The Impact of Microfinance on the Informal Credit Market: An Adverse Selection Model

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Abstract

This paper looks at ‘the other side’ of the much-celebrated microfinance revolution, namely its potential impact on the conditions of access to credit for non-members, along price and quantity dimensions. It uses a standard adverse selection framework to assess how the apparition of this new type of lenders might change the equilibria on rural credit markets, taking into account the strategic reactions of traditional lenders and borrowers. Microfinance is modeled as zero-profit institutions that lend limited funds using joint-liability debt contracts. Traditional lenders supply basic individual loans, with or without market power. We find that microfinance has very different impacts depending on the characteristics on the local market, from decreasing the market interest rate due to competitive pressure, to increasing the market interest rate and decreasing the coverage of creditworthy borrowers due to negative composition externalities. Hence, looking only at credit-market outcomes, the welfare impact of microfinance is ambiguous. We show that the negative predictions happen in a nontrivial range of parameters, corresponding to many real-world situations in which both types of lenders can potentially serve different risk profiles and microfinance institutions don’t have enough capacity to supply the whole population of creditworthy borrowers.

Those arguably less intuitive impacts of microfinance, which have been overlooked until now, are important given the nearly-universal coexistence of MFIs and traditional lenders in developing countries. Moreover, they are not only theoretically likely, but seem to match the empirical evidence presented in the paper. Our paper is thus a contribution in the understanding of the redistributive implications of the microfinance revolution that has been occurring over the last years.

Keywords: Microfinance, Moneylenders, Adverse selection, Horizontal interaction, Composition effect.

JEL Classification Numbers: D82, G21, L1, O16

1 Introduction

Individuals and organizations engaged in promoting economic development are usually concerned not only with generating aggregate growth in developing countries, but also with ensuring that the beneficiaries of this growth include the poorest fringes of the population (a so-called ‘inclusive’ growth). One widely-acknowledged obstacle to achieving this goal has been the difficulty for poor and especially rural households to acquire the capital needed to finance their productive investments and other needs (e.g. Banerjee and Newman 1993, Mookherjee and Ray 2003, Banerjee 2003, ?).

From the 80s onwards, microfinance institutions (MFIs) have spread out around the world, exploiting new contractual structures and organisational forms to supply small, uncollateralized and cheap loans

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to poor people. On the one hand, empirical research has shown that those innovations - and in particular group lending\(^1\) - have generally allowed microfinance to expand outreach and increase repayment performances (see e.g. Khandker et al. 1995, Ahlin and Townsend 2007, Kritikos and Vigenina 2005, Karlan 2007, \(^2\)). On the other hand, theoretical works have been explaining how group lending, by harnessing local information, can mitigate standard adverse selection and moral hazard problems (e.g. Stiglitz 1990, Ghatak 1999, 2000, Besley and Coate 1995, \(^2\)).

However, the existing literature, by focusing on the problem of single lenders trying to tap excess demand, has not yet quite explored an important issue regarding the development of microfinance, namely its impact on the residual informal credit market and on the welfare of non participants. Indeed, MFIs are not operating in a vacuum but rather entering existing local credit systems. Although inefficient in most cases, those informal markets are very important for many people’s life. For instance, a recent survey by the Reserve Bank of India found that between 1995 and 2006, while the outreach of MFIs was booming to about 40 millions borrowers, the number of registered moneylenders increased by 56% and the number of unlicensed lenders was believed to have made similar gains (RBI, 2007)\(^2\). The last All-India Debt and Investment Survey found that informal finance accounts for about 40% of outstanding loan amounts of rural households (NSSO, 2005). It thus seems crucial to understand how they adapt to MFIs and what are the consequences for borrowers. This paper intends contributing to this issue.

Intuitively, MFIs are desirable because they potentially supply credit to otherwise-constrained households. They can also supply credit to households borrowing from moneylenders, which helps limiting the market power of the latter. Yet, in this paper, we argue that MFIs, if they select the safest projects, are also likely to worsen the information problems that cause traditional lenders to charge high interest rates and exclude some creditworthy borrowers. Indeed, MFIs will adversely affect the average probability of repayment to incumbent lenders whenever (i) they select the safest borrowers away from incumbent lenders due to their specific contract features such as group lending with self-selection of members - this is actually what the following model makes explicitly use of, or (ii) microfinance clients finance only risky projects through traditional lenders, or (iii) we observe multiple lending, with traditional loans taken to repay MFIs’ loans. As a result, MFIs may change the structure of rural credit markets in unintended ways, possibly raising interest rates or decreasing coverage, and ultimately hurting some poor borrowers.

We study a (horizontal) competition game between a zero-profit MFI that lends limited funds using joint-liability contracts and traditional moneylenders using basic individual loans.\(^3\) We find that the MFI can have very different impacts on the overall market and welfare, depending on the characteristics of the local market. Over a nontrivial region of parameters, the MFI is shown to trigger an increase of the interest rate charged by moneylenders and of the overall market rate, as well as a decrease of the coverage of creditworthy borrowers. That is, additional competition and lending capacity can have counter-intuitive and negative implications on the efficiency of credit markets and the welfare of borrowers. This adverse situation can only happen when traditional moneylenders are serving (some) safe borrowers in the absence of the MFI, and the latter does not have enough funds to supply loans to the entire population (which is an arguably realistic scenario). Moreover, depending on the amount of market power of moneylenders, the effect can be nonlinear, the MFI potentially triggering a decrease in the interest rate in extremely safe or extremely risky populations.

As a consequence, the impact of microfinance on informal credit markets is not uniform, but can be predicted according to the local configuration. Hence, the question, which is highly-relevant given the almost universal coexistence of the two types of lenders, is ultimately an empirical one. The paper proposes empirical evidence supporting the assumptions of the model and its main predictions. Using panel data from an original household survey in villages of Northeast India, we observe that microfinance clients are borrowing from moneylenders, extensively so before the entry of MFIs and in a reduced way

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\(^1\)Most microfinance programs make use of some form of group-lending schemes, such as peer selection and monitoring, regular public repayments and joint liability. In recent years, a growing number of MFIs have been turning to individual liability (e.g. Grameen II and ASA in Bangladesh, BancoSol in Bolivia). However, most of them still use groups to disburse and collect loans, which implies that some peer screening, monitoring or enforcement is still present (constituting some form of ‘implicit’ joint liability). Moreover, this trend is by no means universal: for instance, BRAC, the largest NGO in the world, still uses explicit group lending and, in India, Self-Help Groups, which adhere fairly strictly to the joint-liability contract, represent 73 per cent of the microfinance sector (Srinivasan, 2009). As a matter of fact, today, it is estimated that only 7% of microfinance loans are made to individuals (MIFA, 2008). In any case, as explained by Besley and Coate (1995), the reason why group liability works is probably not so much because of the formal structure of liability but because, after being together for a while, people start to value their relationships with other members.

\(^2\)Potential important reasons for the continued (indeed increasing) prevalence of moneylenders include confidentiality, round-the-clock availability and speed of processing, flexibility in loan use, lender-of-last-resort nature (RBI, 2007).

\(^3\)The model in this paper explicitly uses joint liability, though the conclusions can probably be generalized to any mechanism that implies some peer screening, monitoring or enforcement.
afterwards. We find that moneylenders charge higher interest rates in villages where some group-lending institutions are present than where there are none. Moreover, we find that this pattern is reversing when the number of such MFIs becomes large, implying a larger capacity and competition. Finally, we find that the increase in interest rate occurs only in non-poor villages, which are relatively less risky. Taken together, those facts provide strong support for the theoretical predictions of the model with competition among individual lenders.

The most closely related papers in the literature are focusing on formal-informal sector interaction. For instance, Hoff and Stiglitz (1997) show that subsidizing the formal sector can result in higher interest rates charged by informal moneylenders, e.g. because a subsidy induces new entry and thus weaker repayment incentives for borrowers. Bose (1998) reaches the same conclusion using a mechanism which is very close to the one discussed in our paper: if some lenders can discriminate between safe and risky borrowers while others cannot, an increase in the supply of credit of the former can worsen the composition of the pool of borrowers of the latter, thus worsening the terms of credit to some borrowers. However, in contrast to this paper, Bose (1998) deals with the vertical interaction between formal and informal sectors and looks at the effect of a public subsidy to the formal sector. More importantly, it gives no justification regarding the fact that one part of the informal sector is informed about borrowers’ type and another is not - while this is endogenously determined by the lending technologies in our model.

In Jain (1999), borrowers can take loans from both the formal and informal sectors, as in our model. The formal sector is monopolistic and decides strategically on the interest rate and the amount of the loan. Subsequently, borrowers turn to the perfectly competitive informal sector for residual financing if needed. He shows that the bank can exploit the informational advantage held by the informal lenders by offering two different types of contracts: a full funding contract at a high interest rate, and a partial funding contract at a lower rate. Indeed, since risky borrowers are being discriminated in the informal market, they will accept a higher interest rate in exchange for full funding in the formal sector. If we share the horizontal-interaction feature of Jain (1999), we do not impose any hierarchy between lenders and focus on a purely informal (or rural) setting, in which no lender has some information or cost advantage over the others. Moreover, lenders decide only on interest rates in our model.\footnote{Introducing two-dimensional contracts would be an interesting extension of our model, even though we know little real-world evidence about extensive variation in the contract terms proposed by traditional lenders within local credit markets (also see Casini 2008 for a more extensive discussion on this issue). Moreover, Jain’s separating-equilibrium mechanism is not feasible in our setting, given e.g. the general preference of safe borrowers for borrowing in groups - see section 4.4.}

Note that Andersen and Malchow-Møller (2006) show that Jain’s insights go through if both formal and informal sectors operate under imperfect competition and behave strategically.

Jain and Mansuri (2003) and Ghosh and Van Tassel (2007) study the interaction between the informal and the microfinance sector, both using a moral hazard framework. Jain and Mansuri (2003) argue that the use of regularly scheduled repayments by MFIs force borrowers to take loans from informal lenders in order to repay microfinance loans. The rationale of the system is that MFIs can thereby benefit from the monitoring advantage of better-informed moneylenders. As a consequence, microfinance can expand the volume of informal lending and may also raise the interest rate in the informal sector. Note that in Jain and Mansuri there is no group aspect involved in MFI’s loans.

Ghosh and Van Tassel (2007) have a very different framework. They develop a two-period model of a credit market supplied by a monopolistic moneylender and a subsidized microfinance institution, in presence of moral hazard and dynamic incentives. In their setting, credit is only profitable for lenders in the second period, once borrowers have acquired enough wealth to cofinance their investment. Microfinance increases the bargaining power of borrowers and decreases the moneylender’s interest rate. However, if subsidy and microfinance outreach increase too far, the moneylender cannot afford to offer loans anymore, and borrowers’ incentives to work hard and to save drop.

Finally, Madestam (2009) constructs a model in which individuals can borrow from banks, who have unlimited funds but face moral hazard at investment stage, and informal lenders, who can control the opportunistic behavior of borrowers but are capital constrained. He finds that access to informal finance raises investment, disciplines borrowers and facilitates banks’ rent extraction (given that informal lenders channel bank funds). The disciplinary effect dominates if banks are competitive, leading to an expanded overall credit provision. By contrast, informal finance serves primarily as an instrument of rent extraction if the bank is a monopolist, leading to an increase in the interest rate and a lower access to bank funds for poor borrowers. Although no formal finance is present in our paper and we use an adverse selection framework, we share some similarities with the paper of Madestam. First, we find that the impact of the lenders with information advantage depends on the market power of the other sector.
Moreover, our model could easily be extended to a framework similar to Madestam’s, in which MFIs would act as an outside option for borrowers (decreasing their reliance on banks and moneylenders). At the same time, MFIs can often be thought of channeling bank funds (e.g., bank-linked SHGs in India, which are the object of the empirical work presented in this paper) and so are likely to impact also on the formal interest rate, an issue which is left for further research.

The remaining of the paper is as follows. First, section 2 motivates our research question with a quick overview of the empirical literature on asymmetric information problems of rural credit markets. It also presents some evidence from two original sets of surveys in central India on the idea that the entry of MFIs in a traditional credit market might change it in important ways, and not always in the sense a reduction of the cost of borrowing. Then, section 3 presents the basic features of our model, which will hold throughout the paper. Section B.1 develops the benchmark perfect-competition. We first present the problems of stand-alone moneylenders and an MFI, and derive the conditions under which inefficient separating equilibria arise. We then study a competition game between the two types of lenders sharing a given informal credit market. We show that the MFI can modify the composition of the borrower pool, forcing moneylenders to increase their break-even interest rate, if safe types can borrow individually (i.e., if moneylenders are at a pooling equilibrium) and the MFI does not have enough capacity to supply the entire population of borrowers. In that case, the overall market interest rate increases, and welfare decreases. In section B.2, we look at the effect of market power and analyze a similar competition game between a not-for-profit MFI and a monopolistic moneylender. We show that the MFI’s presence can have two opposite impacts on the monopolist’s equilibrium interest rate according to the initial situation: it can either force a decrease of the interest rate in case both lenders are exactly the same pool of risky borrowers (competition effect), or foster an increase in the interest rate in case the stand-alone monopolist offers credit to safe borrowers at equilibrium (composition effect). The individual-lending rate increases whenever the MFI does not have enough funds to supply the entire market, the risk composition of the population is not too skewed and the risk heterogeneity is not too extreme. Furthermore, our model predicts that microfinance lowers the coverage of borrowers in that case. Finally, section 6 puts the model to an empirical test. We observe that, consistent with the model’s prediction, the increase in the interest rate charged by moneylenders is only happening in the villages that are less poor and less risky.

2 Some facts about rural credit markets

The core postulate of the paper is the existence of information asymmetries in traditional credit markets, which imply the impossibility for local lenders (be them ‘professional’ or not) to screen borrowers according to their riskiness. To quote Bolnick (1992) about an informal moneylender in Malawi:

*Even with this network [of informal investigators], Mr. C is often unable to judge who is a good risk and who is a bad risk, in part because a person’s behavior can change. One who formerly was a reliable customer may now have more children to feed, or business problems, or obligations to the extended family. It is difficult, he said, to trust anyone. (p. 61)*

Thus, Collins et al. (2009) report in their Portfolios of the Poor that Bangladeshi and Indian households with private interest-bearing loans ended up paying full interest less than half of the time, and in at least a third of all loans the interest was discounted, forgotten, forgiven, or ignored.

A number of recent papers provide solid empirical evidence regarding the existence and impacts of asymmetric information - and in particular adverse selection - in developing credit markets (e.g., Karlan and Zinman 2009, Rai and Klonner 2007 or Giné and Klonner 2005). The model of this paper translates this fact into interest rates, coverage of borrowers as well as welfare, and show how those evolve according to different competition and market configurations. To our knowledge, there exists very few evidence regarding the actual interest-rate behavior of lenders and especially its evolution following market modifications. The only (unpublished) study we could find that investigates the issue presents a pattern consistent with the mechanisms of our model: using village-level data from Bangladesh, Mallick (2009) finds that greater MFI penetration is associated with higher average moneylender interest rates. However, he fails to explain this seemingly counterintuitive result. A recent survey by the Reserve Bank of India points to the same apparent puzzle (though in a milder version):

*In the [177] districts surveyed, and where the presence of MFI-SHG's was significant, the incidence of money lending by traditional moneylenders has come down. However, this has*
Below we display some illustrative first-hand data regarding interest rates charged by traditional lenders and the riskiness of moneylenders’ business. The data come from two sets of household surveys that were collected between 2002 and 2009 in villages of central India, in which a large NGO has been organizing women into Self-Help Groups (SHGs).\textsuperscript{5} Table 1 A and B displays self-reported interest rate data from the first set of surveys, which was realised in 2007 in the states of Orissa, Chhattisgarh and Jharkhand, India. We report the average answers of non microfinance users who were asked about the interest rate charged by different lenders, when they required small loans (doctor visits, daily consumption, etc.) or bigger loans (durable, business-related expenses, etc.). We focus on loans made by traditional lenders, i.e. loans with positive interest rates from professional moneylenders (or pawnbrokers), traders, landlords / employers and other neighbors (outside relatives). Finally, we distinguish between villages without any SHG, with some SHGs (between one and three) and with many SHGs (more than three). For both sizes of loans, we observe a significantly higher interest rate when there are some microfinance presence in the village than when there is none (p-value of 0.00).

Nevertheless, villages with SHGs need not be comparable to villages without SHG because they were selected by the NGO at the first place and because groups are likely to have been formed and to be actually working where the need was important (or where villagers had a high intrinsic motivation etc.). This is why table 1 C rather compares a given set of (selected) treated villages - i.e. villages with microfinance presence - across the number of groups present in the village. It uses data from the second set of surveys, which forms a longitudinal database of SHG members and nonmembers who have been followed from prior to the start of any SHG up to seven years after the opening of SHG(s) - between 2002 and 2009. In those surveys, interviewed households were asked about actual loans that they had been taking in the two years preceding the interview date. When loans have been fully repaid, we use the amounts borrowed, repaid and the actual duration to reconstruct the implicit interest rate of the loans, while we use contract information (either the explicit rate or the amounts borrowed, to be paid and the planned duration) when loans are still pending. Panel C below aggregates data over the years for the same set of treated villages and compares the average interest rates charged by the same types of traditional lenders as in panels A and B in villages without, with some and with many SHG(s).\textsuperscript{6} Results are comparable to those observed in the first two panels: interest rates are on average higher when some SHGs are operating than when there are none. Yet, a non-monotonic relationship now seems to emerge: the interest rate charged by traditional lenders is on average lower when there are more than three groups than when there are one to three group(s). Anticipating the results of our model, this could be consistent with the fact that the competition effect dominates the composition effect when a lot of MFIs are operating.

The last panel of the table 1, if it solves the selection problem due to non-random program placement, might suffer from another issue due to the pooling of different dates. Indeed, no SHG (mostly) refers to first-period data - before any SHG started to operate - and villages are more likely to have more groups as time passes. This can be a problem if there exists a time trend in interest rates, since the difference in the rates charged by traditional lenders in villages with many SHGs might then reflect this trend instead of the effect of the high presence of MFIs. To address this issue, we now take advantage of the panel dimension of the second database to control for time and location through panel regression analysis.\textsuperscript{7} To account for a market-wide trend, we add data on control villages, where no SHG has ever been created and which were chosen to be as comparable as possible to member villages. Finally, we also control for the amount of the loan and whether the borrower is a member of SHG or not, in order to distinguish between members and nonmembers in treated villages. Table 2 presents the result of the following simple

\textsuperscript{5}Those are informal village associations, which are engaged in a variety of collective activities out of which saving and credit are the most important. At every meeting, each woman contributes the agreed weekly savings and the interest (and possibly part of the principal) on the loan she has taken, if any. Members who don’t have a loan yet can require one to the group. Loans are individual but they have to be agreed on by the group and repayment is public. Moreover, there is a strong peer pressure ensuring due repayment, especially on bank loans, for which the group is jointly responsible. Bank-linked SHG is the dominant model in Indian microfinance, which has been promoted by the National Bank for Agriculture and Rural Development (NABARD) since 1992. More information about the surveys and their context can be found in Baland et al. (2008) and Demont (2010).

\textsuperscript{6}Since those are all treated villages, no SHG refers to baseline data, i.e. before the start of SHGs’ operation, or to villages that lost all SHGs over time. The last case actually concerns only one village, the exclusion of which doesn’t change the nature of reported figures.

\textsuperscript{7}Surveys were conducted in 2002 (round 1, before the opening of any group), 2004 (round 2), 2006 (round 3) and 2009 (round 4).
Table 1: Interest rates by SHGs’ presence

<table>
<thead>
<tr>
<th># groups</th>
<th>mean (% monthly)</th>
<th>std dev.</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Small loans (self-reported)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>6.8</td>
<td>2.9</td>
<td>793</td>
</tr>
<tr>
<td>1-3</td>
<td>7.2</td>
<td>2.6</td>
<td>278</td>
</tr>
<tr>
<td>&gt;3</td>
<td>7.4</td>
<td>2.9</td>
<td>289</td>
</tr>
<tr>
<td>B. Big loans (self-reported)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>7.0</td>
<td>2.9</td>
<td>696</td>
</tr>
<tr>
<td>1-3</td>
<td>7.7</td>
<td>2.5</td>
<td>241</td>
</tr>
<tr>
<td>&gt;3</td>
<td>7.6</td>
<td>2.9</td>
<td>253</td>
</tr>
<tr>
<td>C. Actual contracts (longitudinal)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>8.3</td>
<td>3.1</td>
<td>353</td>
</tr>
<tr>
<td>1-3</td>
<td>9.5</td>
<td>7.8</td>
<td>160</td>
</tr>
<tr>
<td>&gt;3</td>
<td>8.1</td>
<td>6.0</td>
<td>136</td>
</tr>
</tbody>
</table>

Data for panels A and B come from a survey by Baland et al. (2008) and data for panel C come from a survey described in Demont (2010). Though the broad area and the partner NGO are the same, the two surveys concern mainly different villages.

Econometric regression performed at the loan level:

\[ INT_i = \beta + \gamma_1 SHG_{v,t} + \gamma_2 SHG_{v,t}^2 + \delta X_i + \mu_t + \nu_v + \epsilon_i \]

where \( INT_i \) is the interest rate charged by the traditional lender for loan \( i \) in village \( v \) at time \( t \), \( SHG \) is the number of SHGs in the village, \( X \) is a vector of loan characteristics (namely the amount borrowed in logs and whether the borrower is an active SHG member), \( T \) is a time fixed effect and \( V \) is a village fixed effect. We cluster standard errors at the household level to control for potential correlation of errors within households.

In table 2, we see that, once the time trend and the fixed characteristics of location are controlled for, we find strong evidence in favor of the pattern identified above: a limited number of SHGs increases the interest rate charged by traditional lenders in the village, while villages with many SHGs experience lower interest rates than villages without SHG. The maximum is located between 3 and 4 groups. Adding controls don’t modify the coefficients of interest, but bring some additional insights. First, moneylenders charge lower interest on bigger loans on average. This is consistent with other empirical studies (see e.g. survey by Banerjee 2003) and points towards the presence of fixed costs in lending (or other mechanisms implying a limit on the interest payments that lenders are able to ask). This means that competition for a given pool of borrowers would naturally tend to increase interest rates. Yet, the amount is clearly not enough to explain the variation in the level of interest rates: when added, all the effect is going into the constant term and the coefficients of the number of SHG groups are unchanged. The theoretical exercise that follows will seek explaining the latter effect, while abstracting from the former by leaving fixed costs out of the model. Finally, we observe that SHG members don’t pay different interest rates on average, nor do people with bigger land ownership. We take this as an interesting indication that lenders cannot really discriminate between borrowers within villages, be it because of informational problems or because of social norms and traditions. A critical feature of our model will indeed be that lenders have to charge one single rate to all borrowers.

As a matter of fact, the patterns presented above might be explained by different causes. Table 3 provides some first insights into the mechanisms. Members dramatically reduce their borrowing from traditional lenders once SHGs start operating. When they still borrow, they take larger loans, which are aimed at financing less productive investments and more consumption or social expenses. In fact, the comparison with the behavior of nonmembers suggests that members might well be the riskiest of the moneylender’s borrowers. All this indicates that the borrower pool of traditional lenders is indeed likely to be modified upon MFIs’ entry, and most probably towards an increased riskiness.

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8Given the large number of households, this adjustment is actually harmless. By contrast, clustering at the higher level of the village would lead to over-rejection given the few number of clusters (37 villages) and their size heterogeneity (Angrist and Pischke, 2008). Nevertheless, the village fixed effects deal with most of the commonality within villages anyway.
Table 2: Interest rate charged by moneylenders and SHG presence: OLS regression

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of groups</td>
<td>0.362 (0.263)</td>
<td>0.375 (0.261)</td>
<td>0.371 (0.273)</td>
</tr>
<tr>
<td>Number of groups$^2$</td>
<td>-0.0487** (0.0230)</td>
<td>-0.0495** (0.0227)</td>
<td>-0.0490** (0.0234)</td>
</tr>
<tr>
<td>Amount borrowed</td>
<td>-0.194** (0.0979)</td>
<td>-0.186* (0.100)</td>
<td></td>
</tr>
<tr>
<td>SHG member</td>
<td>-0.148 (0.255)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>landowned</td>
<td>-0.0469 (0.0633)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>8.316*** (0.220)</td>
<td>9.674*** (0.687)</td>
<td>9.712*** (0.706)</td>
</tr>
</tbody>
</table>

Observations | 1008 | 1008 | 972 |
Adjusted $R^2$ | 0.145 | 0.148 | 0.150 |
$F_{nbshg}$ | 0.00826 | 0.00717 | 0.00838 |
Max_nbshg | 3.722  | 3.791  | 3.792  |

Standard errors in parentheses.
All estimations include village and time fixed effects. Standard errors clustered at the household-level in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Borrowing behavior of members and nonmembers before and after MFIs’ entry

<table>
<thead>
<tr>
<th></th>
<th>Members Before</th>
<th>Members After</th>
<th>Nonmembers Before</th>
<th>Nonmembers After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loans from trad. lenders in 2 years (#)</td>
<td>1.9</td>
<td>0.1</td>
<td>1.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Average amount borrowed from trad. lenders (Roupies)</td>
<td>2890</td>
<td>3774</td>
<td>2706</td>
<td>2749</td>
</tr>
<tr>
<td>Loans for agriculture/business from trad. lenders in 2 years (% all loans)</td>
<td>21.1</td>
<td>15.8</td>
<td>26.6</td>
<td>25.6</td>
</tr>
<tr>
<td>Loans for family/social expenses from trad. lenders in 2 years (% all loans)</td>
<td>43.9</td>
<td>53.5</td>
<td>38.9</td>
<td>42.0</td>
</tr>
<tr>
<td>N$^a$</td>
<td>165</td>
<td>3498</td>
<td>353</td>
<td>1167</td>
</tr>
</tbody>
</table>

$^a$ Lines 2 to 4 are computed using actual loans from traditional lenders: 123 before and 101 after for members, and 226 before and 348 after for nonmembers.

Overall, the above evidence is an interesting indication that competition may not be the only force at work in rural credit markets facing MFIs’ entry, and that the job of traditional lenders is likely to become riskier. In what follows, we progressively build a model that allows explaining the two main facts we observed in table 2: controlling for the amount borrowed and borrowers’ characteristics, (i) a limited presence of microfinance in the local credit market tends to increase the interest rate charged by traditional, individual lenders, (ii) a larger presence tends to decrease this same rate.

3 Basic setup of the model

We use a simple one-period model of a rural credit market with adverse selection (à la Ghatak 2000). The market is populated by N risk-neutral households. Each household is endowed with a risky investment project which requires K units of capital and one unit of labour. Their utility function $U$ is assumed to be continuous and linearly increasing in income ($U' > 0$, $U'' = 0$). The opportunity cost of labour is $\bar{u}$ per unit, which may be viewed as an alternative income that the household would be able to produce if not committed to any project (e.g. wage work). By assumption, households lack the capital required to enter the project, such that they have to finance their investment through borrowing by means of a debt contract. They will do so if they are able to derive a net benefit that is weakly positive from investing$^9$.

Projects once started yield either a high gross return $R^h_i$ or fail and yield a low gross return $R^l_i$, which is normalized to be 0 in the rest of the paper (henceforth $R_i$ without any superscript will refer to $R^h_i$). Households are indexed into two groups, safe ($s$) and risky ($r$), respectively of size $N_s$ and $N_r$ (with $N_s + N_r = N$)$^{10}$. Let us label $\pi$ the proportion of safe types in the population (i.e. $\frac{N_s}{N}$) and $(1 - \pi)$ the proportion of risky types (i.e. $\frac{N_r}{N}$). While those proportions are common knowledge,$^9$

$^9$Without loss of generality, we adopt the following tie-breaking rule: if borrowers are indifferent between investing and enjoying the reservation income, they choose the first option (‘appetite for entrepreneurship’).

$^{10}$Risk types should be interpreted in terms of riskiness of projects - not riskiness of borrowers - as the same borrowers might behave differently in front of different lenders (e.g. SHG members, being forced to limit the riskiness of their group borrowing might apply to moneylenders in order to finance riskier projects).
the risk characteristics of each household is unknown to lenders (screening technology is prohibitively expensive), which force them to charge a unique interest rate to all borrowers. We do not assume any difference in the information structure faced by different lenders, who only differ according to their lending technology. That is because we want to be as general as possible and because it matches the context of our empirical exercise, where microfinance institutions are groups of local women.\footnote{If one wants to think about MFIs external to the village or the local market, it might make sense to assume that local moneylenders have an information advantage. In that situation, depending on how accurate is their knowledge about the risk profile of borrowers is, the results of this model can hold or be reversed. At the extreme, if moneylenders have perfect information, it is easy to foresee that safe borrowers will always prefer borrowing individually, the entry of group-lending institutions potentially improving the quality mix of the pool of individual lender.} Let us denote by $p_i$ the probability of success of the project of type $i$ ($i = r, s$), with $1 \geq p_s > p_r \geq 0$. We make the common assumptions in the literature that $R_s < R_r$ and expected returns are equal for both types of households: $E(R_i) = p_r R_r = p_r R_r = R > 1$. That is, the heterogeneity is in the second moment of the distribution only; lower $p$ implying larger variance and higher risk. In this situation, underinvestment might result in equilibrium with imperfect information (Stiglitz and Weiss, 1981).

The project returns of different borrowers are assumed to be uncorrelated (for the effect of correlated types, see Laffont 2003 or Ahlin and Townsend 2007). Finally, we assume throughout that the investment projects of both types of household are socially profitable, in the sense that their expected return is greater than the opportunity cost of the capital and labour used up in the project:

$$\bar{R}K > \gamma K + \bar{u},$$

where $\gamma > 1$ is the gross cost per unit lent (including bank’s interest rate if moneylenders refinance in the formal sector or if they forego deposits). Condition 1 means that, in a welfare-maximizing situation, all households should get funds (which of course would be the case in a situation with complete information).

There is no (ex post) moral hazard in the model: although actual returns are unknown to lenders, success is perfectly observed and repayment is enforceable.\footnote{This is obviously the case if ex-post state verification is costless. Nevertheless, Gale and Hellwig (1985) showed that, in one-period optimal debt contracts with (sufficiently) costly state verification, lenders pay that cost whenever borrowers default, which leads to the same conclusion as in our simple model (i.e. successful borrowers always repay). This result derives from the fact that, in the presence of limited liability, borrowers always have the incentive to declare realised returns as low as possible, and lenders impose a penalty in case of false reporting. Finally, in the rural setting that we have in mind, social sanctions and/or repeated interactions will also contribute to the enforceability of contracts - even if those aspects are not present in our model.} In case of failure, we assume limited liability in the sense that borrowers cannot repay their loan nor the interest rate due - it is assumed that borrowers do not pledge any collateralizable wealth, for simplicity and also because it is likely to actually best describe the situation of most poor households around the world.\footnote{Often, traditional moneylenders accept as collateral goods or services that have little or no economic value but whose role is to induce higher willingness to repay (given the positive value they have for borrowers). In our model without moral hazard, collateral is therefore not a crucial matter.} Together, limited liability and absence of collateral imply that most instruments used by conventional lenders to address information problems are not available. In this context, joint liability lending can be viewed as a ‘simple mechanism that exploits local information to screen borrowers’ (Ghatak, 2000).

Throughout, traditional lenders - who lend individually - are referred to as ‘moneylenders’, whereas ‘MFIs’ are operating joint lending. We call ‘mixed market’ a market with the two types of lending institutions, and ‘residual market’ the market supplied by traditional moneylenders - or the share of a mixed market that is not served by MFIs.

## 4 Perfect competition

In the basic version of the model, lenders follow a zero-profit rule, which can be viewed as a reduced form of a profit maximization problem under perfect competition or Bertrand competition (with all lenders facing the same technology). Alternatively, it could be derived from utility maximization problem of not-for-profit institutions (e.g. NGO). That is, lenders react passively to the composition of the pool of borrowers and charge a price that allows them to break-even according to their respective lending technologies.

As useful building blocks, we first derive the problems of stand-alone lenders using individual and group lending, and then compare the two contracts from the borrowers’ standpoint. We then analyze a competition game between the two lenders in the presence of limited lending capacity.
4.1 Equilibrium with individual lending

We model individual lending as the following sequence of events. First, lenders compete and the market determines the equilibrium price of funds. Second, borrowers observe the market rate \( r \) and decide whether to borrow at this rate or not. Third, households who borrowed invest, Nature decides the outcome, and repayment is made according to the debt contract. Households who did not borrow enjoy the reservation income \( \bar{u} \).

Let us first derive the problem of moneylenders expecting to serve the entire population (pooling equilibrium). At equilibrium, they break even by equalizing the average expected repayment from the loans extended to borrowers with the average opportunity cost of capital (‘zero-profit constraint’, or ZPC):

\[
\pi p_s K r^{I,P} + (1 - \pi) p_r K r^{I,P} = \gamma K
\]  

(2)

where the superscript I and P stand for individual lending and pooling equilibrium respectively, \( r^{I,P} \) is the gross interest rate (principal plus net interest rate).

Would-be borrowers compute their net individual payoff from investment as:

\[
U^{I,P}_i = p_i K (R_i - r^{I,P})
\]  

(3)

Note that, since \( p_s R_s = p_r R_r = \bar{R} \) and \( p_s > p_r \), expected payoff is always larger for risky households, because they have to repay less often than safe borrowers and are thus implicitly subsidized by the latter.

At a pooling equilibrium, the solution to (2) is

\[
r^{I,P} = \frac{\gamma}{\bar{p}} > 1
\]  

(4)

where \( \bar{p} = \pi p_s + (1 - \pi) p_r \) is the average individual probability of success of households. Intuitively, the break-even interest rate decreases with the proportion of safe individuals \( \pi \) and the probabilities of success \( p_i \). Given (1), it is easy to check that risky households always borrow at this rate. On the contrary, if \( r^{I,P} \) is too high, safe borrowers might not able to derive a positive expected payoff from investment. We then observe a separating equilibrium (S) and moneylenders break-even if

\[
p_r K r^{I,S} = \gamma K \iff r^{I,S} = \frac{\gamma}{p_r} > 1.
\]  

(5)

That is, when lenders anticipate that safe borrowers don’t apply at \( r^{I,P} \), the equilibrium interest rate increases due to the higher probability of default in their pool of borrowers. We can now assess the conditions of existence of the two different equilibria.

**Proposition 1** The market for individual loans is at an efficient pooling equilibrium if \( \bar{R} K - \bar{u} \geq \frac{\bar{p}}{\bar{p}} \gamma K \), and at an inefficient separating equilibrium otherwise.

**Proof.** Given (3), safe borrowers will be excluded from the market whenever \( U^{I,P}_s = p_s K (R_s - r^{I,P}) < \bar{u} \iff \frac{\bar{p}}{\bar{p}} \gamma K > \bar{R} K - \bar{u} \). Anticipating the higher riskiness of their borrower pool, lenders then charge \( r^{I,S} \). At that rate, risky borrowers choose to borrow since \( \bar{R} K - \gamma K > \bar{u} \) given (1). That situation is inefficient because safe types are excluded although they have socially valuable projects (adverse selection).

As a conclusion, the likelihood of adverse selection increases with the cost of capital (because safe borrowers expect to bear it more often than risky borrowers), the proportion of risky borrowers in the population and their effective riskiness. It decreases with the riskiness of safe borrowers, because safe borrowers then anticipate to pay less often the interest rate that reflects only partially their own riskiness (appendix A.1 works out the derivatives). Finally, the higher the difference between safe wage and expected return from investment the higher the probability that safe households apply for a loan at equilibrium. This, in turn, will be determined by factors like the size, fragmentation and competition state of local markets for goods and services, and the education of households - all of which are left outside this model.

4.2 Equilibrium with group lending

We now turn to the problem of a lender that lends to groups that are collectively responsible for repayment (joint liability). That is, although loans are still individual and every borrower is still re-
sponsible for paying back her own loan, successful group members have in addition to pay for (part of) the obligations of defaulting partners. As is well known, this is a scheme that is widely used by microfinance institutions around the world in order to mitigate information asymmetries. Formally, we define a joint-liability debt contract as a contract \((r^J, c)\), where \(r^J\) is the interest rate and \(c > 0\) is the per-unit indemnisation that a successful group member has to pay if her mate cannot repay her loan.\(^{14}\)

We model group lending as the following game. First, the (unsubsidized) risk-neutral lenders (‘MFIs’) choose joint-liability contracts that satisfy zero expected profit and credibility constraints (see below). Second, borrowers who agree on those terms form groups and take up a loan. Third, as before, investment takes place. Nature decides about the realizations and lenders get reimbursed according to contract terms. To simplify analysis, we assume borrowers have to form groups of two, which is a standard assumption in the literature that implies no loss of generality in our setup.

Either because borrowers know well each other within a tightly-knit village allowing repeated interactions or because they can signal each other’s type by means of side payments, borrowers who are asked to form groups voluntarily in order to access a loan typically pair up with same types. Intuitively, this is because borrowers expecting their project to be successful will want to avoid having to repay for defaulting peer as much as possible. In other words, pairing with risky individuals increases expected costs of borrowing, and it does increasingly so the safer the borrower. In this context, it is easy to show that there is no mutually beneficial way for risky and safe borrowers to group together, and homogenous groups represent the only stable outcome of the pairing game (Ghatak 1999 gives a formal proof).\(^{15}\)

Given assortative matching at the group formation stage, MFIs contemplating lending to the entire population face homogenous groups (S,S) and (R,R) with probability \(p_s\) and \((1-p_s)\) respectively, so that the ZPC writes:

\[
[p_sKr^J + (1 - p_s)p_sk]\pi + [p_sKr^J + (1 - p_s)p_rKc] \gamma = c
\]

where the superscript J stands for joint liability. Note that, for simplicity, we implicitly focus on the set of feasible joint-liability payments, which successful borrowers can always pay for (given limited liability):

\[
J,P \leq J,P - R_s
\]

We impose the following credibility constraint: the amount of joint liability cannot exceed the amount of individual liability, i.e.

\[
c \leq J,P
\]

This is an important assumption that implies that MFIs cannot use the amount of joint liability as an independent screening device, since no \(c\) would be high enough to deter risky borrowers from applying.\(^{17}\) This goes against the results of Ghatak (2000). However, taking an amount of joint liability lower than the amount of individual liability seems to make sense, in order to avoid e.g. that successful partners of failing borrowers prefer to declare their partner to be successful (i.e. the contract is incentive-compatible ex-post). Not surprisingly, this also seems to be in line with what group-lending programmes do in practice.

\(^{14}\)In practice, there are differences in the way how microfinance institutions enforce joint liability contracts. Sometimes, they require the group to pay a fixed penalty in case of one member’s default. In this case, the interpretation of \(c\) is literal. However, the form of joint liability for defaults in actual group-lending programmes often takes the form of denying future credit to all group members in case of default by one member, until the loan is repaid. Usually, the defaulting members pay back their obligations to other group members (Huppi and Feder, 1990), but with a delay. In our static framework, the term \(c\) can then be interpreted as the net present discounted value of the cost of sacrificing consumption during the ‘grace period’ in order to pay joint liability for a partner. Note that this cost exists precisely because of the credit market imperfection (Gangopadhyay et al., 2005).

\(^{15}\)Note that Sadoulet (1999) and Guttman (2008) show that this property does not necessarily hold if borrowers are denied future access to credit in case of group’s default (dynamic framework) and if side payments are possible. The little empirical evidence available about matching in actual joint-liability contracts points towards assortative matching (e.g. Ahlin 2009).

\(^{16}\)This condition is not needed to get our results but eases their presentation because it ensures that an equilibrium on the group lending market always exists, s.t. mixed markets can indeed be discussed. Moreover, it is typically implied by conditions (7) and (1) - but not always, e.g. if success probability of risky borrowers is very low (see appendix A.3 for a formal discussion).

\(^{17}\)Condition 7 implies that an increase (decrease) in the probabilities of success will result in an increase (decrease) in the interest rate charged by MFIs, as the higher (lower) expected repayment will dominate the lower (higher) joint-liability payments (see appendix A.1 for a formal exposition). A direct consequence is that risky borrowers will be better off at a joint pooling equilibrium than at an individual separating equilibrium, which is shown in section 4.3. Finally, assumption (7) also ensures that the joint-liability contract in our model is feasible, in the sense that the gross interest rate is always greater than unity (also see appendix A.3).
The net individual payoff from investment to borrowers is then:

\[ U_i^{J,P} = p_i K (R_i - r_i^{J,P} - (1 - p_i) c) \]  

Under joint liability, risky borrowers still anticipate a lower probability of repayment than safe borrowers. However, they now bear an additional cost because their partner defaults more often than in safe borrowers’ groups. That is, although the explicit rate is the same for every borrower in the market, MFIs are able to implicitly charge a lower interest rate to safe borrowers and a higher interest rate to risky borrowers. Yet, we show in appendix A.2 that the utility of risky borrowers is still always higher than for safe individuals.

At a pooling equilibrium, the equilibrium interest rate is:

\[ r_i^{J,P} = \frac{\gamma}{\bar{p}} - \frac{c}{\bar{p}} (\bar{p} - \pi p_s^2 - (1 - \pi) p_r^2) > 1 \]  

and the range of joint-liability payments that satisfy the credibility constraint (7) is:

\[ 0 < c \leq \frac{\gamma}{2 \bar{p} - \pi p_s^2 - (1 - \pi) p_r^2} \]

Note that the last condition is actually sufficient to ensure that the joint-liability contract is feasible \((r_i^{J,P} > 1)\), which is proved in appendix A.3.

As is obvious from (9), the joint liability technology allows a reduction in interest rate because it decreases the probability for the lender not to be reimbursed (‘insurance effect’). Even though risky borrowers expect to pay more of those insurance payments than safe borrowers, their overall payments are lower in expected terms and \(r_i^{J,P}\) is still decreasing in \(\pi\) and \(p_i\), formal proof in appendix A.1.

At a separating equilibrium, MFI de facto faces homogenous groups of risky individuals, and the break-even interest rate is

\[ [p_i K r_i^{J,S} + (1 - p_i) p_r Kc] = \gamma K \iff r_i^{J,S} = \frac{\gamma}{p_r} - (1 - p_r) c > 1 \]  

Again, it is easy to see that this rate is lower than in the individual-lending case. One can also show that \(r_i^{J,S} > r_i^{J,P}\): although lenders are partially insured against default thanks to joint liability, this obviously happens only if one member is successful, s.t. lenders still expect higher default rates from risky borrowers overall - see appendix A.4 for a formal proof.

**Proposition 2** The market for joint-liability loans with assortative matching is at an efficient pooling equilibrium if \(\bar{R}K - \bar{u} \geq \frac{p_r}{\bar{p}} (\gamma K - cK(1 - \pi)p_s(p_s - p_r))\), and at an inefficient separating equilibrium otherwise.

**Proof.** Given that the utility of risky borrowers is always higher than for safe individuals (see appendix A.2), a separating equilibrium will still involve risky individuals only. It will happen if \(U_i^{J,P} = \bar{R}K - p_i K(r_i^{J,P} + (1 - p_i) c) < \bar{u} \iff \bar{R}K - \frac{p_r}{\bar{p}} (\gamma K + cK(1 - \pi)p_s (p_s - p_r)) < \bar{u} \iff \bar{R}K - \bar{u} < \frac{p_r}{\bar{p}} (\gamma K - cK(1 - \pi)p_s(p_s - p_r)).\) Finally, the utility of risky borrowers at a separating equilibrium is:

\[ U_i^{J,S} = \bar{R}K - \gamma K > \bar{u} \] (given 1), so that risky borrowers always apply. 

As is obvious from proposition 2, the range of parameters - \(\pi, p_i\) - which gives rise to pooling equilibria increases with respect to the individual-lending case (see appendix ?? for a graphical illustration). That is, the group-lending technology limits adverse selection by allowing lenders to implicitly charge a lower interest rate for safe borrowers - thereby relaxing their participation constraint. However, it is unable to avoid completely the exclusion of worthy safe borrowers. As previously, the likelihood of adverse selection increases with the cost of capital, the proportion of risky borrowers in the population and their riskiness. However, in contrast to the individual-lending case, the probability of success of safe borrowers reduces the likelihood of their exclusion because it decreases the expected amount of joint-liability payments besides the interest rate itself (see appendix A.1).

---

\[18\] In the special case in which potential borrowers don’t know each other and cannot get any information on the others’ risk characteristics, groups are formed randomly and group lending does not offer any improvement upon individual lending. Indeed, using our model, it is easy to show that lower interest charges are then exactly compensated by expected joint liability payments (see also Laffont and N’Guessan 2000). However, this conclusion might not hold in the presence of correlation between entrepreneurs’ returns (see Laffont 2003).
4.3 Comparing the two contracts

From the two previous sections, we can summarize borrowers’ preferences as follows.

**Lemma 1** If such loans are available, safe borrowers always prefer borrowing in groups (from MFIs). Risky borrowers are better off borrowing from moneylenders if a pooling equilibrium is feasible under individual lending, and from MFIs otherwise.

**Proof.** We distinguish 3 possible cases.

1. If $RK - \bar{u} \geq \frac{p}{\bar{p}} \gamma K$, we have pooling equilibria in both group and individual lending.

   In this case, we have that $U_{s}^{1, P} > U_{s}^{1, I}$ iff $\frac{\gamma K p_{s} - (1 - \pi) p_{s}^{2} - (1 - \pi) p_{r}^{2}}{\bar{p}} > \frac{\gamma K p_{s} - (1 - \pi) p_{s}^{2} - (1 - \pi) p_{r}^{2}}{p}$, which is always satisfied. Conversely, we have that $U_{r}^{1, P} < U_{r}^{1, I}$ iff $\frac{\gamma K p_{r} - (1 - \pi) p_{r}^{2} - (1 - \pi) p_{s}^{2}}{p} > \frac{\gamma K p_{r} - (1 - \pi) p_{r}^{2} - (1 - \pi) p_{s}^{2}}{\bar{p}}$, which is always satisfied given (7) - appendix A.1.2 shows this. Hence risky borrowers prefer group lending over individual lending because the lower interest rate outweighs the expected extra joint-liability payments.

2. If $\frac{p}{\bar{p}} (\gamma K - cK(1 - \pi)p_{s}(p_{s} - p_{r})) \leq RK - \bar{u} < \frac{p}{\bar{p}} \gamma K$, a pooling equilibrium is feasible under group lending but not under individual lending.

   In that case, safe borrowers are obviously better off borrowing at MFI. As for risky borrowers, we have that $U_{s}^{1, I} > U_{s}^{1, S}$ iff $\frac{\gamma K p_{s} - (1 - \pi) p_{s}^{2} - (1 - \pi) p_{r}^{2}}{p} - \frac{cK p_{s} - (1 - \pi) p_{s}^{2} - (1 - \pi) p_{r}^{2}}{\bar{p}} > 0$, which is satisfied given (7) - appendix A.1.2 shows this. Hence risky borrowers prefer group lending over individual lending because the lower interest rate outweighs the expected extra joint-liability payments for risky borrowers: $U_{r}^{1, S} = U_{r}^{1, I} = RK - \gamma K$, such that borrowers are indifferent between borrowing in groups or individually.

3. Finally, if $RK - \bar{u} < \frac{p}{\bar{p}} (\gamma K - cK(1 - \pi)p_{s}(p_{s} - p_{r}))$, we have a separating equilibrium even under group lending, and the lower interest rate is exactly compensated by the expected extra joint-liability payments for risky borrowers: $U_{r}^{1, S} = U_{r}^{1, I} = RK - \gamma K$, such that borrowers are indifferent between borrowing in groups or individually.

4.4 Equilibrium in mixed markets

In this section, we consider the following situation. In a given geographical area, capital-constrained households have the opportunity to take up individual loans from traditional moneylenders (ML) or to participate in group loans organized by a group-lending institution (MFI). We thus analyze a competition game between the two types of lenders described in the previous sections.

We impose that the MFI does not have enough funds to serve the entire market, i.e. it can serve maximum $N_{\text{max}} < N$ borrowers. That is because, in our very stark setup, MFI attracts all types of borrowers given its better lending technology (see lemma 1), thus pushing ML out of business. Clearly, this is not what we observe in reality. Limited fund availability (which depends, say, on the amount of savings from members or on external funding sources) is one potential explanation, which we model in the simplest form here. Yet, any other reason explaining why some people keep borrowing from ML, independently of the risk characteristics (e.g. cost of attending meetings, role of social connections etc.), would deliver the same insights\(^{19}\). Let $0 < \alpha < 1$ be the importance of the capital constraint to MFI - i.e. $\alpha = \frac{N_{\text{max}}}{N}$. Without loss of generality, the individual-lending market is assumed to have no financing constraint. That is, though borrowers might have to compete to get funds from their preferred source, the entire population would be served in a complete-information setting (i.e. there is no a priori inefficiency). Note that, given the absence of fixed costs in lending, this simple constraint does not modify any of the results that we derived earlier. For instance, MFI’s ZPC when serving all borrowers is $(p_{r} - p_{s})(\alpha Kr^{d} + (1 - p_{s})p_{r}Kc) \pi + (p_{r} - p_{s})(\alpha Kr^{d} + (1 - p_{s})p_{r}Kc) (1 - \pi) = \gamma K$, which is identical to (6).

In that situation (and given risk neutrality), each lender has to guarantee at least the same utility level to borrowers as its competitors if it wants to attract some of them. Specifically, every mixed-market equilibrium an additional set of participation constraints such that

\[
\begin{align*}
U_{i}^{d} &> U_{i}^{s} \quad U_{i}^{d} > U_{i}^{f} \quad \forall i = r, s \text{ iff agent } i \text{ borrows primarily from ML (MFI)} \\ U_{i}^{f} &> U_{i}^{s} \quad \forall i = r, s \text{ iff agent } i \text{ borrows equally from both lenders.}
\end{align*}
\]

\(^{19}\)One can surely think of several reasons for not borrowing from MFI that would be correlated with risk characteristics. This is certainly an interesting avenue to explore, though needing more assumptions regarding the direction and size of those correlations.
The timing of events is as follows. First, both lenders announce the terms of their debt contract, which satisfy zero-profit, credibility, and incentive-compatibility constraints. Second, borrowers decide whether and where to borrow. Third, unserved borrowers can decide to borrow from the other lender. Fourth, as before, investment takes place. Nature decides about the realizations and lenders get reimbursed according to contract terms.

This section keeps assuming perfect competition (or zero profit objective), so that the lenders simply react passively at the composition of the pool of borrowers (section B.2 looks at the effects of market power). Moreover, from lemma 1, we know that safe borrowers are always better off borrowing jointly (whatever the specific conditions of both types of contracts), s.t. they will always ask funds (if any) from MFI in the first place. As a consequence, the only strategic players are the risky borrowers, whose behavior will determine market equilibria.

According to the parameter values, three market configurations are possible: safe borrowers can be served by (1) no lender, (2) MFI only or (3) both lenders. We will now discuss the optimal choice of risky borrowers in each of them, as well as the resulting impact of MFI’s presence along price, quantity and welfare dimensions. Table 5 summarizes the results. Starting in the upper-left cell and rotating clockwise, we find the following situations.

1. If capital cost or risky borrowers’ riskiness and size in the population are so high that MFI cannot offer a pooling equilibrium either, MFI and ML compete exclusively for risky borrowers. The presence of the other lender in the market does not change their respective ZPC since both lenders expect to serve a scaled-down pool of unchanged riskiness. Therefore, MFI and ML still break-even at \( r^{I.S} \) and \( r^{J,S} \) respectively. From lemma 1, we know that risky borrowers are indifferent between the two lending technologies in that situation. As a consequence, the two lenders share the population of risky borrowers according to their availability of funds. Compared to the situation in which ML serves the market alone, MFI has no effect on coverage since safe borrowers are still excluded, nor on the residual interest rate since the composition of ML’s pool is unaffected. MFI does not affect welfare.

2. If a separating equilibrium exists in the ML’s market and group-lending is able to achieve a pooling equilibrium, MFI can potentially limit credit rationing and attract unserved safe investors back to the market. Yet, in that situation, we know from lemma 1 that it also attracts the risky borrowers who prefer borrowing in groups than borrowing individually. As a consequence, MFI lends its funds equally to the two sub-populations at the interest rate \( r^{J,P} \). Unserved safe borrowers stay excluded because ML is unable to serve them without making losses given the separating equilibrium situation (see proposition 1). Unserved risky borrowers borrow from ML at \( r^{I.S} \). Hence, MFI has no effect on the residual interest rate but increases coverage by serving some safe borrowers who would be excluded under individual-lending. MFI also increases welfare in the Pareto sense since it makes safe and (some) risky borrowers better off without reducing the utility of any other agent.

3. If a pooling equilibrium is feasible in the market of individual loans, lemma 1 tells us that risky borrowers might prefer borrowing individually, depending on how many safe borrowers remain in the pool. The following table provides the strategy space of risky borrowers.

<table>
<thead>
<tr>
<th>Primary source of borrowing</th>
<th>( N^{\text{max}} \geq N_s )</th>
<th>( U_{I,P}^{\text{max}} &lt; \bar{u} )</th>
<th>( U_{I,P}^{\text{max}} \geq \bar{u} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>MFI</td>
<td>(A)</td>
<td>(A)</td>
<td>(A)</td>
</tr>
<tr>
<td>ML</td>
<td>(B)</td>
<td>(C)</td>
<td>(D)</td>
</tr>
</tbody>
</table>

Notes: conditions for \( U_{I,P}^{\text{max}} \geq \bar{u} \) are given by expression (13) below. Cases are in decreasing order w.r.t. \( (N^{\text{max}} - N_s) \) from left to right. Optimal strategy is in bold font.

If risky types choose to borrow from MFI (situation A), they share its funds with safe borrowers, and the unserved borrowers of both types go to ML. Hence, the average expected utility of risky and safe borrowers are respectively

\[
\bar{R}K = p_r r^{I,P} K - p_r \alpha K (r^{I,P} + (1 - p_r)c - r^{I,P}) \quad \text{and} \\
\bar{R}K = p_s r^{I,P} K - p_s \alpha K (r^{I,P} + (1 - p_s)c - r^{I,P}).
\]
If risky types choose to borrow from ML, different situations can arise depending on the size of $N_{max}$ and the market parameters. First, if $N_{max} \geq N_s$ (situation B), MFI serves all safe borrowers, so that the average expected utility of risky and safe borrowers are respectively

$$\mathcal{R}_K - p_r r^{I,S} K$$ and

$$\mathcal{R}_K - p_r K (r^{I,SS} + (1 - p_s)c),$$

where $r^{I,SS} = \frac{\bar{s}}{p_r} - (1 - p_s)c$ is the break-even interest rate when MFI faces a completely safe pool of borrowers.

In the other case, if $N_{max} < N_s$, constrained safe borrowers can or cannot go to ML. If they do, they will face an interest rate $r^{I,P_{max}}$ such that:

$$(N_s - N_{max}) K p_r r^{I,P_{max}} + N_s K p_r r^{I,P_{max}} = \gamma K (N_s - N_{max} + N_r) \iff r^{I,P_{max}} = \gamma \frac{1 - \alpha}{p - \alpha p_s}.$$ 

That is, ML has to increase its interest rate due to the lower proportion of safe types in its pool of borrowers. As a result, constrained safe borrowers ask money to ML if

$$U^{I,P_{max}}_s \geq \bar{u} \iff \mathcal{R}_K - \bar{u} \geq \gamma K \frac{p_s(1 - \alpha)}{p - \alpha p_s}. \tag{13}$$

Given the pooling equilibrium situation, we know this condition is always satisfied for certain parameters: for instance, for $\alpha = 0$, we reach a necessary condition identical to the pooling equilibrium condition, and, for $\pi = 1$, the necessary condition becomes $\mathcal{R}_K - \bar{u} \geq \gamma K$, which is always the case. However, condition (13) is not always satisfied: given the pooling equilibrium situation, a sufficient condition is $\alpha (\bar{p} - p_s) \geq 0$, which is never satisfied. That is, both situations C and D can arise, depending on parameter values. The likelihood of situation D - i.e. unserved borrowers going to ML - is decreasing with the lending capacity of the MFI relative to the overall population (or the lower the risk heterogeneity $\frac{\alpha \bar{p}}{p}$).

If condition (13) fails (situation C), then part of the safe borrowers remain unserved, and the average expected utility of risky and safe borrowers are respectively

$$\mathcal{R}_K - p_r K r^{I,S}$$ and

$$\frac{N_{max}}{N_s} \left[ \mathcal{R}_K - p_r K \left( r^{I,SS} + (1 - p_s)c \right) \right]. \tag{14}$$

By contrast, if condition (13) holds true (situation D), the average expected utility of risky and safe borrowers are respectively

$$\mathcal{R}_K - p_r K r^{I,P_{max}}$$ and

$$\mathcal{R}_K - p_r K r^{I,P_{max}} - p_s \frac{N_{max}}{N_s} K \left( r^{I,SS} + (1 - p_s)c - r^{I,P_{max}} \right). \tag{15}$$

By backward induction, we can compare the outcomes and find the optimal strategy for risky borrowers, which in turn determines the market equilibria. It is quite easy to see that risky types are always better off borrowing from MFI, except in situation D. Indeed, if safe borrowers who are not served by MFI are able to derive a positive benefit from borrowing individually, then risky types can achieve their first-best situation, taking individual loans and benefiting from the implicit subsidy of safe types (albeit reduced as compared to section 4.1). Appendix A.5 gives the formal conditions on the parameters and shows that this case always exists for high enough $\pi, p_s$ and $c$.

Note that, interestingly, MFI is able to charge a joint-liability obligation that is high enough to completely screen out risky borrowers in this situation (contrary to the stand-alone case in section 4.2).

Hence, if both lender types are able to serve all borrowers (configuration 3), the impact of MFI can be to increase welfare (delivering cheaper credit to part of the population and having no effect on the residual interest rate), or to increase the residual interest rate. Moreover, in the latter case it
can be shown that the average interest rate in the entire economy increases as well (see appendix A.6), so that the overall welfare effect is unambiguously negative (given that the same amount of projects end up being financed and lenders are making zero profits anyway).

Table 5: Lenders’ expected clients and MFI’s impacts in mixed competitive markets

<table>
<thead>
<tr>
<th>ML \ MFI</th>
<th>separating</th>
<th>pooling</th>
</tr>
</thead>
<tbody>
<tr>
<td>separating</td>
<td>clients: ((0, \max(\frac{N_r}{N_s}, \ N_r - N_{\text{max}}))); ((0, \min(\frac{N_r}{N_s}, N_{\text{max}})))</td>
<td>clients: ([0, N_r - (1 - \pi)N_{\text{max}}]); ([\pi N_{\text{max}}, (1 - \pi)N_{\text{max}}])</td>
</tr>
<tr>
<td>impact: 0</td>
<td>impact: (\Delta^+) coverage and welfare</td>
<td></td>
</tr>
<tr>
<td>pooling</td>
<td>impossible</td>
<td></td>
</tr>
<tr>
<td>pooling</td>
<td>(N_{\text{max}} \geq N_s) or cond. (13) KO</td>
<td></td>
</tr>
<tr>
<td>pooling</td>
<td>([N_s - \pi N_{\text{max}}, N_r - (1 - \pi)N_{\text{max}}]); ([\pi N_{\text{max}}, (1 - \pi)N_{\text{max}}])</td>
<td></td>
</tr>
<tr>
<td>impact: (\Delta^+) welfare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pooling</td>
<td>(N_{\text{max}} &lt; N_s) and cond. (13) OK</td>
<td></td>
</tr>
<tr>
<td>pooling</td>
<td>clients: ([N_s - N_{\text{max}}, N_r]); ([N_{\text{max}}, 0])</td>
<td></td>
</tr>
<tr>
<td>impact: (\Delta^-) interest and (\Delta^-) welfare</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: ‘clients’ is to be read as follows: \([\text{expected safe borrowers served by ML, expected risky borrowers served by ML} ; \text{expected safe borrowers served by MFI, expected risky borrowers served by MFI}]\).

This completes the first part of our model. Before turning to the market power case, let us state the main message of our discussion so far.

**Conclusion 1 The impact of microfinance in competitive informal credit markets**

*Focusing on the interesting region of parameters for which group lending is able to supply credit to (some) safe borrowers:

1. If there is adverse selection in the individual-lending market, group lending increases the efficiency of the market but is unable to completely solve it (even if it has enough funds to serve all unserved population).

2. If safe borrowers can access individual loans:

   (a) Group lending increases the interest rate of individual loans if MFI has not enough funds to serve the entire safe population and unserved safe borrowers can still access individual loans. Microfinance is welfare-reducing in this case.

   (b) As MFI’s fund availability (relative to the safe population) increases, risky borrowers prefer borrowing from MFI, and group lending has no effect on the interest rate of individual loans. Microfinance is then welfare-improving.

That is, this simple model of competitive informal lending explains the empirical puzzle presented in sec 2: microfinance can lead to an increase in the moneylenders’ interest rate if the proportion of safe borrowers in the population is high and/or the average riskiness of the population is relatively low. An illustration is given in appendix B.1, which displays the interest rate charged by the two types of lenders when standing alone (solid lines) or when sharing the market (small-dot line), for a varying proportion of safe borrowers in the population. Holding all other parameters constant at values that satisfy the conditions of the model, we observe an increase in the individual-lending and the overall interest rates for high concentrations of safe borrowers (under the conservative assumption that MFI has enough funds to serve half of the entire population).

Yet, this first version of our model, though predicting that the interest rate cannot increase if the MFI’s funds are relatively important, is unable to explain the decrease in the interest rate observed in the data for large number for microfinance groups. This is probably due to increased competition, which the next section examines.
5 Market power

In this section, we relax one of the major assumptions of the previous analysis, namely that moneylenders follow a zero-profit rule.\(^{20}\) We then answer to the same question as before regarding the consequence of the entry of a group-lending institution (MFI) in the market. We first present the individual decision problem of a monopolistic individual lender (ML), and then analyze the competition with a not-for-profit MFI.

5.1 Individual lending under monopoly

The monopolist maximizes profit:

\[
\max_r \Pi = D(r)p(r)r^{ML} - \gamma D(r) \quad \text{s.t.} \quad \Pi \geq 0 \quad (16)
\]

where

\[
D(r) = \begin{cases} 
NK & \text{if } r \leq r^{I,\text{max}}_r \\
N_rK & \text{if } r \leq r^{I,\text{max}}_r \\
0 & \text{if } r > r^{I,\text{max}}_r
\end{cases}
\]

is the (non linear) demand function and

\[
p(r) = \begin{cases} \bar{p} & \text{if } r \leq r^{I,\text{max}}_r \\
pr & \text{if } r \leq r^{I,\text{max}}_r \\
0 & \text{if } r > r^{I,\text{max}}_r
\end{cases}
\]

Facing this problem, the monopolistic lender has two possible strategies: either to offer a high interest rate contract that is accepted by risky households only (regime 1) or to offer a low interest rate contract that is accepted by both types of entrepreneurs (regime 2) - not supplying anything can never be profit maximizing given the efficiency assumption.

If it serves only risky, then it is optimal to set \(r^{I,\text{max}}_r\) s.t. \(p_r(R_rK - r^{I,\text{max}}_rK) = \bar{u}\), which leads to the equilibrium interest rate \(r^{I,\text{max}}_r = \frac{RK - \bar{u}}{pr}\), and a profit equal to \(\Pi^{ML,1} = N_r(\bar{RK} - \bar{u} - \gamma K)\) (which is always positive given 1). Whereas if it serves both types of households, it is optimal to set \(r^{I,\text{max}}_s = \frac{RK - \bar{u}}{pr}\), yielding a lender’s profit \(\Pi^{ML,2} = N\left(\frac{\bar{p}}{pr}\right)(\bar{RK} - \bar{u} - \gamma K)\) (which can be negative).

Regime 1 has the virtue that the lender can extract all the surplus from risky types. Yet, the expected losses from financing only risky borrowers might be so high that regime 2 is actually more profitable. We derive the following proposition:

**Proposition 3** The monopolist enjoying monopoly power serves the entire market (regime 2) if \(\pi \gamma K < (\bar{RK} - \bar{u})(\frac{\bar{p}}{pr} - 1 + \pi)\), and serves only risky borrowers (regime 1) otherwise.

**Proof.** We have that regime 2 yields a higher profit than regime 1 iff \(\Pi^{ML,2} > \Pi^{ML,1} \iff N(\bar{RK} - \bar{u})\frac{\bar{p}}{pr} - N_r\gamma K > N_r(\bar{RK} - \bar{u}) - N_r\gamma K \iff (\bar{RK} - \bar{u})(N\frac{\bar{p}}{pr} - N_r) > \gamma K(N - N_r) \iff (\bar{RK} - \bar{u})(\frac{\bar{p}}{pr} - (1 - \pi)) > \gamma K \pi. \) □

That is, it is sometimes optimal for the monopolist to refrain from charging the maximum interest rate in order to keep safe borrowers in the pool. Its choice depends on the success probabilities and the proportion of risk types in the population. If the relative success probability of risky individuals increases (meaning that both types become more equal), so does the likelihood of a pooling equilibrium. To the contrary, if the cost of capital and the proportion of risky borrowers in the population increase, a separating equilibrium is more likely to happen. Finally, recalling the threshold of section 4.1, it is easy to check that a monopolist always rations credit more often than a competitive moneylender would do.

Under regime 1, utility of all borrowers is equal to \(\bar{u}\). In the pooling equilibrium (regime 2), the utility of borrowers is given by

\[
U^{ML,2}_i = p_rK\left(R_i - \frac{\bar{RK} - \bar{u}}{pr}\right) \quad (17)
\]
such that the moneylender extracts all surplus from safe borrowers (\( U_s^{ML} = \bar{u} \)) and leaves a positive surplus to risky borrowers (\( U_r^{ML} = \bar{R}K - p_r\bar{R}K - \bar{u} \)).

5.2 Equilibrium in the mixed market: competition game between a monopolistic moneylender and a not-for-profit MFI

We now analyze a competition game between the monopolistic lender described in the previous section and a lender (MFI) who uses the group-lending technology such as described in section 4.2. As before, we assume that MFI has a financing capacity equal to \( 0 < \alpha < 1 \) and that ML has no financing constraint. However, contrary to the perfect-competition case, there are now two sets of strategic players, ML and the population of risky borrowers, whose choices will determine market equilibria.

The timing of events is similar to the previous section. First, both lenders announce simultaneously the terms of their debt contract that allow them to break-even (for MFI) or to maximize profit (for ML), such that credibility and incentive-compatibility constraints are satisfied. Second, borrowers decide whether and where to borrow. Third, unserved borrowers can decide to borrow from the other lender. Fourth, investment takes place, Nature decides about the realizations and lenders get reimbursed according to contract terms.

Let us review the different scenarios, which are summarized in table 7 below.

1. When the stand-alone ML chooses regime 1 and the MFI is at a separating equilibrium (because of high capital costs or high proportion of risky borrowers), the two lenders are perfectly competing for the same pool of risky borrowers. Then, if \( \alpha \geq (1 - \pi) \), ML has no choice but to cut its profits to zero and charge \( r_s^{1,\max} \) such that risky borrowers are indifferent between the two lending technologies (see lemma 1). However, if \( \alpha < (1 - \pi) \), ML can still make positive profits by serving the unserved risky at rate \( r_r^{1,\max} \). Microfinance is welfare-improving in this last case. Yet, in any situation, microfinance has no effect on coverage and the credit market is inefficient.

2. When the stand-alone ML chooses regime 1 and the MFI is at a pooling equilibrium, lemma 1 indicates that ML cannot prevent risky borrowers from switching to MFI. That is, both types of borrowers apply at MFI and the only effect of MFI is to scale down the size of the borrower pool. Since the expected relative riskiness of its pool doesn’t change, ML still focuses on risky borrowers and charges the same interest rate \( r_r^{1,\max} \). As a result, MFI increases welfare by making some safe and risky borrowers better-off without making other agents worse-off. MFI increases coverage by attracting some safe borrowers back to the market, though its impact is suboptimal due to its inability to screen out risky borrowers.

3. In case ML chooses regime 2 when standing alone, MFI is necessarily in a pooling situation. From lemma 1, we know that safe borrowers always prefer borrowing in groups than individually (even if the lender makes zero profit), so ML cannot prevent them from leaving his pool. Hence, depending on MFI’s financing capacity, ML can find it optimal to switch to regime 1. Note that charging any other interest rate than \( r_s^{1,\max} \) or \( r_r^{1,\max} \) cannot be profit-maximizing. Indeed, the only candidate, i.e. the interest rate at which risky borrowers are indifferent between a pooling joint-liability contract and an individual contract, is always dominated by \( r_s^{1,\max} \) or \( r_r^{1,\max} \).

The following table provides the strategy space of ML.

If ML chooses to focus on risky borrowers and charge \( r_r^{1,\max} \) (situation A), then both types of borrowers are better off borrowing from MFI, and ML serves \((N_r - (1 - \pi)N^{\max}) \) risky borrowers, yielding a profit of

\[
\Pi(A) = [N_r - (1 - \pi)N^{\max}] (\bar{R}K - \bar{u} - \gamma K). \quad (18)
\]

If ML chooses regime 2 instead, different situations can arise depending on the size of \( N^{\max} \) and the market parameters. First, if \( N^{\max} \geq N_s \) (situation B), both types of borrowers are better off borrowing from MFI - risky types anticipating a switch to regime 1 in case they allow all

---

\[21\] Without loss of generality, we assume the following tie-breaking rule: when individuals are indifferent between borrowing in groups or individually, they choose the first option.

\[22\] Intuitively, if that rate is greater than \( r_s^{1,\max} \), we know from lemma 1 that ML is making losses since risky types prefer the joint-liability contract when both lenders are making zero profit. While if that rate is lower than \( r_s^{1,\max} \), ML can increase its profit by charging \( r_s^{1,\max} \) because this would increase the quality mix of its borrower pool (some risky borrowers leaving and some safe arriving).
the two sets of conditions are always overlapping, their joint realization will happen for intermediate values of \( \frac{p_r}{p_s} \). The latter observation implies a tension with the conditions for regime 2 (which needs \( \frac{p_r}{p_s} \) not too high). That is, if the two sets of conditions are always overlapping, their joint realization will happen for intermediate values of \( \frac{p_r}{p_s} \) only.

Table 6: Possible strategies of ML and market configurations

| Regime | \( N^\text{max} \geq N_s \) | \( U_r^J \geq U_r^J, \text{safe lenders} \) | \( \frac{p_r}{p_s} \) allowed in regime 2, we check that the following necessary condition is always true: \( \overline{\pi} > \overline{\pi} \) risky borrowers and \( \overline{\pi} \) safe borrowers, yielding a profit of

\[
\Pi(B) = [N - N^\text{max}] \left( \frac{\overline{p}}{p_s} (\bar{R}K - \bar{u}) - \gamma K \right).
\]

In other words, if \( \frac{p_r}{p_s} \) is high, because a high \( p_s \) decreases the interest rate of ML, while a low \( p_r \) decreases the probability that risky borrowers end up repaying their obligations and increases the implicit interest rate they would face at MFI.\(^{23}\)

If risky borrowers prefer borrowing individually (situation C), ML’s profit is

\[
\Pi(C) = \left[ N_r p_r + (N_s - N^\text{max}) \frac{p_r}{p_s} \right] (\bar{R}K - \bar{u}) - [N - N^\text{max}] \gamma K,
\]

while if they prefer going to MFI (situation D), ML’s per-borrower profit is

\[
\Pi(D) = [N - N^\text{max}] \left( \frac{\overline{p}}{p_s} (\bar{R}K - \bar{u}) - \gamma K \right).
\]

In that case, MFI serves only safe borrowers at the interest rate \( \overline{p} \).

By backward induction, we can compare ML’s strategies to determine market equilibria. Because ML would optimally choose to serve all borrowers if alone in the market, it is clear that situations B and D are preferred to situation A. However, in situation C, ML might prefer to focus on risky borrowers because regime 2 would only attract part of the safe borrowers and thus becomes less interesting than in the absence of MFI. Formally, dividing both (18) and (21) by \( N \),

\[
\Pi(A) > \Pi(C) \iff (\bar{R}K - \bar{u}) \left[ 1 - \alpha \right] (1 - \overline{\pi}) > 0
\]

which is less demanding than proposition 3 and therefore can happen. Indeed, plugging the maximum level of \( \overline{\pi} \) allowed in regime 2, we check that the following necessary condition is always true:

\[
\overline{\pi} \geq \frac{p_r}{p_s} \left( \frac{2}{p_r} - p_s \right)
\]

\( \overline{\pi} \) is

\[
\Pi(C) \iff \alpha > \frac{\overline{\pi}}{p_r} \left( \frac{2}{p_r} - p_s \right)
\]

Notes: conditions for \( U_r^J, \text{safe lenders} \) are given by expression (20) below. Cases are in decreasing order w.r.t. \( (N^\text{max} - N_s) \) from left to right. Optimal strategy is in bold font.

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\Pi(A) > \Pi(C) \iff (\bar{R}K - \bar{u}) \left[ 1 - \alpha \right] (1 - \overline{\pi}) > 0
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\[
\overline{\pi} \geq \frac{p_r}{p_s} \left( \frac{2}{p_r} - p_s \right)
\]

Notes: conditions for \( U_r^J, \text{safe lenders} \) are given by expression (20) below. Cases are in decreasing order w.r.t. \( (N^\text{max} - N_s) \) from left to right. Optimal strategy is in bold font.
satisfied:

\[
(\hat{R}K - \hat{u})\frac{p_r(1 - \pi) + (1 - \pi)p_r - p_s}{(1 - \alpha)p_s} \iff \alpha(1 - \pi)(p_s - p_r) > 0.
\]

It is easy to check that ML is more likely to focus on risky borrowers, and increase its interest rate as a consequence of MFI's presence, the larger the \(\alpha\) and the lower the \(\pi\) (since those decrease the available pool of unserved safe borrowers), as well as the higher \(p_r\).

Hence, if both lender types are able and willing to serve all borrowers (configuration 3), the impact of MFI can be to increase welfare (delivering cheaper credit to part of the population and having no effect on the residual interest rate), or to increase the residual interest rate and decrease coverage. That is, in this last case, even tough more funds become available on the market, less borrowers end up being served because of the more severe information problems. Finally, we show in appendix A.6 that the average interest rate in the entire economy increases in this last case as well, so that the overall welfare effect is unambiguously negative (given that the less projects end up being financed and lenders are making lower profits).

Table 7: Lenders’ expected clients and MFI’s impacts in mixed markets with market power

<table>
<thead>
<tr>
<th>ML \ MFI</th>
<th>separating</th>
<th>pooling</th>
</tr>
</thead>
<tbody>
<tr>
<td>clients:</td>
<td>([0, \max(N_s, N_r - N_{max})); (0, \min(N_s, N_{max})])</td>
<td>([0, N_r - (1 - \pi)N_{max}); (\pi N_{max}, (1 - \pi)N_{max})])</td>
</tr>
<tr>
<td>regime 1</td>
<td>impact: (\Delta^-) interest if (\alpha \geq 1 - \pi)</td>
<td>impact: (\Delta^+) coverage and welfare</td>
</tr>
</tbody>
</table>

\(N_{max} \geq N_s\) or cond. (20) KO

<table>
<thead>
<tr>
<th>N_{max} &lt; N_s and cond. (20) OK</th>
</tr>
</thead>
<tbody>
<tr>
<td>clients: ([0, N_r); (N_{max}, 0))</td>
</tr>
<tr>
<td>impact: (\Delta^+) interest, (\Delta^-) coverage and (\Delta^-) welfare</td>
</tr>
</tbody>
</table>

Note: ‘clients’ is to be read as follows: \([\text{expected safe borrowers served by ML, expected risky borrowers served by ML}) ; (\text{expected safe borrowers served by MFI, expected risky borrowers served by MFI})\].

The following conclusion summarizes the results.

**Conclusion 2 The impact of microfinance in monopolistic informal credit markets**

1. If group lending is unable to attract safe borrowers, both lenders compete for risky borrowers, which can force ML to cut its interest rate.

2. If safe borrowers can borrow jointly but are excluded from the individual-lending market, group lending increases the efficiency of the market but is unable to completely solve it (even if it has enough funds to serve all unserved population).

3. If safe borrowers can access individual loans:
   
   (a) If MFI has not enough funds to serve the entire safe population \(N_{max} < N_s\) and ML prefers to focus on risky borrowers given the increased riskiness of its borrower pool, group lending increases the interest rate of individual loans and decreases coverage of the overall market. Microfinance is welfare-reducing in this case.

   (b) If MFI has enough funds to serve the entire safe population \(N_{max} \geq N_s\) OR if MFI’s financing capacity is very low \(N_{max} << N_s\), group lending has no effect on the interest rate of individual loans. Microfinance is then welfare-improving.

That is, the introduction of market power for individual lenders does not modify the main insights found in the previous version of the model: microfinance can increase the equilibrium individual-lending (and market) rate because it worsens the informational problem. Yet, we find two additional results
that are interesting. First, in case microfinance increases the residual interest rate, the coverage of the overall market decreases. That is, although additional lending resources are present in the market, less borrowers can end up being financed. Second, we find that microfinance can also decrease the residual (and market) interest rate if they are competing for exactly the same pool of risky borrowers.

Appendix B.2 provides a graphical summary of the results obtained in the different cases, by means of a simulation. Holding all other parameters constant at values that satisfy the conditions of the model, we observe an increase in the individual-lending and the overall interest rates for intermediate concentrations of safe borrowers in the population (under the conservative assumption that MFI has enough funds to serve half of the entire population).

6 Empirical test

This final section puts the model to a more precise empirical test. We use the longitudinal database about the financial behavior of rural Indian households, which we already introduced in section 2. In that section, we had observed that (i) the level of interest rate charged by moneylenders does not decrease with respect to its no-MFI level as the number of SHGs increases (see table 1), and (ii) SHG members are borrowing from moneylenders before the opening of the SHG - and even afterwards, though in a dramatically reduced magnitude (see table 3). In terms of our model, it implies that we should be in the region of parameters that allow both lenders to potentially lend to all borrowers (what we called configuration 3). Let us summarize the testable predictions of the model for that region. As a result from the entry of MFI on traditional credit markets:

1. If the traditional market is competitive,
   (a) the individual-lending interest rate increases with respect to the no-MFI situation when the lending capacity of MFI is limited and the proportion of safe borrowers in the population is high (very negative $N_{\text{max}} - \alpha$);
   (b) in that case, the MFI supplies a safer pool than moneylenders (and the two lenders serve an identical pool otherwise);
   (c) in general, the volume of loans is unaffected.

2. If traditional lenders have market power,
   (a) the individual-lending interest rate increases when the lending capacity of MFI is limited and the proportion of safe borrowers in the population is not too high (not too negative $N_{\text{max}} - \alpha$);
   (b) in that case, the volume of loans decreases and the MFI supplies a safer pool than moneylenders;
   (c) if $(N_{\text{max}} - \alpha)$ becomes very negative, the individual-lending rate returns to its no-MFI level, and both lenders serve an identical pool of borrowers.

We estimate the following model, for each loan $i$ that occurred in village $v$ at time $t$:

$$\text{INT}_{i,v,t} = \beta + \gamma_1 \text{SHG12}_{v,t} + \gamma_2 \text{SHG34}_{v,t} + \gamma_3 \text{SHG5}_{v,t} + \delta \text{Member}_v + \mu T_t + \nu_v V_v + \epsilon_{i,v,t}$$

where SHG12, SHG34 and SHG5 are dummies indicating that the village has respectively one or two SHG(s) (low capacity), three or four SHGs (intermediate capacity) and five or more SHGs (high capacity).

We choose this dummy specification in order to make as little assumption as possible regarding the functional form of the relationship between number of groups and interest rate charged by moneylenders. However, using a quadratic form (as in section 2) yields very similar results.

The following graphs summarize the coefficients of the SHG variables.

The regression analysis confirms that there can be an increase in the interest rate charged by moneylenders in villages with a limited number of SHGs (as compared to villages without any SHG). If we think about the number of groups as proxying $\alpha$, the fund availability of MFI, this seems to be in line with the perfect-competition model: higher rate for low $\alpha$ and rate identical to no-MFI situation for high $\alpha$. Yet, the model indicates there should be a difference between villages with a safer profile and villages with a riskier profile. Figure 3 explores this issue by comparing poor and non-poor villages (where poverty is thought as a proxy for borrowers’ average riskiness). We see that the increase in the interest rate is entirely driven by non-poor - or safe - villages, which is in line with the theory that says that MFI has no impact on the interest rate if the proportion of safe borrowers is low.
Figure 1: Relationship between the interest rate charged by moneylenders and the number of SHGs in the village: estimates from OLS fixed-effects regression

![Diagram showing the relationship between interest rate charged by moneylenders and number of SHGs in the village, with point estimates and 95% confidence intervals.](image)

Output from the OLS regression of the above model with fixed-effects and controls (base category: no SHG; 1007 observations; standard errors clustered at the household level).

Figure 2: Relationship between the interest rate charged by moneylenders and the number of SHGs in the village: estimates from OLS fixed-effects regression

![Diagram showing the relationship between interest rate charged by moneylenders and number of SHGs in poor and non-poor villages, with point estimates and 95% confidence intervals.](image)

Output from the OLS regression of the above model with fixed-effects and controls (base category: no SHG; 1007 observations; standard errors clustered at the household level).
7 Conclusion

There is no doubt that microfinance has managed expanding access to finance in poor areas worldwide. One of the distinctive feature that allowed this success is the practice of group lending, which is to be found in most microfinance programmes (such as, to name only the most famous, the Grameen Bank in Bangladesh, BancoSol in Bolivia, FINCA in Peru, NABARD in India or Bank Kredit Desa in Indonesia). However, while focusing on direct stakeholders, the existing literature has not yet touched the redistributive aspects of the microfinance revolution. Given the almost-universal coexistence of MFIs and traditional lenders in developing countries, it is important to analyse how they modify equilibria on rural credit markets and how they affect the access to credit of non participants. Once we take a market-wide view, it is indeed not clear that microfinance is always welfare-improving. In fact, field observations as the ones presented in this paper indicate that informal lenders can charge higher interest rates when MFIs are present in the same market than when they stand alone. This work intends to contribute to understanding this issue.

We used an adverse selection model, with moneylenders supplying individual loans and MFIs operating joint liability schemes in presence of limited funds. In the standard version of the model, lenders are in a competitive environment and make zero profit. In this case, it was shown that, if there is assortative matching at the group formation stage, group lending institutions considerably modify the market. Since they always increase utility of safe borrowers, MFIs increase welfare and efficiency by attracting constrained safe borrowers back to the market, if any. Yet, safe borrowers who already borrowed from moneylenders will switch to MFI upon its opening, leading to an increase in the riskiness of the moneylenders’ pool of borrowers. As a consequence, informal lenders have to raise the interest rate of the residual market in order to avoid making losses in expected terms. Moreover, in this last case, the overall market rate increases as well, meaning that the impact of microfinance on social welfare is unambiguously negative.

When individual lenders have market power, they can choose to serve all borrowers or only risky ones, depending on which strategy gives them the highest profit. Once a zero-profit, group-lending institution settles in the market, a monopolist individual lender can attract risky individuals only. As a result, depending on the choice he was making in the pre-entry situation, the impact of the MFI’s entry can be to force the monopolist to cut its interest rate (competition effect), or to give up supplying credit to relatively safe borrowers and raising its interest rate (composition effect). Moreover, microfinance decrease market coverage in this last case, implying once again a negative welfare impact.

Therefore, our model predicts that, in a real world setting with a continuum of risk types and limited funds, the likely effect of the development of microlenders using group-lending schemes is indeed to relax the credit constraint on relatively safe individuals (which is the classical effect emphasized in the literature), but also potentially to raise the interest rate and to decrease the coverage of the cream-skimmed residual market. The second effect will in fact arise if moneylenders have limited market power (such that the competition effect is weak) and/or if they optimally choose to serve relatively safe borrowers in a stand-alone situation (such that the quality of their pool of borrowers is adversely affected by the MFI). This means that poor borrowers who cannot access microfinance (e.g., because they are too safe or to the contrary because there are perceived as too risky by their fellows, because they are lacking social connections to set up a group, or simply because MFIs cannot supply the entire market due to limited funds) might well be hurt by its apparition. Finally, the effects that we emphasized in this paper - though our exposition framed them in a market-entry setting - are not one-shot events. In a mixed market, as soon as MFI sector increases lending (due to a subsidy, increased funds, or the entry of a new microlender), the individual-lending sector will experience the kind of composition effect that we highlighted in the paper, which is likely to generate a rise in interest rates on traditional credit markets (as in Bose 1998) or a reduction in credit coverage.

This neglected potential impact of microfinance is of big importance given the limited outreach of basic financial services in rural environments and the high interest rates that are often reported in traditional credit markets. It surely deserves serious empirical attention in the future. Interestingly, the different pieces of evidence presented in this paper indicate that the presence of MFIs in rural credit market does not lead to cheaper credit for non members but rather the contrary. Moreover, there seems to be a nonlinear effect of the number of such MFIs, which may be a consequence of the mechanisms put forward in the model.

We believe our results also fit into the broader literature about evaluating the impact of microfinance. They imply that looking at average treatment effect on the treated (ATT) might mechanically overestimate the impact of microfinance if the control group comes from the same village or local market...
environment. More importantly, if controls are outside the local environment, it is crucial to take into account nonmembers (i.e., borrowers outside microfinance in microfinance villages) in the analysis in order to have a complete picture about the impact of microfinance. As this model made clear, there exist potentially important negative externalities and redistributive effects, which it would be helpful to quantify (e.g., designing randomized experiments that are able to take into account equilibrium effects).

Further research could generalize the model to continuous risk types. Also, one could introduce the possibility for MFIs to screen borrowers by varying the sizes of individual and joint liabilities (see Ghatak 2000). However, this should surely strengthen the composition effect of the present model given the further increase (decrease) of the utility of good (bad) types under joint lending that it would bring. In the same line, moral hazard issues could be studied as well by assuming imperfect monitoring of the lenders. Other studies have shown that group lending can also attenuate moral hazard (e.g., Banerjee et al. 1994, Ghatak and Guinnane 1999). Therefore, there are good reasons to expect similar results: the quality of the pool of borrowers in the residual market worsens, leading to interest rate increases in order to cover anticipated losses. By contrast, turning to a dynamic framework, in which borrowers and lenders would have repeated interactions, could affect the nature of group formation and hence the selection of good risks by MFIs. Furthermore, other competition frameworks could be envisaged, such as the competition between competitive moneylenders and a for-profit MFI (as this is a much-debated recent evolution of microcredit). Finally, the interaction with the formal sector, though less relevant in some low financial depth environments, is certainly an important issue to explore. As shown by Madestam (2009), if MFIs channel bank funds, they can contribute to higher rent extraction from banks.
References


A Mathematical appendix

A.1 Derivatives

This section provides the formal expressions for the variation of the various interest rates and adverse-selection thresholds in the text with respect to the risk parameters $\pi$ and $p_r$.

A.1.1 Individual lending

Derivatives of the interest rate are obvious. Derivatives of the adverse selection threshold $A^I \equiv \frac{\pi}{p_{r}} \gamma K$ are as follows.

1. $\frac{\partial A^I}{\partial \pi} = -\frac{\pi}{p_{r}} \gamma K \frac{\partial p_{r}}{\partial \pi} < 0$, given $\frac{\partial p_{r}}{\partial \pi} > 0$.

2. $\frac{\partial A^I}{\partial p_{r}} = -\frac{\pi}{p_{r}} \gamma K \frac{\partial p_{r}}{\partial p_{r}} + \frac{\gamma K}{p_{r}} > 0$.

   Indeed, using the fact that $\frac{\partial p_{r}}{\partial p_{r}} = \pi$, $\frac{\gamma K}{p_{r}} (1 - \frac{\pi}{p_{r}} \frac{\partial p_{r}}{\partial p_{r}}) > 0 \iff \frac{\pi}{p_{r}} \frac{\partial p_{r}}{\partial p_{r}} < 1 \iff (1 - \pi) \frac{p_{r}}{p_{r}} > 0$, which is always true.

3. $\frac{\partial A^I}{\partial \pi} = -\frac{\pi}{p_{r}} \gamma K \frac{\partial \pi}{\partial p_{r}} < 0$, given $\frac{\partial \pi}{\partial p_{r}} > 0$.

A.1.2 Group lending

Derivatives of the interest rate $r_{L,P} = \gamma \left( \frac{\pi}{p_{r}} - \frac{\gamma}{\pi} (\bar{p} - \pi p_{r}^2 (1 - \pi) p_{r}^2) \right)$ and the adverse selection threshold $A^I \equiv \frac{\pi}{p_{r}} (\gamma K - cK (1 - \pi) p_{r} (p_{s} - p_{r}))$ are as follows.

1. $\frac{\partial r_{L,P}}{\partial \pi} = -\gamma \left( \frac{\partial p_{r}}{\partial \pi} - \frac{cp_{r}^2 \partial \pi}{\partial p_{r}} + c(1 - \pi) \frac{\partial p_{r}}{\partial \pi} - cp_{r} \frac{\partial p_{r}}{\partial p_{r}} \right) < 0$.

   Indeed, using the fact that $\frac{\partial p_{r}}{\partial \pi} = p_{s} - p_{r}$, $\frac{\gamma}{\pi} \left( \frac{\partial p_{r}}{\partial \pi} - \frac{c}{\pi} (p_{s}^2 - p_{r}^2) - \frac{\partial p_{r}}{\partial p_{r}} \frac{\gamma c}{\pi} \frac{c}{p_{r}^2} (1 - \pi) p_{r}^2 < 0 \iff (p_{s} - p_{r}) \left( \frac{\pi}{p_{r}} \frac{c}{p_{r}^2} + \frac{\pi}{p_{r}} (\gamma p_{r}^2 - (1 - \pi) p_{r}^2) \right) < 0. \right.$

   Using (7), a sufficient condition for this is $\frac{\gamma p_{r}^2 (p_{s} - p_{r}) + \gamma c}{\pi} p_{r}^2 - (1 - \pi) p_{r}^2 < \gamma$, which is always true.

2. $\frac{\partial A^I}{\partial \pi} = -\gamma \left( \frac{\partial p_{r}}{\partial \pi} - \frac{cp_{r}^2 \partial \pi}{\partial p_{r}} + 2c(1 - \pi) \frac{\partial p_{r}}{\partial p_{r}} \right) < 0$.

   Indeed, replacing $\frac{\partial \pi}{\partial p_{r}}$ by its value, we have $\frac{\pi}{p_{r}} \left( c(\pi p_{r}^2 + 2(1 - \pi) p_{s} - (1 - \pi) p_{r}^2) - \gamma \right) < 0$, which is always true given that the sufficient condition $\frac{\gamma p_{r}^2 (p_{s} - p_{r}) + \gamma c}{\pi} p_{r}^2 - (1 - \pi) p_{r}^2 < \gamma$ is satisfied.

3. $\frac{\partial A^I}{\partial p_{r}} = -\gamma \left( \frac{\partial p_{r}}{\partial \pi} - \frac{cp_{r}^2 \partial \pi}{\partial p_{r}} + c(1 - \pi) \frac{\partial p_{r}}{\partial \pi} - cp_{r} \frac{\partial p_{r}}{\partial p_{r}} \right) < 0$, by a symmetrical reasoning.

   Substituting $\frac{\partial p_{r}}{\partial \pi}$ and using (7), we have $\frac{\gamma}{\pi} \left( \frac{\partial p_{r}}{\partial \pi} - \frac{c}{\pi} (p_{s}^2 - p_{r}^2) - c(1 - \pi) p_{r}^2 - \gamma \right) < 0 \iff c(2p_{r}p_{s} - p_{r}^2 + \pi p_{r}^2 - cp_{r}^2) < \gamma \iff 2 p_{r}^2 p_{s} - (1 - \pi) p_{r}^2 < \gamma \iff p_{r}^2 (2 - \pi p_{r}^2) < 0 \iff p_{r}(2p_{r} - 2) + (1 - \pi) p_{r}^2 < 0 \iff 2p_{r}(p_{r} - 1) < 0$.

4. $\frac{\partial A^I}{\partial \pi} = -\gamma \left( \frac{\partial p_{r}}{\partial \pi} - \frac{cp_{r}^2 \partial \pi}{\partial p_{r}} + c(1 - \pi) \frac{\partial p_{r}}{\partial \pi} - cp_{r} \frac{\partial p_{r}}{\partial p_{r}} \right) < 0$.

   Indeed, replacing $\frac{\partial \pi}{\partial p_{r}}$ by its value, we have $\frac{\pi}{p_{r}} \left( c(\gamma p_{r}^2 (p_{s} - p_{r}) + \gamma c) p_{r}^2 - (1 - \pi) p_{r}^2 \right) < 0 \iff p_{r}^2 (2 - \pi p_{r}^2) < 0 \iff 2(1 - \pi) p_{r}^2 < 2p_{r}(p_{r} - 1) < 0$.

5. $\frac{\partial A^I}{\partial p_{r}} = -\gamma \left( \frac{\partial p_{r}}{\partial \pi} - \frac{cp_{r}^2 \partial \pi}{\partial p_{r}} + c(1 - \pi) \frac{\partial p_{r}}{\partial \pi} - cp_{r} \frac{\partial p_{r}}{\partial p_{r}} \right) < 0$.

   Replacing $\frac{\partial \pi}{\partial p_{r}}$ by its value, we have $\frac{\gamma}{\pi} \left( \frac{\gamma}{\pi} (2p_{r} - 2) - \pi p_{r}^2 \right) < 0 \iff \frac{\gamma}{\pi} \left( \frac{\gamma}{\pi} (2p_{r} - 2) - \pi p_{r}^2 \right) < 0$.

   Replacing $\frac{\partial \pi}{\partial p_{r}}$ by its value, we have $\frac{\gamma}{\pi} \left( \frac{\gamma}{\pi} (2p_{r} - 2) - \pi p_{r}^2 \right) < 0$.

   Substituting $\frac{\partial A^I}{\partial p_{r}}$ and using (7), we have $\frac{\gamma}{\pi} \left( \frac{\gamma}{\pi} (2p_{r} - 2) - \pi p_{r}^2 \right) < 0 \iff 2(1 - \pi) p_{r}^2 < 2p_{r}(p_{r} - 1) < 0$.

   Replacing $\frac{\partial \pi}{\partial p_{r}}$ by its value, we have $\frac{\gamma}{\pi} \left( \frac{\gamma}{\pi} (2p_{r} - 2) - \pi p_{r}^2 \right) < 0$.

   Substituting $\frac{\partial A^I}{\partial p_{r}}$ and using (7), we have $\frac{\gamma}{\pi} \left( \frac{\gamma}{\pi} (2p_{r} - 2) - \pi p_{r}^2 \right) < 0$.

   Substituting $\frac{\partial A^I}{\partial p_{r}}$ and using (7), we have $\frac{\gamma}{\pi} \left( \frac{\gamma}{\pi} (2p_{r} - 2) - \pi p_{r}^2 \right) < 0$.

   Substituting $\frac{\partial A^I}{\partial p_{r}}$ and using (7), we have $\frac{\gamma}{\pi} \left( \frac{\gamma}{\pi} (2p_{r} - 2) - \pi p_{r}^2 \right) < 0$.

   Substituting $\frac{\partial A^I}{\partial p_{r}}$ and using (7), we have $\frac{\gamma}{\pi} \left( \frac{\gamma}{\pi} (2p_{r} - 2) - \pi p_{r}^2 \right) < 0$.
A.2 Risky borrowers are always better off than safe borrowers under group lending

Given (8),

\[ U_r^J > U_s^J \iff \bar{R}K - p_r r^J K - p_r (1 - p_r) cK > \bar{R}K - p_s r^J K - p_s (1 - p_s) cK \]
\[ \iff (p_r - p_s) r^J + (p_r (1 - p_r) - p_s (1 - p_s)) c < 0 \]

Given that \( c < r^J \), a sufficient condition is:

\[ p_r - p_r^2 - p_s^2 = p_s - p_r \iff (p_s - p_r)(p_s + p_r - 2) < 0 \]

which is always true.

A.3 Feasibility of joint-liability contract

We first show that condition (7), \( c \leq r^{J,P} \), is sufficient to ensure that \( r^{J,P} > 1 \).

Let us derive the following useful result:

\[ C = 2\bar{p} - \pi p_s^2 - (1 - \pi)p_r^2 < 0. \]

Given that \( 0 \leq p_r < p_s \leq 1 \), the function \( C \) is increasing in \( \pi \). Indeed, \( \frac{\partial C}{\partial \pi} = 2p_s - 2p_r - p_s^2 + p_r^2 > 0 \iff p_s + p_r < 2 \). Therefore, it is sufficient to check that \( C < 1 \) for \( \pi = 1 \), i.e. at the maximum of \( C \):

we have that \( 2p_s - p_s^2 < 1 \iff p_s^2 - 2p_s + 1 > 0 \), which is satisfied for any \( p_s < 1 \). We now turn to our main point:

\[ r^{J,P} > 1 \iff \frac{\gamma}{\bar{p}} - \frac{c}{\bar{p}}(\bar{p} - \pi p_s^2 - (1 - \pi)p_r^2) > 1 \iff c < \frac{\gamma - \bar{p}}{(\pi p_s^2 - (1 - \pi)p_r^2)} \]

We can check that this condition is implied by \( c \leq r^{J,P} \iff c \leq \frac{\gamma - \bar{p}}{2\bar{p} - \pi p_s^2 - (1 - \pi)p_r^2} \) because

\[ \frac{\gamma - \bar{p}}{\bar{p} - \pi p_s^2 - (1 - \pi)p_r^2} > 2\bar{p} - \pi p_s^2 - (1 - \pi)p_r^2 \iff \gamma < 2\bar{p} - \pi p_s^2 - (1 - \pi)p_r^2 \]
given \( \gamma > 1 \) and \( C < 1 \), i.e. the unity condition is less restrictive than condition (7) and \( c \leq r^{J,P} \Rightarrow r^{J,P} > 1 \).

Second, we show that the same condition (7) usually implies that any successful borrower can always repay for its defaulting partner. Indeed, we have that

\[ r^{J,P} + c \leq R_s \iff \frac{\gamma}{\bar{p}} - \frac{c}{\bar{p}}(\bar{p} - \pi p_s^2 - (1 - \pi)p_r^2) + c \leq R_s \iff c \leq \frac{lR_s - \gamma}{\pi p_s^2 + (1 - \pi)p_r^2} \]

Therefore, a sufficient condition for the contract to be feasible is

\[ \frac{lR_s - \gamma}{\pi p_s^2 + (1 - \pi)p_r^2} \geq \frac{\gamma}{2\bar{p} - \pi p_s^2 - (1 - \pi)p_r^2} \iff R_s \left( \frac{\bar{p} - \pi p_s^2 - (1 - \pi)p_r^2}{2} \right) \geq \gamma. \]

Given the condition (1) that both projects are socially profitable, which links \( R_s, p_s \) and \( \gamma \), the above will be satisfied unless \( p_r \) is very low.

A.4 Proof of \( r^{J,S} > r^{J,P} \)

\[ \frac{\gamma}{\bar{p}} - \frac{c}{\bar{p}}(\bar{p} - \pi p_s^2 - (1 - \pi)p_r^2) < \frac{\gamma}{p_r} - c(1 - p_r) \iff \gamma(1 - \frac{\bar{p}}{p_r}) - c(p_r \bar{p} - \pi p_s^2 - (1 - \pi)p_r^2) < 0 \]
\[ \iff c < \gamma \frac{p_r - \bar{p}}{p_r \pi p_s (p_r - p_s)} \iff c < \frac{\gamma}{p_r p_s}, \]

which has been shown to be true in A.1.2.
A.5 Risky types prefer borrowing individually in mixed markets

When MFI doesn’t have enough funds to serve the entire safe population and safe borrowers can derive positive utility from individual loans (situation D of section 4.4), it is optimal for risky types to borrow individually if

\[ RK - \alpha Kp_r (r^{I,P} + (1 - p_r)c) - (1 - \alpha)Kp_r r^{I,P} \leq RK - Kp_r r^{I,P,max} \iff \]

\[ RK - \alpha Kp_r \left( \frac{\gamma}{\bar{p}} - \frac{c}{\bar{p}}(\bar{p} - \pi p_s^2 - (1 - \pi)p_r^2) + (1 - p_r)c \right) - (1 - \alpha)Kp_r \frac{\gamma}{\bar{p}} \leq RK - Kp_r \gamma \frac{1 - \alpha}{\bar{p} - \alpha p_s} \iff \]

\[ \alpha \gamma \frac{p_r (1 - \pi)(p_s - p_r)}{\bar{p} - \alpha p_s} + \alpha \frac{p_r}{\bar{p} - \alpha p_s} (\bar{p} - \pi p_s^2 - (1 - \pi)p_r^2) - \alpha cp_r (1 - p_r) \leq 0 \iff \gamma \frac{(1 - \pi)(p_s - p_r)}{\bar{p} - \alpha p_s} + c\pi p_s (p_r - p_s) \leq 0 \iff \gamma \frac{1 - \pi}{\bar{p} - \alpha p_s} - c\pi p_s \leq 0 \]

Given the incentive-compatibility condition (7), a necessary condition is:

\[ \gamma \left( \frac{1 - \pi}{\bar{p} - \alpha p_s} - \frac{\pi p_s}{2\bar{p} - \pi p_s^2 - (1 - \pi)p_r^2} \right) \leq 0 \iff (1 - \pi)(2\bar{p} - \pi p_s^2 - (1 - \pi)p_r^2) \leq \pi p_s(\pi - \alpha + (1 - \pi)p_r) \]

\[ \iff (1 - \pi)(2\bar{p} - \pi p_s^2 - (1 - \pi)p_r^2) \leq 0 \iff \alpha \leq 1 - \frac{1 - \pi (2 - p_s)\bar{p}}{\pi p_s} \]

which can always be realized given that \( \alpha < \pi \leq 1 \) in situation D (e.g. for high \( \pi \)). Moreover, given that safe borrowers can borrow individually (i.e. the realization of condition (13)), a sufficient condition is \((RK - \bar{u})\frac{1 - \pi}{(1 - \alpha)p_s} - cKp_s \leq 0\), which is not necessarily the case but is always satisfied for high \( \pi \) and \( p_s \).

A.6 MFI increases overall interest rate in competitive mixed markets

At a pooling equilibrium, the individual-lending market charges \( r^{I,P} = \frac{\gamma}{\bar{p}} \) to all borrowers. In situation D of section 4.4, when risky types prefer borrowing individually (see A.5 above), the average interest rate in the economy is:

\[ (r^{I,P,max}(N_r + N_s - N_{max}) + (r^{I,SS} N_{max}) \frac{1}{N} = \left( \gamma \frac{1 - \alpha}{\bar{p} - \alpha p_s} (N - N_{max}) + \left( \frac{\gamma}{p_s} - (1 - p_s)c \right) N_{max} \right) \frac{1}{N}. \]

Hence, the average interest rate in the economy increases if

\[ \frac{\gamma (1 - \alpha)^2}{\bar{p} - \alpha p_s} + \alpha \frac{\gamma}{p_s} - \alpha (1 - p_s)c > \frac{\gamma}{\bar{p}} \iff \gamma \frac{(\bar{p} - p_s)^2}{(\bar{p} - \alpha p_s)p_s \bar{p}} > \alpha (1 - p_s)c \]

which is always true given that the LHS is positive and the RHS is negative.

B Summary: simulation

B.1 Perfect competition

The figure presents a simulation with the following parameter values: \( \gamma = 1.5, K = 1, p_s = 0.9, p_r = 0.5, c = 1.5, \alpha = 0.5 \), and a varying proportion of safe (and hence risky) borrowers in the population. It summarizes the major findings of . The first part of the curves (with high interest rate and zero slope) is the separating-equilibrium region, while the second part (with low interest rate and negative slope) is the pooling-equilibrium zone. One can see easily that group lending - the lowest line in the graph - allows both a reduction in the interest rate and an increase in the likelihood of a pooling equilibrium. In mixed markets, traditional lenders increase their interest rate when the proportion of safe borrowers is high (from 0.75, see the dotted line). Moreover, the market interest rate (in-between line) is also increasing in that region.
B.2 Market power

Using the same parameter values, we now plot the results of section . The monopolist increases the interest rate and the credit rationing (see dashed line, the zero slope reflects the full rent appropriation by the monopolist). Yet, when few risky borrowers are present in the market, it is optimal for him to serve all borrowers (for \((1 - \pi) \leq 0.35\) in our simulation). When it faces the competition of the MFI, the monopolist can find it optimally to switch from regime 2 to regime 1 and charge the maximum rate of interest, for intermediate values of \(\pi\) (see dotted line). Once again, we see that the market rate (plain line) is also increasing in that case. Note that we don’t find any decrease of the interest rate in the region in which MFI serves only risky borrowers (leftwards), because in our simulation \(\alpha > (1 - \pi)\) in that region.
Figure 4: Interest rates charged by zero-profit MFI and monopolistic ML, over the composition of the borrower pool