favor of borrowers: when there are different Micro Finance Institutions (MFI) to which borrowers can apply for credit, the link borrower-lender becomes weaker. This creates incentive for borrowers to engage in potentially harmful behavior like, for instance, multiple borrowing.

Practitioners report that the presence of a competitor in the market can weaken an MFI in two respects. First, it can reduce the borrowers' incentives for repayment. These incentives, in fact, depend importantly on the threat of being denied access to further credit in case of default. Second, due to the lack of well functioning credit bureaus, borrowers might take multiple loans. In these cases, the level of indebtedness can become so large to render repayments extremely unlikely.

This paper focuses on the issue of multiple borrowing, relating it to the strategic behavior of competing MFIs. We analyze how contracts chosen by competing MFIs can affect borrowers' incentives for multiple borrowing and how this, in turn, can influence the choices of MFIs.

Technically, allowing borrowers to take out more than one loan is equivalent to assuming that MFIs cannot share information about the borrowers they are serving, and that borrowers do want to take multiple loans. Both assumptions must be considered carefully. Some Microfinance markets, especially the ones characterized by a higher degree of competition, do show a certain level of information sharing. Indeed, there are more and more attempts to implement credit bureaus, as well as different examples of bilateral agreements between MFIs to share the most relevant information. Nonetheless, practitioners report that in most markets borrowers do take multiple loans and hide their real level of indebtedness. As a consequence, making reliable assessments of credit risk becomes more difficult and, thus, important financial losses are more likely to hit MFIs.

The literature has proposed mainly two different explanations for multiple-

borrowing. The first is that *ex-post*, i.e. after the loan is taken and invested, some unexpected negative shocks can hurt borrowers and their businesses. This can make it impossible for them to repay the loan. Thus, borrowers might decide to take a second loan in order to repay the first, increasing dangerously their level of indebtedness.

A second motivation for multiple borrowing comes from the fact that micro-loans can be too small to cover the borrowers' needs for a specific investment. In order to obtain the missing capital, they might find it convenient to hide their real level of indebtedness and ask for additional loans at different institutions.

We show that even ruling out negative shocks, and assuming that loans are optimally sized, borrowers might have incentives to take multiple loans. We analyze two different situations, in order to address both an empirical observation and a theoretical caveat. First, borrowers might desire a second loan to invest in a different and possibly riskier use. We take this into account by allowing borrowers to choose on whether to undertake one or more investments.

Second, in many Microcredit markets (as in normal credit markets) a fraction of borrowers is rationed. The standard theoretical models explaining this phenomenon are based on the hypothesis that (i) borrowers can (or want) to take one loan only, (ii) loan applications are committing: if a borrower applies for a loan, she cannot *ex-post* breach the contract. When these last assumption is violated, borrowers might want to simultaneously apply for loans at different institutions just to have a higher chance to get a good contract. If this happens, the rationing (and screening) mechanisms à la Stiglitz and Weiss fail. In our model, we provide a simple solution to this problem, showing under which condition the result of the credit rationing model extends to this particular setup. Note that both motivations provided above, give borrowers *ex-ante* incentives for multiple borrowing.

An additional empirical motivation to justify our modeling strategy comes from the fact that, although micro-loans are typically made to individuals, profits, burdens and responsibilities of the investments are typically shared within households. Many MFIs, for instance, make loans primarily to women since they are considered safer. But empirical evidence shows ([list examples here](#)) that although women are the members of the family officially taking out the loan, often men are the ones controlling the relevant investment decisions and taking mostly care of the business. Independently of that, within households it is likely to find a certain level of solidarity. Thus, if more than one member of the household has a loan, the probability of repayment depends on the success of both investments. This creates an

artificial correlation between the probabilities of default and makes loans riskier. Our model can also be interpreted as a way to take into account these circumstances, shifting the focus from individuals to households.

To the best of our knowledge, the only theoretical paper tackling the problem of multiple borrowing is McIntosh and Wydick (2005). They also focus on microfinance, but their approach is different in at least two respects: (i) they consider dynamic incentives, (ii) the incentives to multiple borrow depend solely on an exogenous parameter measuring the borrowers' impatience. In other words, borrowers trade off the utility from borrowing more today with the risk of being denied credit access tomorrow. The choice is not influenced by the contract design. Our paper is based on a static model and, as such, considers ex-ante incentives only. The added value of this approach is that it allows to study how the incentives for multiple borrowing can be controlled by appropriate contract design. These incentives are, in fact, endogenously determined by the contracts chosen by MFIs.

Fluet and Garella (2007), consider banks' incentives to reschedule loans to borrowers in financial distress. They assume that borrowers are indebted with many lenders. Each lender cannot observe the performance of the borrowers with the other lenders. In their model, borrowers lend from multiple sources by assumption, since they want to finance a big scale project. Each lender finance only a share of the whole, unique project.

Other papers study the effects of the presence of a credit bureau on borrowers in terms of reputation building (see for instance Vercammen (1995)). In this branch of the literature, credit bureaus are an important disciplining device. De Janvry, McIntos and Sadoulet (2006), study the impact of the implementation of a credit bureau on both demand and supply side using a natural experiment.

The organization of the paper is the following: in the next section we introduce the model and analyze the incentives for multiple borrowing when a credit bureau is not at work. In Section 3 we describe the strategic behavior of two competing MFIs, first assuming the existence of a perfectly functioning credit bureau and then allowing borrowers to take multiple loans. We explain how the strategic behavior of MFIs influences the borrower incentives to take out more than one loan. In section 4 we analyze the consequences of the presence of an altruistic MFI in the market. In section 5 we propose a different pricing strategy consisting of a fixed-fee to be paid up-front at the moment of the application. In section 6 we conclude.

2 The model

We model a market characterized by asymmetric information and oligopolistic competition. We assume that, due to high management costs, each MFI can only offer one contract¹. Contracts are chosen simultaneously. We assume that MFIs are not perfectly symmetric in that they have different capacities.²

This assumption can be interpreted in different ways. For instance the high capacity MFI could be a firm that entered the market beforehand, and had therefore more time to accumulate capital. Alternatively the high capacity institution could be a ‘normal’ bank downscaling her business into a market that has previously been pioneered by a small NGO.

More formally, we consider a market in which two MFIs, say a and b , are operating. We assume that each MFI is endowed with a capacity α^j , $j \in \{a, b\}$. Without loss of generality let $\alpha^a > \alpha^b$. Finally, let $\alpha^a + \alpha^b \leq 1$, so that the market is not necessarily fully covered.³ There is a unit measure of borrowers demanding a loan, whose size is, for simplicity, set to one. Each borrower can be interpreted as a single individual or as a household. There are two potential investment opportunities in the market, available to everybody. Both investments give the same return to a given borrower, but we assume that only one of them can be given priority. In other words, we assume that borrowers exert a bigger effort in one investment, that is successful with probability p , and only residual effort in the second one, that is successful with probability p' , where $p' \leq p$. The level of effort is exogenously given.

There is fraction β of Safe borrowers, characterized by a return R_s and a probability of success p_s for the first investment and p'_s for the second, with $p'_s \leq p_s$. The remaining $1 - \beta$ borrowers are Risky and are characterized by a return R_r and probabilities of success p_r and p'_r , $p'_r \leq p_r$, on the first and second investment respectively. We also set $p_s R_s = p_r R_r = m$, $p'_s R_s = p'_r R_r = m'$, $p_s > p_r$ and $p'_s > p'_r$. Hence, $R_s < R_r$. The last assumption makes sure that all borrowers have the same expected return, so that MFIs are ex-ante indifferent between them.

Let $x^i \in [0, 1]$ denote the fraction of the demand MFI i is willing to serve

¹Add footnote here to motivate the assumption

²This asymmetry allows to avoid the use of mixed strategies. In Casini (2008) [4] the asymmetry is obtained via the use of a dynamic game.

³This assumption is not necessary to prove the existence of screening equilibria. Nonetheless it is useful for the exposition since it ensures that an equilibrium in pure strategies of the PM model, be it with or without screening, *always* exists.

or, equivalently, the probability for each borrower to obtain the scarce funds. We can define a contract as a pair $C^i = (x^i, D^i)$, in which MFIs specify the repayment D^i , inclusive of principal and interests, and the probability x^i for a borrower to be served. Each MFI offers only one contract. The borrower type is private information. We use two tie-breaking rules: first, we assume that if a contract leaves the borrowers with no rent, they still prefer borrowing to not borrowing; second, we assume that if MFIs are indifferent between two non-screening strategies, they prefer to serve both types rather than targeting the residual demand.⁴

2.1 Incentives for Multiple Borrowing

Most of the credit rationing models that followed Stiglitz and Weiss (1981)' seminal contribution assume that borrowers can take out one loan only. This is equivalent to assuming that either MFIs can share information about the borrowers they are serving, or that borrowers do not want to take multiple loans. Both assumptions must be considered carefully when examining microcredit markets. Although there exist examples of information sharing through the creation of credit bureaus, the amount of information available to MFIs is generally scarce.⁵ In countries like India, for instance, people are not even registered at birth, so that most of the inhabitants of rural areas are not identifiable through an ID. In this situations MFIs can only rely on informal information and personal knowledge to asses on the credit history of potential borrowers. As a consequence, in many markets borrowers do take multiple loans by hiding their real level of indebtedness.⁶ This can lead to incorrect risk assessment by MFIs and, as a consequence, to important financial losses.

In what follows we formalize the behavior of borrowers when, due to lack of information sharing, multiple borrowing is possible. In order to do it we assume that borrowers take out at most one loan from each MFI. We exclude strategic default and assume that borrowers repay their loans as much as they can, even when they don't manage to pay back the whole capital. In other words, partial reimbursements are allowed⁷. [*comment more on this hypothesis. Add evidence.*]

⁴This rule is only relevant for non-screening equilibria.

⁵see for instance de Janvry, McIntosh and Sadoulet (2008) [5].

⁶see for instance McIntosh, de Janvry and Sadoulet (2005) [13].

⁷Most microcredit contract requires very frequent repayment instalments, so total default is considered a rare event. See, for instance, Armendariz & Morduch page 31 and ss)

Each loan is invested in a distinct and independent business. The return on investments is strictly related to types: a Risky borrower gets the same return on all the investment she makes. But we assume that one of the two investments has a lower probability of being reimbursed. This can be either interpreted as excessive level of investment by the borrowers, or as inability to properly manage two projects at the same time. A different way to read this assumption is to interpret borrowers as members of a household. Each household has a primary business, in which much of the efforts and resources are invested, and a secondary one to which only the residual assets are dedicated.

We keep the implicit assumption that the loan size offered by the MFI is the optimal one, so that no borrower wants to invest more money in the same project. In other words, investing more money in the same business does not increase the probability of success. This clearly rules out the incentives to multiple borrow arising from imperfect contract design, allowing us to identify the pure effects generated by competition and adverse selection. For the time being, suppose that applications for credit are committing: if a borrower applies for a loan and the application is accepted, she cannot decline the contract. We also assume that $R_r < D^a + D^b$, so that being successful in only one investment is not enough to repay two loans.

If a borrower applies for only one loan from MFI i , she enjoys the following *ex-ante* utility:

$$U_j(C^i) = x^i p_j (R_j - D^i) \quad \text{with } j = s, r \quad \text{and } i = a, b$$

since she attains the loan with probability x^i , earns R_j with probability p_j in which case she repays D^i .

Suppose now that a Risky borrower applies for credit at both MFIs simultaneously. The *ex-ante* utility she gets from applying for two different loans is given by the weighed sum of the utilities she gets in four different situations:

1- The borrower applies at both MFIs and both applications are accepted:

$$x^a x^b [p_r (1 - p'_r) R_r + p'_r (1 - p_r) R_r + 2p_r p'_r R_r + \\ - p_r (1 - p'_r) R_r - p'_r (1 - p_r) R_r - p'_r p_r (D^a + D^b)]$$

2- She applies at both MFIs but only a accepts the application:

$$x^a (1 - x^b) p_r (R_r - D^a)$$

3- She applies at both MFIs but only b accepts the application:

$$x^b (1 - x^a) p_r (R_r - D^b)$$

4- She applies at both MFIs and none of the application is accepted: in this case the expected utility is simply zero.

Summing up the equations above we get:

$$p_r p'_r x^a x^b (2R_r - D^b - D^a) + x^b (1 - x^a) p_r (R_r - D^b) + x^a (1 - x^b) p_r (R_r - D^a) \quad (1)$$

We can compare this equation with the expected utility a Risky borrower enjoys by applying at one MFI only. Suppose, without loss of generality, that the Risky borrowers prefer the contract offered by a . Then equation (1) must be compared to $x^a p_r (R_r - D^a)$. Rearranging the formulas, it is easy to see that the condition for the Risky borrowers *not* to prefer to multiple-borrow is given by:

$$(R_r - D^b)(p'_r x^a + 1 - x^a) < x^a (R_r - D^a)(1 - p'_r) \quad (2)$$

Similar calculations can be made for the Safe types assuming, without loss of generality, that they prefer the contract offered by MFI b . This leads to the analogous condition:

$$(R_s - D^a)(p'_s x^b + 1 - x^b) < x^b (R_s - D^b)(1 - p'_s) \quad (3)$$

Note that for p'_s and p'_r small enough, the conditions are jointly satisfied when x^a and x^b are high. In other words, a higher level of rationing can increase the borrower incentives to apply for credit at different MFIs simultaneously.

The result hinges on the assumption that borrowers repay their loans as much as they can. That is, even if they do not have money enough to repay both loans, they refund the MFIs at least partially. This is quite plausible in microfinance markets. Evidence shows that borrowers almost never totally default on their loans. This is mainly a consequence of the fact that most MFIs offer loans whose repayment is done by very frequent instalments, starting almost immediately after the issue.

Note that we did not assume any criterion to establish which MFI has priority in case of partial reimbursement. In general, the ranking can be made dependent on the borrowers preferences. But the conditions stated above do *not* depend on borrower preferences about which MFI to give priority to. There could obviously be several motivations for a borrower to prefer repaying first one MFI rather than the other (different dynamic incentives, different enforcement power etc.). But this is immaterial for this part of the analysis. In our static set-up, any assumption in this respect would influence MFIs' profits rather than borrower utility.

Multiple borrowing produces a considerable reduction of the total welfare. From the MFIs point of view, the loss is determined by the higher probability of defaults. From the borrowers point of view, the most apparent consequence of multiple lending is the exclusion of a higher number of borrowers. In fact, given the capacity constraint of the MFIs, if borrowers take more than one loan, then less individuals can be served. This loss outweighs the gain in terms of utility of the borrowers that do access credit. In fact, the low probability of repaying the second loan ensures that the same amount of money gives in the aggregate more utility if it is invested by two different individuals (or households).

In general, it is clear that the conditions stated above depend on the contract chosen by both MFIs. In what follows, we investigate whether there exist competitive equilibria in which MFIs offer contracts such that there are no incentives for multiple borrowing. Drawing on Casini (2008) [4] we solve two different models. First, we consider the case in which two *profit maximizing* MFIs compete in the market. This set-up describes better a more mature microcredit market like the ones, for instance, in Bangladesh or Bolivia. Second, we assume that one of the MFI is *altruistic*, and we show how this behavioral assumption changes the equilibrium predictions. This set-up is empirically relevant since most microcredit markets have been pioneered by socially motivated institutions and NGOs. Their example has then attracted numerous imitators with more profit oriented goals. Thus, mixed competition is observable in many markets.

3 Profit Maximizing Competition (PM Model)

Some of the most celebrated and imitated MFIs are profit maximizing or, at least, so they claim. In large part, Microfinance has become famous because of its promise of being able to effectively reduce poverty while running a profitable business. But very few MFIs actually manage to earn profit. Still profit seeking is considered by many practitioners as a ‘best practice’ for the success of a microfinance program. For this reason, we start by assuming that both MFIs are profit maximizing. The solution of this model provides also a useful benchmark allowing us to draw some interesting policy conclusions.

For ease of exposition, we first solve the model by assuming that multiple borrowing is not possible, because of perfect information sharing between MFIs. We then relax this hypothesis to show the existence of equilibria in which borrowers do not want to take multiple loans.

We prove the existence of two different types of equilibria. The first type is characterised by screening whereas the second one is a pooling equilibrium in which no screening takes place. Both types are akin to the ones described in Casini (2008) in a sequential set-up.*[Insert here summary of the multiBor case]*⁸ We will not consider equilibria in mixed strategies.

3.1 Information Sharing

Define a function $B^i(\cdot, \cdot) : \mathbb{R}_+^2 \times [0, 1]^2 \rightarrow [0, 1]$, assigning to each combination of contracts the mass of borrowers preferring MFI i . Let $P^i(\cdot, \cdot) : \mathbb{R}_+^2 \times [0, 1]^2 \rightarrow [0, 1]$ be the mapping assigning to each combination of contracts the probability of repayment of MFI i 's pool of clients. It takes value p_r , p_s or $p_b := \beta p_s + (1 - \beta)p_r$ when the MFI serves respectively the Risky, the Safe or Both types of borrowers. Finally, let $X^i(C^a, C^b, \alpha^i) := \min\{x^i B^i(C^a, C^b), \alpha^i\}$ denote the mass of borrowers served by i . MFI i faces the following maximization problem:

$$\max_{x^i, D^i} \Pi^i = X^i(C^a, C^b, \alpha^i) \left[P(C^a, C^b) D^i - 1 \right]$$

Since by assumption $\alpha^i < 1$, whatever i 's strategy is, her competitor can always target the residual demand $(1 - X^i(C^a, C^b, \alpha^i))$, and impose on it a monopoly price. For the sequel, it is useful to calculate the profit MFI a earns serving the residual demand of the Risky types, when b faces a demand $B^b(C^a, C^b) = 1$ and serves both types. a optimally sets $D^a = R_r$, extracting the whole surplus from the residual Risky borrowers. Since by assumption $\alpha^a < (1 - \alpha^b)$, she earns:

$$\Pi_{ResR}^a = \alpha^a (1 - \beta)(m - 1). \quad (4)$$

In the same way we can define the profit a earns serving the residual demand of both types. She sets $D^a = R_s$, extracting all the Safe borrower's surplus and leaving the Risky ones a rent. She earns:

$$\Pi_{ResB}^a = \alpha^a [\beta(m - 1) + (1 - \beta)(p_r R_s - 1)] \quad (5)$$

Whether Π_{ResR}^a or Π_{ResB}^a is bigger depends on the particular values of the parameters. Π_{ResR}^b and Π_{ResB}^b are analogously defined.

⁸The no-screening equilibria, although arising from an intuition similar to Casini (2008), are somewhat specific to the simultaneous setting we are describing. In Casini (2008) non-screening equilibria are separating, whereas in this model they are pooling.

We can now describe the borrowers' reaction functions. For any given contract chosen by the competitor, an MFI has three different choices: (i) Offer a contract that attracts *all* the borrowers of a specific type (i.e. a screening contract); (ii) Target the residual demand of the chosen sector(s); (iii) Offer a non-specialized contract, suited to attract both types. Given the definition of Π_{ResB}^i and the assumption $\alpha^a + \alpha^b \leq 1$, the last option gives the same profit as serving the residual demand of both types. In what follows we state the conditions supporting the first choice.

Lemma 1. *If i chooses a contract such that $D^i \leq R_s$ and $x^i \leq \hat{x}(D^i) < 1$ where $\hat{x}(D^i)$ is defined as:*

$$\begin{aligned} \frac{(1 - \alpha^j)(m - 1)}{m - p_r D^i} & \quad \text{if} \quad \Pi_{ResR}^j \geq \Pi_{ResB}^j \\ \frac{(1 - \beta)(m - 1) - \Pi_{ResB}^j}{(1 - \beta)(m - p_r D^i)} & \quad \text{if} \quad \Pi_{ResB}^j \geq \Pi_{ResR}^j \end{aligned}$$

then j 's optimal reaction is to offer a contract ($x^j = 1; D^j = R_r - \frac{x^i}{x_j}(R_r - D^j)$), so that screening takes place with i serving the Safe borrowers and j serving the Risky ones.

Proof. See Appendix B. □

\hat{x}_s^i is the value of x^i making MFI i indifferent between engaging in a screening strategy serving the Safe borrowers only (earning $\hat{x}^i \beta (p_s D^i - 1)$) and the best of her outside options. The intuition behind this result is standard: if i wants to serve only the Safe borrowers, she must ration some of them. What is less standard is that the number of excluded borrowers depends on the prevailing j 's outside option. A similar intuition is at the basis of the next lemma.

Lemma 2. *If i offers a contract (x^i, D^i) characterized by:*

$$D_{min}^i < D^i \leq \hat{D}^i(x^i) := R_r - \frac{1}{x^i} \hat{x}^j (R_r - D^j) \quad (6)$$

where

$$\hat{x}^j := \max \left\{ \alpha^j \left(1 + \frac{(1 - \beta)(p_r R_s - 1)}{\beta(m - 1)} \right), \frac{(1 - \beta)(m - 1)}{\beta(m - 1) + (1 - \beta)(m - p_r R_s)} \right\}$$

and $D_{min}^i < R_s$ is the minimum value of D^i making j indifferent between the screening profit and the relevant outside option, then j 's optimal reaction is to offer a contract ($x^j = \hat{x}^j; D^j = R_s$), so that screening takes place with i serving the Risky borrowers and j serving the Safe ones.

Proof. See Appendix B. □

Also in this case, to attain screening, Risky borrowers must be given better conditions via a reduction of the repayment D^j (the informational rent). At the same time some of the Safe borrowers must be rationed.

An important implication of the lemmas above is that if specialization is an equilibrium in a microfinance market, then it is an equilibrium with *credit rationing*. This rationing is due to the combined effect of adverse selection and oligopolistic competition. Different than in Stiglitz and Weiss (1981), where rationing is merely a consequence of the presence of ‘bad’ types in the market, in our model the value of x is determined by the outside option of the competitor. In Lemma 1, i chooses the level of rationing in order to make the screening strategy optimal for j . In Lemma 2, i increases the information rent offered to the Risky borrowers in order to reduce rationing of the Safe ones and increase j ’s profit. This is an explanation for rationing in markets with a limited availability of contract types and oligopolistic competition that, to our knowledge, has not been explored before.

Let j be the MFI serving the Risky borrowers. Knowing the MFIs’ reaction functions, we can now describe the conditions making screening equilibria possible.

Proposition 1. *Suppose that $\alpha^j \geq (1 - \beta)$ for $j \in \{a, b\}$. Then, in the simultaneous model with two profit maximizing MFIs, there exist screening equilibria when the following condition is satisfied:*

$$\hat{x}_s^i < \frac{(1 - \beta)(m - 1) - \alpha^j[\beta(m - 1) + (1 - \beta)(p_r R_s - 1)]}{(1 - \beta)(m - p_r R_s)} \quad (7)$$

for $i \neq j$, $i \in \{a, b\}$.

Proof. See Appendix B □

Screening is only possible when the capacity of the MFI serving the Risky types is high enough to serve them all. Where it not the case, some of the Risky borrowers would apply for credit to the MFI targeting the Safe borrowers making the equilibrium unsustainable. Interestingly, screening equilibria are more likely to exist when the level of heterogeneity is high. In fact, \hat{x}_s^i is increasing in $m - p_r R_s$, whereas the threshold defined in Proposition 1 is decreasing. The result is quite intuitive: when heterogeneity is high, the opportunity cost of serving the ‘wrong’ type is larger.

Note that to prove this result we make no use of the assumption $\alpha^a + \alpha^b \leq 1$. Indeed the result is valid more generally. Nonetheless, the more α^a differs

from α^b , the larger is the range of parameters for which screening equilibria exist. Moreover, the high capacity MFI is more likely to serve the Risky types in equilibrium. This is particularly true when $\alpha^a > \max\{\beta, 1 - \beta\}$. It is easy to show that in this case α^b is smaller than $1 - \beta$.⁹ So if a targets the Risky, b 's outside options to the screening strategy (in particular the option of undercutting a) are clearly less interesting.

What happens when the conditions in Proposition 1 are not satisfied? We can show that under our hypothesis, there always exists a pooling Nash equilibrium in which MFIs do not screen the borrowers. In order to prove it, define $D^*(i)$ as the repayment such that:

$$\alpha^i[\beta(p_s D^*(i) - 1) + (1 - \beta)(p_r D^*(i) - 1)] = \max\{\Pi_{ResR}^i, \Pi_{ResB}^i\}$$

$D^*(i)$ is the repayment such that the profit from serving both types is equal to the profit from serving the residual demand. We can introduce the following proposition:

Proposition 2. *The couple of contracts $C^a = (1, D^*(a))$, $C^b = (1, D^*(b))$, is a Nash equilibrium of the simultaneous game with profit maximizing MFIs.*

Proof. See Appendix B □

This last result hinges on the hypothesis that $\alpha^a + \alpha^b \leq 1$. As showed in the proof, this implies that $D^*(a) = D^*(b)$ so that no MFI has incentives to deviate. The hypothesis on the capacity constraints is not unrealistic since despite the rapid increase of credit supply in development countries, many markets are still not saturated, and most MFIs are still struggling to increase their outreach.

3.2 Absence of Credit Bureaus

In the previous section we showed how the design of contracts can be of incentive or disincentive for borrowers to take multiple loans. Clearly, the decision concerning which contract to offer depends on the competitive interaction between Microfinance institutions. In this section we reconsider the equilibria described in the previous one to see how and if the prediction we made are influenced by the existence of agreements to share information. We show that for a large range of parameters the screening equilibria are robust to this assumption.

⁹Let $\beta > (1 - \beta)$. Then $\alpha^a > \beta \Rightarrow 1 - \alpha^a < 1 - \beta \Rightarrow \alpha^b < (1 - \beta)$.
If instead $\beta < (1 - \beta)$, then $\alpha^a > (1 - \beta) \Rightarrow 1 - \alpha^a < \beta \Rightarrow \alpha^b < \beta \Rightarrow \alpha^b < (1 - \beta)$

In the simultaneous model with two profit maximizing firms, we showed that there are equilibria in which screening takes place. In these equilibria the MFI targeting the Safe types, say MFI b (that is the one with low capacity), sets $x^b < 1$ and D^b as high as possible, namely equal to R_s . The competing MFI a (the one with high capacity) serves instead the Risky borrowers setting $x^a = 1$ and D^a low enough in order to leave them with the necessary informational rent.

We characterized these equilibria in a model in which we assumed that MFIs have perfect information about the borrowers' level of indebtedness. We now want to check whether, and under which conditions, these equilibria are robust to changes in the informational structures. In other words, we want to understand whether the screening contracts described above create *ex-ante* incentives for multiple-borrowing. We consider the equilibrium contracts described in the previous section and we check whether they satisfy conditions (2) and (2) in Section 2.1. This is done in the following Propositions. We start by considering the screening equilibria.

Proposition 3. *When two profit maximizing MFIs with different capacities compete setting their contracts simultaneously, in the screening equilibria there are no ex-ante incentives for multiple-borrowing if $p'_r < \hat{p}'_r$, where*

$$\hat{p}'_r := \frac{(1 - \beta)(m - 1) - \Pi_{ResB}^a}{(1 - \beta)(2m - p_r R_s - 1) - \Pi_{ResB}^a} < 1.$$

Proof. See Appendix B □

The Proposition above shows that screening equilibria are robust to the specific type of incomplete information we are considering when the probability of succeeding in the second project is low enough. Note that no conditions are required on p'_s . The implication of this result is that, if the contracts are properly defined and their enforcement is not an issue, multiple lending is *ex-ante* not a problem whenever the market is risky enough.

Screening is not the only possible outcome of the competitive interaction between MFIs. We showed that, for some values of the parameters, pooling equilibria can prevail. The result of Proposition 3 extends to these cases in a very similar way: when MFIs offer identical contracts, there are no incentives for ex-ante multiple borrowing as long as the market is risky enough. The result is formalized in the next proposition.

Proposition 4. *When two profit maximizing MFIs with different capacities compete setting their contracts simultaneously, in the no-screening equilibria*

there are no ex-ante incentives for multiple borrowing if $p'_s < 1/2$ and $p'_r < 1/2$.

Proof. The result follows immediately from Proposition 2 and equations (2) and (3) by replacing $D^a = D^b = D^*$ and $x^a = x^b = 1$. \square

It is interesting to compare the results of propositions 3 and 4. The relative performance of screening equilibria versus no-screening ones is ambiguous. In fact, for screening equilibria to provide the right incentives, only a condition on p'_r must be fulfilled. When no-screening equilibria prevail, conditions on both p'_s and p'_r are needed. Clearly, when $\hat{p}'_r > 1/2$ then screening makes multiple lending unambiguously less likely. By using the definition of \hat{p}'_r we can note that

$$\hat{p}'_r > 1/2 \iff (1 - \alpha^a)(1 - \beta)(p_r R_s - 1) > \alpha^a \beta (m - p_r R_s).$$

If $\alpha^a > 1/2$, then the condition is satisfied when the fraction $(1 - \beta)$ of risky borrowers is high and/or when the difference between the safe and the risky borrowers is relatively small in terms of return and probability of success (so that $(p_r R_s - 1)$ is close to $(m - 1)$). If $\alpha^a < 1/2$, then the condition is more easily satisfied. Since by assumption $\alpha^a \geq \alpha^b$, this means that screening is particularly useful and likely to take place when the market is still largely unserved.

When $\hat{p}'_r < 1/2$, no clear comparison is possible. In fact, screening equilibria are somewhat more fragile since, even if only the risky types have incentives for multiple borrowing, the equilibria are not sustainable.

In any case, one important implication of these results is that, since $p'_s > p'_r$, whenever the Safe types have incentives to multiple borrow also the Risky ones have. Thus, MFIs have no reason to multiple lend, even in the extreme case in which $p'_s > p_r > p'_r$.

A different way to put it is to say that if $\hat{p}'_r > 1/2$ and $p'_r \in [1/2, \hat{p}'_r]$, then screening can become a way to solve the problem of multiple borrowing. In this case, in fact with a non-screening strategy multiple borrowing is unavoidable. Screening, instead allows to eliminate the incentives for all the borrowers to take more than one loan. Note, moreover, that screening is in this case much easier to sustain in equilibrium since the profit from all the outside options, for both MFI a and b is importantly reduced.

4 Altruism and Competition

We now turn to consider a model in which MFIs characterized by different behaviors compete in the same market. We assume that the goal of one

of the MFIs, say MFI a , is poverty reduction. MFI b , instead, maximizes her profit. The model describes a common situation in microcredit markets where often, the very first institutions operating are non-profit organizations with poverty reduction goals. These institutions are then followed by more profit oriented imitators.

There are different possible ways to model altruistic behavior. We consider a sophisticated form of altruism that we label as *Smart Altruism*. This is the behavior of an MFI that takes into account the effect her strategy has on her competitor's clients: a smart MFI maximizes the sum of the utilities of *all* the borrowers in the market subject to a non-bankruptcy constraint (NBC). This behavioral assumption fits a market in which the altruistic MFI is a larger institution running a well structured program. In the appendix we also examine a simpler form of altruism, that we label *Naive Altruism*, for which we assume that a 's altruism leads to the maximization of the sum of her clients' utility only. This assumption is useful to describe small project-based programs, endowed with less resources and technical knowledge. As in the previous section, we first solve the model assuming that multiple borrowing is impossible. We then check how this hypothesis influence the equilibrium prediction. We discuss the advantages and disadvantages of such an assumption, together with the implications in terms of policy.

4.1 Information Sharing

The type of altruism we consider consists in the maximization of the total borrower welfare. As sketched above, a smart altruistic MFI is concerned with the welfare of her clients *and* with the welfare of the customers served by her competitor. In other words, she takes into account the consequences her strategy has on the competitor's behavior and on her customers. We show that under this behavioral assumption there exist equilibria in which MFIs specialize in different market niches.

Without loss of generality, assume that a is altruistic and b is profit maximizing¹⁰. Then a is a *smart* altruistic MFI if she solves the following maximization problem:

¹⁰We have assumed that $\alpha_a > \alpha_b$, but our results do not depend on a being the altruistic MFI.

$$\begin{aligned} \max_{D^a, x^a} X^a(C^a, C^b, \alpha^a)[m - P(C^a, C^b)D^a] + \\ X^b(C^b, D^a, \alpha^b)[m - P(C^b, C^a)D^b] \end{aligned} \quad (8)$$

subject to:

$$X^a(C^a, C^b, \alpha^a)[P(C^a, C^b)D^a - 1] \geq 0 \quad NBC$$

MFI a has three options: serve the Safe borrowers (inducing screening), serve the Risky ones (also inducing screening), or target both types. The option of serving the residual demand is clearly always dominated. In what follows, we analyze in more detail these possibilities.

Consider first the case in which a serves Both types of borrowers. There are no screening issues and a 's altruism has no positive effect on b 's customers. To maximize the borrowers' utility functions a sets D^a as low as possible, namely $D^a = 1/p_b$, so that the NBC binds. x^a is set as high as possible, so that also the capacity constraint binds. b is left with the residual demand and the total borrower welfare depends on whether $\Pi_{ResR} > \Pi_{ResB}$ or vice versa.

As in Lemma 2, let D_{min}^i be the value of D^i making MFI j indifferent between the screening profit and the best outside option. In what follows we describe the reaction function of a smart altruistic MFI.

Lemma 3. *If a behaves as a Smart Altruistic MFI and b maximizes her profit, then all the contracts allowing a to serve the Safe types only are dominated strategies.*

Proof. See Appendix B □

The result is due to the fact that, to make screening possible, some of the Safe borrowers must be rationed. The amount of screening needed is inversely related to the repayment D . So that if a wants to serve the Safe borrowers, a lower D^a corresponds to a lower x^a . That mitigates the positive effects of altruism. Moreover, a 's behavior has limited influence on b 's. In equilibrium, in fact, the level of the informational rent that b leaves to the Risky borrowers depends on her outside option only, and not on the specific contract offered by a . Thus, a 's altruism influences b 's strategy only via the elimination of one outside option: undercutting a 's contract is no longer profitable. But there is no direct effect arising from harsher price competition.

When, instead, a targets the Risky types, screening is possible. To understand why, we have to consider two different effects. First, an altruistic MFI wants to leave the Risky borrowers with the highest possible utility. In terms of screening, this means that the informational rent is set to its maximum. Since the level of rationing is decreasing in the informational rent, a 's altruism makes screening more interesting also for a profit maximizing b . The second effect is a consequence of harsher price competition. MFI a , in fact, can set her contract so cheap to make it affordable also for the low-return Safe borrowers. Thus, unlike the standard screening model, b cannot extract all the rent from them.

The combination of these effects makes this strategy particularly attractive for a . But from b 's point of view the effects are potentially countervailing. Still, as showed in the next proposition, there exist equilibria with screening in which a serves the Risky types and b the Safe ones.

Proposition 5. *Suppose that a behaves as a Smart Altruistic MFI and b maximizes her profit. Then if $\alpha^a \leq \bar{\alpha}$ there exist screening equilibria in which a serves the Risky borrowers setting $C^a = C(1, \max\{1/p_r, D_{min}^a + \epsilon\})$, and b serves the Safe borrowers setting $C^b = C(1 - \epsilon, D^a - \epsilon)$, where $\epsilon \in \mathbb{R}$.*

Proof. See Appendix B. □

The threshold $\bar{\alpha}$ is defined in the appendix. Interestingly, $\bar{\alpha}$ is decreasing in β and increasing in α^b . This implies that screening is more likely to take place in: (i) a market in which the proportion of Risky borrowers is high; this is due to the fact that in the equilibrium described above the Risky borrowers are the ones enjoying the highest welfare; (ii) a market in which the profit maximizing firm is big enough; this effect is clearly due to the fact that a cares also about b 's clients welfare.

4.2 Absence of Credit Bureaus

In the previous subsection we described the behavior of a smart altruistic MFI when borrowers cannot take more than one loan. We showed that the presence of this type of institution can lead to equilibria with screening in which MFIs offer very similar contracts.

Do the equilibria described in Proposition 5 survive when there is no information sharing? The answer depends again on the value of p'_r and p'_s . Given that ϵ can be chosen arbitrarily small, the next result is just a corollary of proposition 4.

Corollary 1. *When a Smart Altruistic MFI competes with a Profit Maximizing one, in the screening equilibria there are no ex-ante incentives for multiple-borrowing if $p'_s < 1/2$ and $p'_r < 1/2$.*

Proof. The result follows from Proposition 4 and equations (2) and (3) \square

Drawing from the remarks in the previous section, we can observe that when $\hat{p}'_r < 1/2$, the presence of an altruistic MFI makes screening equilibria more resistant to missing information. Interestingly, when no-screening equilibria prevail, safe borrowers do not have ex-ante incentives to multiple-borrow.

Proposition 6. *When a Smart Altruistic MFI competes with a Profit Maximizing one, in the no-screening equilibria Safe borrowers never have ex-ante incentives for multiple-borrowing. Risky borrowers have incentives to multiple borrow only if $\Pi_{ResB} \geq \Pi_{ResR}$ and*

$$p'_r > \frac{R_r - 1/p_b}{2R_r - R_s - 1/p_b}$$

Proof. see Appendix B. \square

Note that the threshold defined in proposition 6 is always greater than 1/2. Thus multiple lending takes place only when the probability of being successful in the second investment is quite high.

5 Non Committing Applications

The results above are based on the assumption that when a borrower applies for credit at a specific MFI, he is somehow locked in by its application. In other words he cannot apply, wait to see whether the application is accepted or not, and then eventually decide whether to take the money or decline the contract. This assumption seems, at a first glance, essential to the implementation of screening equilibria. Suppose it does not hold and consider the following situation: a and b have set contracts such that the conditions for screening examined above are satisfied. In that case a Risky borrower can decide to apply for credit to both MFIs even though ex-ante she prefers the contract specifically designed for his type, say (x_r, D_r) . Let the (x_s, D_s) be the contract designed for the Safe borrowers. Then a Risky borrower can wait for the realization of x_s , and in case of positive outcome accept (x_s, D_s)

and decline (x_r, D_r) . In this case her expected utility is obviously greater than what she would get applying only for (x_r, D_r) :

$$x_s(m - p_r D_s) + (1 - x_s)(m - p_r D_r) > (m - p_r D_r)$$

since $D_s \leq D_r$. Given that all the Risky borrowers have the same identical incentives, the MFI supposed to serve the Safe types has no reason whatsoever to set a contract satisfying the conditions of Proposition 1. Thus, no equilibrium with screening exists.

The essence of the problem is that in the model borrowers bear no costs for shopping around, applying for credit, and declining offers. In the example above, applying for the contract designed for the Safe borrowers is equivalent to getting a lottery ticket for free.

In the previous section we implicitly assumed that declining an application has an arbitrarily high cost. The same type of assumption is made in most of the credit rationing models à la Stiglitz and Weiss. In what follows, we show that by imposing a simple application fee, MFIs can avoid borrowers to apply for mere opportunistic reasons. More importantly, we show how this fee depends on the contract offered by the competing MFIs.

Re-define a contract as a triple (x^i, D^i, k^i) , where k^i is a fixed fee to be paid at the moment of the application. Obviously, a high enough k discourages borrowers from applying to more than one MFI. Suppose that borrowers, irrespective of their types, are endowed with an initial wealth w whose size is private information. For the sake of our discussion we do not need to define an upper bound for w , but considering microcredit markets it is reasonable to think of w as being very small.

Interestingly, in a screening equilibrium the level of k^i such that borrowers do *not* want to apply to multiple MFIs depends on the values of x^i and D^i set by a and b . To see that just observe that:

$$x_s(m - p_r D_s) - k + (1 - x_s)(m - p_r D_r) - k \leq (m - p_r D_r) - k \Leftrightarrow k \geq x_s p_r (D_r - D_s)$$

Thus, k must be bigger the bigger is the difference between D_r and D_s . This allows us to link together MFI's strategies, altruistic behavior and multiple borrowing. Note, in fact, that in the screening equilibria described in Proposition 5, contracts are identical up to an arbitrarily small constant $\epsilon \in \mathbb{R}$. So, the presence of a smart altruistic MFI in the market makes screening equilibria possible even in markets characterized by very low initial wealth w .

When both MFIs are profit maximizing, the difference $(D_r - D_s)$ is higher. This increase is partially offset by a lower value of x_s . Thus, if w is not too low, screening is still possible.

This simple result highlights how important the role of altruistic MFIs can be in poor areas in which MFIs would like to differentiate their contracts. A profit maximizing institution can greatly benefit from the presence of a socially motivated microcredit program, especially when informational asymmetries are substantial and the borrowers are very poor.

The application fee k can obviously be interpreted as the cost of the effort necessary to apply for credit (preparing the documents, going to the closest bank branch, getting informed on the contract conditions). Even when k is interpreted as a financial transfer, such a tariff could be easily applied in those markets in which implementing a credit bureau is for some reason impossible. Indeed, evidence shows that most micro-borrowers do have some liquidity even before having access to credit. In fact, as said before, microcredit mechanisms are commonly based on very frequent repayment installments, starting almost immediately after the loan disbursement. In other words, borrowers often start repaying before earning the profit from their investment. For that to be possible, they must have some initial wealth. This mechanism is considered a good substitute for collateral in those areas in which legal seizing of personal belongings in case of default is impossible or particularly difficult.

6 Conclusions

Microfinance has attracted an important variety of actors, pursuing different objectives and competing with each other to attract clients. Our model describes the interaction between these actors in a tractable framework capturing the special features of microcredit markets.

Our results are relevant in two respects. First, we show how increasing competition can make informational asymmetries harsher and how proper contract design can help mitigating this issue. We concentrate on the *ex-ante* incentive to multiple-borrow in order to evaluate the effects of the absence of a credit bureau. Second, we show how important it is to take into account the different motives of MFIs. The interaction of competing MFIs leads to remarkably different equilibria when these different objectives are taken into account.

Understanding the mechanism driving our results is very important for those who are working to enlarge the outreach and promote the development of microfinance.

Our model does not tackle all the issues created by insufficient information sharing between MFIs. In particular, using a static model, we concen-

trate only on the *ex-ante* incentives to multiple borrow. A dynamic set-up would be needed to address the *ex-post* incentives arising from unpredicted negative shocks. Thus, our result should not be read as aiming at understating the importance of a credit bureau. Our emphasis is rather on how MFIs can minimize their risk when sharing information is not possible. We believe this is an interesting approach since in many developing countries the conditions making the creation of a credit bureau possible are still far from being fulfilled.

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A Naive Altruism

We define a *naive* altruistic institution as an MFI solving the following maximization problem:

$$\max_{D^a, \alpha^a} X^a(C^a, C^b, \alpha^a)[m - P(C^a, C^b)D^a] \quad (9)$$

subject to:

$$X^a(C^a, C^b, \alpha^a)[P(C^a, C^b)D^a - 1] \geq 0 \quad NBC$$

where $X^i(C^a, C^b, \alpha^i) := \min\{x^i B(C^a, C^b), \alpha^i\}$. The behavior of MFI b is the same described in Section 3.1. Define $p_b := \beta p_s + (1 - \beta)p_r$. A *naive* altruistic MFI maximizes the utility of all the borrowers she serves taking into account a non-bankruptcy constraint. The solution of the problem above is described in the next proposition.

Proposition 7. *A Naive Altruistic MFI always set $D^a = 1/p_b$. The profit maximizing competitor reacts serving the residual demand.*

Proof. Suppose for a moment that a has complete information about the borrowers type, so that she can screen them. Whatever her preferred sector is, she sets her contract so as to leave her customers the highest possible utility while taking into account the NBC. The maximal utility she can give to her customers without going bankrupt is $(1 - \beta)(m - 1)$ if she serves the Risky, $\beta(m - 1)$ if she serves the Safe, and $\alpha^a(m - 1)$ if she serves Both types.

We have some cases to consider. First, suppose that $\alpha^a > \max\{\beta, 1 - \beta\}$. Then a perfectly informed a *always* prefers to serve both types. If, instead, a has incomplete information, she can still ensure her customers the payoff $\alpha^a(m - 1)$ serving both types. This is simply done by setting $D^a = \frac{1}{p_b}$, that is the value making her NBC binding. b cannot undercut this offer, or she would make negative profits. Moreover, because of adverse selection, the borrower welfare attainable from serving only Risky or only Safe clients is surely not greater than $(1 - \beta)(m - 1)$ and $\beta(m - 1)$, respectively.

Second, suppose that $\alpha^a < \max\{\beta, 1 - \beta\}$. If $(1 - \beta) > \beta$ then serving the Risky types cannot give a profit higher than that attainable by serving both types with $D^a = 1/p_b$, since the capacity constraint binds. The same argument applies when $\beta > (1 - \beta)$. We can then conclude that targeting Both types is a strictly dominating strategy for a Naive Altruistic MFI.

Consider now the reaction of b . She cannot undercut a 's contract, or she would make negative profit. Screening is clearly impossible. Thus, the best reaction is to target the residual demand. \square

A *naive* altruistic MFI always chooses a contract that attract both types, and she makes it as cheap as possible setting $D^a = 1/p_b$, that is the repayment making the NBC binding. This simple model shows that an MFI concerned only with her customers' welfare has no incentive whatsoever to engage in a screening strategy. Trying to differentiate her offer from that

of the competitor can only decrease her positive impact on borrowers. Depending on the values of the parameters, b 's reaction is either to serve the residual demand of the Risky types or to serve the residual demand of Both.

B Omitted Proofs

Proof of Lemma 1: Suppose that i is willing to serve the Safe borrowers only, and that she offers the contract described in Lemma 1. We show that j 's optimal reaction is to offer a screening contract. The values of x^i we are looking for, are easily obtained computing the profits j would get serving the Risky borrowers only, that is when $B^j(C^i, C^j) = 1 - \beta$. His maximization problem in this case is given by:

$$\max_{x^j, D^j} \Pi_{rs}^j = (1 - \beta)x^j(p_r D^j - 1)$$

In order to have $B^j(C^i, C^j) = 1 - \beta$, we need the following conditions to hold.

$$\begin{aligned} D^j &\leq R_r && PC1 \\ D^i &\leq R_s && PC2 \\ x^j p_r (R_r - D^j) &\geq x^i p_r (R_r - D^i) && IC1 \\ x^i p_s (R_s - D^i) &\geq x^j p_s (R_s - D^j) && IC2 \end{aligned}$$

Consider first the constraints $PC1$ and $IC1$. The $IC1$ is always binding since the left hand side is decreasing in D^j . Solving it for D^j we get:

$$D^j = R_r - \frac{x^i}{x^j}(R_r - D^i)$$

What about x^j ? Substituting D^j in the profit function we get:

$$\Pi_{rs}^j = (1 - \beta)x^j [p_r R_r - p_r \frac{x^i}{x^j}(R_r - D^i) - 1] = (1 - \beta)(x_r p_r R_r - x^j - p_r x^i (R_r - D^i))$$

that is clearly maximized for $x^j = 1$ given that $p_r R_r = m > 1$. So j can set:

$$\begin{cases} x^j = 1 \\ D^j = R_r - \frac{x^i}{x^j}(R_r - D^i) \end{cases} \quad (10)$$

that gives her the expected profit:

$$\Pi_{rs}^j = (1 - \beta)[(m - 1) - p_r x^i (R_r - D^i)] \quad (11)$$

This profit must be compared with the j 's outside options. She can:

1. Target the Risky sector, but serve only the residual demand of the Risky. It is then optimal to set $D^j = R_r$ and $x^j = 1$, that gives profit $\alpha^j(1 - \beta)(m - 1)$.

2. Target the residual demand of Both types. This leads to profit $\alpha^j[\beta(m-1) + (1-\beta)(p_r R_s - 1)]$.
3. Target both types undercutting the Incumbent's contract. This can be done by setting $x^j = 1$ and $D^j = D^i$. The profit is then $\Pi_{Both} = \alpha^j[\beta(m-1) + (1-\beta)(p_r R_s - 1)]$.

Note that since, by assumption $\alpha^i + \alpha^j < 1$, the outside options 2 and 3 are equivalent. Depending on the parameters and on the assumptions about MFIs' behavior, one of the remaining options dominates the other. When $\Pi_{ResR}^j \geq \Pi_{ResB}^j$ we need this condition to hold for j to engage in screening:

$$(1-\beta)[(m-1) - p_r x^i (R_r - D^i)] > \alpha^j (1-\beta)(m-1) \quad (12)$$

Solving the inequality for x^i we find the threshold:

$$\hat{x} := \frac{(1-\alpha^j)(m-1)}{m - p_r D^i} \quad (13)$$

When $\Pi_{ResB}^j \geq \Pi_{ResR}^j$, the following condition is needed:

$$(1-\beta)[(m-1) - p_r x^i (R_r - D^i)] > \alpha^j [\beta(m-1) + (1-\beta)(p_r R_s - 1)] \quad (14)$$

and solving for x^i we get:

$$\hat{x} := \frac{(1-\beta)(m-1) - \alpha^j [\beta(m-1) + (1-\beta)(p_r R_s - 1)]}{(1-\beta)p_r (R_r - D^i)} \quad (15)$$

Note that in all these cases \hat{x} is not necessarily in $[0, 1)$. If \hat{x} is greater than one, then screening is clearly possible for any $x^i < 1$.

We still have to show that these values of \hat{x}^I make screening possible. We have to verify that given j 's optimal reaction, the value \hat{x}_s satisfies also condition (IC2). Replacing $x^j = 1$ and $D^j = R_r - \frac{x^i}{x^j}(R_r - D^i)$ in the IC2 we get:

$$x^i (R_s - D^i) \geq [R_s - R_r + x^i (R_r - D^i)] \Rightarrow x^i (R_s - R_r) \geq R_s - R_r$$

that is satisfied for any $x^i \in [0, 1)$. □

Proof of Lemma 2: Suppose that i wants to specialize in the Risky sector inducing j to serve the Safe sector and to offer an incentive compatible contract. In this case j solves this maximization problem:

$$\max_{x^j, D^j} \Pi_{sr}^j = \beta x^j (p_s D^j - 1)$$

To have $B^j(C^i, C^j) = \beta$, the following conditions must be fulfilled:

$$\begin{aligned}
D^j &\leq R_s && PC1 \\
D^i &\leq R_r && PC2 \\
x^i p_r(R_r - D^i) &\geq x^j p_r(R_r - D^j) && IC1 \\
x^j p_s(R_s - D^j) &\geq x^i p_s(R_s - D^i) && IC2
\end{aligned}$$

We have to consider two possible cases: (i) i sets $D^i \geq R_s$; (ii) i sets $D^i < R_s$. We show that as long as $D^i > R_s$ i can raise j 's profit from screening by setting a lower D^i . When, instead, $D^i < R_s$, j 's profit decreases when D^i becomes too low. In fact, a lower D^j (necessary to have screening) is only in part compensated by a higher x^j .

(i) $D^i \geq R_s$. This is the relevant case when both MFIs are profit maximizing. Consider first the IC2. When $D^i \geq R_s$ the RHS is negative, and the PC binds. Thus j can set $D^j = R_s$. In order to attain screening, IC1 must be satisfied. Solving it for x^j we find the condition:

$$x^j \leq \frac{x^i(R_r - D^i)}{R_r - D^j} := \hat{x} \quad (16)$$

that is binding at the optimum. Notice that if $D^i = R_r$, (16) is true only for $x^j = 0$. So i must offer a contract with $D^i < R_r$. j 's expected profit is then:

$$\Pi_{sr}^j = \beta \hat{x}(m-1) \quad (17)$$

This must be compared with j 's outside options. She can:

1. Target both types offering a non incentive compatible contract characterized by $D^j = R_s$ and $x^j = 1$. This strategy gives profit $\Pi_{br}^j = \alpha^j(\beta(m-1) + (1-\beta)(p_r R_s - 1))$. In this case, for j to prefer serving the Safe types, we need $\Pi_{sr}^j \geq \Pi_{br}^j$. In formulas:

$$\beta x^j(m-1) \geq \alpha^j(\beta(m-1) + (1-\beta)(p_r R_s - 1)) \implies x^j \geq \alpha^j \left(1 + \frac{(1-\beta)(p_r R_s - 1)}{\beta(m-1)}\right)$$

Replacing x^j with (16) we get:

$$D^i \leq R_r - \frac{\alpha^j}{x^i} \left[1 + \frac{(1-\beta)(p_r R_s - 1)}{\beta(m-1)}\right] (R_r - R_s) := \hat{D}^i$$

2. Target the Risky sector, undercutting i : also in this case, as showed above, to induce screening i must set $D^i = R_r - x^j/x^i(R_r - R_s)$. We can determine the relevant value of x^j by solving the inequality :

$$\begin{aligned}
\beta x^j(m-1) &\geq (1-\beta)[(m-1) - p_r x^j(R_r - R_s)] \implies \\
x^j &\geq \frac{(1-\beta)(m-1)}{\beta(m-1) + (1-\beta)(m - p_r R_s)}.
\end{aligned}$$

Now replacing again x^j with (16) we get:

$$D^i \leq R_r - \frac{1}{x^i} \left[\frac{(1-\beta)(m-1)}{\beta(m-1) + (1-\beta)(m-p_r R_s)} \right] (R_r - R_s) := \hat{D}^i$$

If we define

$$\hat{x}^j := \max \left\{ \alpha^j \left(1 + \frac{(1-\beta)(p_r R_s - 1)}{\beta(m-1)} \right), \frac{(1-\beta)(m-1)}{\beta(m-1) + (1-\beta)(m-p_r R_s)} \right\}$$

then $\hat{D}^i(\hat{x}^j)$ gives the upper bound for D^i .

(ii) $D^i < R_s$. This case is relevant when one MFI, say i , is altruistic. We can rewrite the incentive constraints when i sets $D^i \leq R_s$ and $x^i = 1$:

$$\begin{aligned} x^j p_s(R_s - D^j) \geq p_s(R_s - D^i) &\Rightarrow D^j \leq R_s - \frac{R_s}{x^j} + \frac{D^i}{x^j} \\ p_r(R_r - D^i) \geq x^j p_r(R_r - D^j) &\Rightarrow D^j \geq R_r - \frac{R_r}{x^j} + \frac{D^i}{x^j} \end{aligned}$$

The equations above delimit an interval of contracts satisfying both incentive constraints. Note that for $x^j < 1$ this interval for D^j exists and has a strictly positive measure. So, for any contract offered by i with $D^i < R_s$, j can make screening possible by choosing $x^j < 1$ and $D^j = D^i - \epsilon$, with $\epsilon \in \mathbb{R}_+$, making the safe borrower's incentive constraints binding. By doing that she earns $\Pi_{sr} \cong x^j \beta(p_s D^i - 1)$. She chooses this strategy iff it gives her a higher profit than the possible outside options: serving the residual demand or undercutting i 's contract. Let then D_{min}^i be the value of D^i making j indifferent between the screening profit and the outside option. That gives the lower bound for D^i . \square

Proof of Proposition 1: The proof hinges on Lemma 1 and Lemma 2. Suppose that MFI i , with $i \in \{a, b\}$ has offered an incentive compatible contract targeting the Safe borrowers, that is a contract such that $D^i \leq R_s$ and $x^i < 1$. Assume also that $\alpha^j \geq 1 - \beta$, with $j \neq i$, $j \in \{a, b\}$. Then MFI j 's reaction is to offer an incentive compatible contract, too (that is a contract characterised by $D^j = R_r - x^i(R_r - D^i)$ and $x^j = 1$) if the profit from screening is higher than the best possible outside option. MFI j 's profit from serving the Risky types in a screening set-up is given by

$$\Pi_r^j(C^i) = (1-\beta)[(m-1) - x^i(m - p_r D^i)]$$

The best outside option for j , given i 's contract, is to undercut it offering $D^j = D^i$ and $x^j = 1$. That would give her $\Pi_{Both}^j(C^i) = \alpha^j(\beta(p_s D^i - 1) + (1-\beta)(p_r D^i - 1))$. Thus the condition for MFI j to prefer screening is: $\Pi_r^j(C^i) > \Pi_{Both}^j(C^i)$. As showed in Lemma 1 and 2, MFI i optimally sets $D^i = R_s$. Thus, the condition above can be rewritten as:

$$x^i \leq \frac{(1-\beta)(m-1) - \alpha^j[\beta(m-1) + (1-\beta)(p_r R_s - 1)]}{(1-\beta)(m - p_r R_s)} \quad (18)$$

In order for the strategies defined above to be an equilibrium, we need MFI i to prefer setting x^i smaller than the upper bound above rather than playing her outside options. Several alternatives are available to i . Assume first that $\alpha^i > \beta$. There are then two cases:

(i) The best outside option is to serve both types setting $D^i = R_s$ and $x^i = 1$. In this case for i to prefer a screening strategy we need this condition to hold:

$$x^i \geq \frac{\alpha^i[\beta(m-1) + (1-\beta)(p_r R_s - 1)]}{\beta(m-1)} := \tilde{x}_s^i \quad (19)$$

(ii) The best outside option is to undercut MFI j 's contract. We have to distinguish two sub-cases. If $\alpha^i \geq (1-\beta)$ the screening condition is:

$$x^i \geq \frac{(1-\beta)(m-1)}{\beta(m-1) + (1-\beta)(m-p_r R_s)} := \tilde{x}_s^i \quad (20)$$

If instead $\alpha^i < (1-\beta)$ the condition is:

$$\beta x^i (m-1) \geq \alpha^i (1-\beta) [(m-1) - x^i (m-p_r R_s)]$$

that can be rewritten as:

$$x^i \geq \frac{\alpha^i (1-\beta)(m-1)}{\beta(m-1) + \alpha^i (1-\beta)(m-p_r R_s)} := \tilde{x}_s^i \quad (21)$$

To have an equilibrium, equation (18) and one of the three equations defining \tilde{x}_s^i ((19), (20), (21)) must be satisfied simultaneously.

Consider now the case in which $\alpha^i < \beta$. It is easy to see that in this case equilibria similar to the one described above are still possible. If $\alpha^i > \tilde{x}_s^i$ then the results showed above hold true. If the capacity is instead very small, then the level of screening is implicitly defined by α^i . To see that, just observe that when $\alpha^i < \tilde{x}_s^i$ and $D^i \leq R_s$ the outside option examined at point (i) can be ruled out. In fact, j can impose a screening strategy just by giving the Risky borrowers the adequate informational rent. \square

Proof of Proposition 2: Suppose first that $\Pi_{ResR} > \Pi_{ResB}$, and that MFI a offers a contract with $x^a = 1$ and $D^a = D^*(b)$. We describe the optimal reaction of b . Given a 's capacity constraint, the residual demand is given by $1 - \alpha^a$, but by assumption $\alpha^b \leq (1 - \alpha^a)$. So b cannot do better than offering $D^*(b)$. In fact, by definition $D^*(b)$ satisfies this condition:

$$\alpha^b [\beta(p_s D^*(b) - 1) + (1-\beta)(p_r D^*(b) - 1)] = \alpha^b (1-\beta)(m-1)$$

that can be rewritten as $\beta(p_s D^*(b) - 1) + (1-\beta)(p_r D^*(b) - 1) = (1-\beta)(m-1)$. We now show that offering $x^a = 1$ and $D^a = D^*(b)$ is a best reaction for a given

b 's contract. For a not to be willing to undercut b 's contract, $D^*(b)$ must satisfy this condition:

$$\alpha^a[\beta(p_s D^*(b) - 1) + (1 - \beta)(p_r D^*(b) - 1)] = \alpha^a(1 - \beta)(m - 1),$$

since $\alpha^a \leq (1 - \alpha^b)$. The condition is clearly satisfied. So a 's best reply, given our tie-breaking rule, is also to offer $x^a = 1$ and $D^a = D^*(b)$. Analogous reasoning can be used for the case in which $\Pi_{ResR}(\alpha^b) < \Pi_{ResB}(\alpha^b)$. \square

Proof of Lemma 3: Let a be a smart altruistic MFI and b a profit maximizing one. Suppose that b sets a contract characterized $D^b \geq R_s$ and $x^b = 1$. a has then three possibilities: (i) target the Safe types and induce screening; (ii) target both types, (iii) target the Risky types undercutting b . We prove that option (i) is always dominated by (ii).

(i) We already know from Lemma 1 that a screening contract is a best response for b if $x^a \leq \hat{x}(D^a)$. Now we check whether serving only the Safe borrowers offering a screening contract is a best response for a . We have to consider the effects of a 's choice on both the Safe borrowers she serves *and* the Risky borrowers served by b . Note first that when $x^a = \hat{x}(D^a)$, b 's optimal contract does not depend on D^a . b 's reaction is to offer $D^b = R_r - \frac{x^a}{x^b}(R_r - D^a)$. Substituting for the adequate value of $\hat{x}(D^a)$, it is very easy to check that the value D^b is independent of D^a . It follows that also b 's profit and the Risky borrowers' welfare are independent of a 's choice. This implies that a 's altruism has no beneficial effects on the Risky borrowers served by b . So, what matters is the utility enjoyed by the Safe borrowers. Note that, in all the cases analyzed in Lemma 1, $\hat{x}(D^a)$ is increasing in D^a . Thus, for a there is a trade-off between offering a 'cheaper' contract and rationing more. To find the optimal solution substitute for $\hat{x}(D^a)$ in the objective function, that in this case reduces to $\beta x^a p_s (R_s - D^a)$. In the relevant interval this is decreasing and concave in D^a . The NBC becomes $\beta x^a (p_s D^a - 1) \geq 0$. a chooses the lowest possible value of D^a , that is the value that makes her profit equal to zero. This is given by $D^a = 1/p_s$. The total borrower welfare is:

$$\bar{B}W_{sr} = \beta \hat{x}(1/p_s)(m - 1) + (1 - \beta)(m - p_r D^E) \quad (22)$$

(ii) In this case there are no screening issues and a 's altruism has no effect on b 's customers. To maximize the borrowers' utility functions a sets D^a as low as possible, namely $D^a = 1/p_b$, so that the NBC binds. x^a is set as high as possible, so that also the capacity constraint binds. b is left with the residual demand and the total borrower welfare is given by:

$$BW_B = \begin{cases} \alpha^a(m - 1) & \text{if } \Pi_{ResR} > \Pi_{ResB} \\ \alpha^a(m - 1) + \alpha^b(1 - \beta)p_r(R_r - R_s) & \text{if } \Pi_{ResB} > \Pi_{ResR} \end{cases} \quad (23)$$

Now we show that serving the Safe types only is a dominated strategy for a . Consider first the case in which $\Pi_{ResR} > \Pi_{ResB}$. We can replace the values of $\hat{x}(D^a)$

(first formula in Lemma 1) and $D^b = R_r$ in equation (22). After some computations the formula simplifies to:

$$BW_{sr} = \alpha^a(m-1) \left[-\frac{\beta}{m - p_r/p_s} + \beta \frac{p_r}{p_s} \frac{1}{m - p_r/p_s} + 1 \right]$$

For BW_{sr} to be bigger than BW_B we need the term in squared bracket to be bigger than one. This happens if and only if

$$m - \frac{p_r}{p_s} + \beta \left(\frac{p_r}{p_s} - 1 \right) > m - \frac{p_r}{p_s} \implies \frac{p_r}{p_s} > 1$$

that is impossible since by assumption $p_r < p_s$.

Consider now the case in which $\Pi_{ResB} > \Pi_{ResR}$. As above, we replace the values of $\hat{x}(D^s)$ (second formula in Lemma 1) and $D^b = R_s$ in equation (22). The result is a strictly decreasing and concave curve in β . Note that $\Pi_{ResB} > \Pi_{ResR}$ if $\beta \geq \frac{m - p_r R_s}{2m - p_r R_s - 1} = \beta^c$. Substituting this threshold in (22) we get an upper bound:

$$BW_{sr}(\beta^c) = \frac{(m-1)[2mp_s - p_r - p_r m]}{(p_s m - p_r)(2m - p_r R_s - 1)} \alpha^a(m-1)$$

We have to prove that the first multiplier is smaller than one. The condition can be rewritten as:

$$R_r \left(2 - \frac{p_s}{p_r} \right) < R_s$$

Replacing $R_r = \frac{p_s}{p_r} R_s$ in the formula above we get:

$$2 \frac{p_s}{p_r} - \left(\frac{p_s}{p_r} \right)^2 - 1 < 0 \implies \left(\frac{p_s}{p_r} - 1 \right)^2 > 0$$

that is clearly always satisfied. Given the monotonicity and the concavity of BW_{sr} , this is enough to prove that a always prefers serving both types. \square

Proof of Proposition 5: Suppose that b sets an incentive compatible contract characterized by $D^b \leq \max\{1/p_r, D_{min}^a\}$ and $x^b < 1$. Then, a chooses between serving the Risky borrowers only and serving both types. In the first case, to maximize the Risky borrower's utility, a sets $x^a = 1$ and D^a as low as possible. The value of D^a that makes the NBC binding is $1/p_r$. Note that as a consequence of our assumptions $1/p_r \leq R_s$. As described in Lemma 2, if a sets $x^a = 1$ and $D^a = \max\{1/p_r, D_{min}^a + \epsilon\}$, then b 's response is indeed to offer an incentive compatible contract with $x_s = 1 - \epsilon$ and $D^b = D^a - \epsilon$. Suppose now that $\Pi_{ResR} > \Pi_{ResB}$. Then D_{min}^a is the solution to the following equation:

$$\beta(p_s D_{min}^a - 1) = \alpha^b(1 - \beta)(m - 1) \implies D_{min}^a = \frac{(1 - \beta)m + \beta}{p_s}$$

For a to prefer serving the Risky types it must be that:

$$\beta p_s(R_s - D_{min}^a) + (1 - \beta)p_r(R_r - D_{min}^a) \geq \alpha^a(m - 1).$$

Solving for α^a we get:

$$\alpha^a \leq \frac{(m - 1) \left[\alpha^b \beta + (1 - \beta) \beta \frac{p_r}{p_s} \right] + (1 - \beta)(m - p_r R_s)}{m - 1} := \bar{\alpha}$$

Analogous calculations can be done for the case $\Pi_{ResB} > \Pi_{ResR}$. The equations to solve are:

$$\begin{aligned} \beta(p_s D_{min}^a - 1) &= \alpha^b[\beta(m - 1) + (1 - \beta)(p_r R_s - 1)] \\ \alpha^b p_s(R_s - p_s D_{min}^a) + (1 - \beta)p_r(R_r - p_r D_{min}^a) &\geq \alpha^a(m - 1) + \alpha^b(1 - \beta)(m - p_r R_s) \end{aligned}$$

When $D_{min}^a < 1/p_r$, a can offer the maximum possible welfare to the Risky borrowers. We can compute the total welfare the borrowers would get if $\epsilon = 0$. Let us call this approximation \overline{BW}_{rs} . Then, the value of $\bar{\alpha}$ is the solution to the equation $\overline{BW}_{rs} > BW_B$. If $\Pi_{ResR} > \Pi_{ResB}$ we have:

$$\alpha^b \left(m - \frac{p_s}{p_r} \right) + (1 - \beta)(m - 1) \geq \alpha^a(m - 1) \Rightarrow \alpha^a \leq (1 - \beta) + \alpha^b \frac{m - \frac{p_s}{p_r}}{m - 1} := \bar{\alpha}$$

Analogously, when $\Pi_{ResB} > \Pi_{ResR}$ we have

$$\begin{aligned} \alpha^b \left(m - \frac{p_s}{p_r} \right) + (1 - \beta)(m - 1) &\geq \alpha^a(m - 1) + \alpha^b(1 - \beta)(m - p_r R_s) \Rightarrow \\ \alpha^a &\leq (1 - \beta) + \alpha^b \frac{\beta(m - p_r R_s) + p_r R_s - \frac{p_s}{p_r}}{(m - 1)} := \bar{\alpha} \end{aligned}$$

□

Proof of Proposition 3: Assume that MFI b serves the Safe borrowers and MFI a serves the Risky ones. In the equilibria with screening of the simultaneous model b sets $x^b = \hat{x}_s < 1$ and $D^b = R_s$, whereas a sets $x^a = 1$ and $D^a = \hat{D}_r$, where \hat{x}_s and \hat{D}_r are defined as in Lemma 1.

When we substitute these values in equations (2) and (3), we get the following conditions:

$$(R_r - R_s)p'_r < (R_r - \hat{D}_r)(1 - p'_r)$$

for the Risky not to multiple-borrow, and

$$(R_s - \hat{D}_r)(p'_s x^b + 1 - x^b) < x^b(R_s - R_s)(1 - p'_s) = 0$$

for the Safe not to multiple borrow. The second condition is always satisfied since $\hat{D}_r > R_s$. The first condition is satisfied for

$$p'_r < \frac{R_r - \hat{D}_r}{2R_r - R_s - \hat{D}_r} = \frac{(1 - \beta)(m - 1) - \alpha_a[p_r R_s - 1 + \beta(m - p_r R_s)]}{(1 - \beta)(2m - p_r R_s - 1) - \alpha_a[p_r R_s - 1 + \beta(m - p_r R_s)]}$$

Note that the threshold is well defined since it always belong to the interval $[0, 1]$. \square

Proof of Proposition 6: In the no-screening equilibria, the Smart Altruistic MFI a offers a contract $C^a = (x^a = 1, D^a = 1/p_b)$. The profit maximizing MFI b reacts offering $D^b = R_s$ when $\Pi_{ResB} \geq \Pi_{ResR}$, and $D^b = R_r$ when $\Pi_{ResR} \geq \Pi_{ResB}$. Suppose first that $\Pi_{ResR} \geq \Pi_{ResB}$. Then, plugging the appropriate values in equations (2) and (3), it follows immediately that borrowers do not have ex-ante incentives to multiple-borrow. Suppose now that $\Pi_{ResB} \geq \Pi_{ResR}$. Than equation (3) is always satisfied, whereas equation (2) becomes:

$$(R_r - R_s)p'_r \leq (R_r - 1/p_b)(1 - p'_r) \Leftrightarrow p'_r \leq \frac{R_r - 1/p_b}{2R_r - R_s - 1/p_b}$$

\square