

Market Structure and Borrower Welfare in Microfinance *

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Abstract

Motivated by recent controversies surrounding the role of commercial lenders in microfinance, we analyze borrower welfare under different market structures, considering a benevolent non-profit lender, a for-profit monopolist, and a competitive credit market. To understand the magnitude of the effects analyzed, we simulate the model with parameters estimated from the MIX Market database. Our results suggest that market power can have severe implications for borrower welfare, while despite possible information frictions competition typically delivers similar borrower welfare to non-profit lending. In addition, for-profit lenders are less likely to use joint liability than non-profits.

Keywords: microfinance; market power; for-profit; social capital

JEL codes: G21, O12, D4, L4, D82

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Commercialization has been a terrible wrong turn for microfinance, and it indicates a worrying “mission drift” in the motivation of those lending to the poor. Poverty should be eradicated, not seen as a money-making opportunity.

Muhammad Yunus, New York Times, January 14th 2011¹

The success of MFIs across the world has been tremendous over the last two decades, culminating in the Nobel Peace Prize for the Grameen Bank and its founder Dr. Muhammad Yunus. However, in the last few years there has been some controversy about the activities of some microfinance institutions (henceforth, MFIs) that has stirred a broader debate about commercialization and mission drift in the sector.² There are concerns that some MFIs are profiteering at the expense of poor borrowers, attracted by the high repayment rates, and charging very high interest rates which seemingly contradicts the original purpose of the MFI movement, namely making capital accessible to the poor to lift them out of poverty.³ While the discussion has been mostly about “commercialization”, there is an implicit assumption that these lenders enjoy some market power, for example, in Yunus’s statement that microcredit has “[given] rise to its own breed of loan sharks”.⁴ This critique is acknowledged within the MFI sector and has led to calls for tougher regulations, for example, in the form of a new bill, entitled the “Micro Finance Institutions (Development and Regulation) Bill” being tabled in the Indian Parliament.

The academic literature on microfinance, both theoretical and empirical, has not kept pace with these developments.⁵ It has typically assumed lenders to be non-profits or to operate in a perfectly competitive market, and which more generally ignores the issue of market structure in considering the welfare effects of microfinance (see for example, the recent review by Banerjee (2013)). Our paper aims to fill this gap, both theoretically and empirically, which would allow us to understand and interpret the recent controversies.

¹ Accessible at <http://www.nytimes.com/2011/01/15/opinion/15yunus.html>

² For instance, SKS in Andhra Pradesh, India, Banco Compartamos of Mexico, LAPO of Nigeria. See, for example, MacFarquahr (New York Times, April 13, 2010), and Sinclair (2012).

³ In addition, the results from several randomized experiments in India, Mongolia, Morocco, and the Philippines suggest that while microfinance has a positive effect in starting small businesses, but it did not have a statistically significant effect reducing poverty. See Banerjee et al. (2010), Attanasio et al. (2011), Crépon et al. (2011), and Karlan and Zinman (2009). By design these studies look at a single MFI and its borrowers rather than addressing industry or market level issues. Nevertheless the results suggest the need to look at factors that might be limiting the impact of microfinance on its stated goal of poverty alleviation.

⁴ The New York Times, 14th January 2011.

⁵ Exceptions are Cull et al. (2007), Cull et al. (2009) and Baquero et al. (2012).

Most of the existing work has looked at the remarkable repayment rates achieved by MFIs. In a world where lenders are not necessarily acting in the best interests of borrowers, we need to look beyond repayment rates. More broadly, the existing literature, both theoretical and empirical, has typically adopted a partial equilibrium framework focusing on one MFI and a given set of borrowers, whereas a lot of the issues these debates have thrown up require looking at the broader market and institutional environment within which a MFI operates. This allows us to evaluate borrower welfare looking beyond repayment rates - looking at the types of loans offered, interest rates, and the extent of credit rationing. In addition, we can show that some of the changes in the lending patterns - for example, some suggestive evidence that there has been some decline in joint liability loans relative to individual liability loans (see Giné and Karlan (2013)) may indeed be related to changes in market structure, e.g., increasing commercialization.

Our paper analyzes the consequences of for-profit or commercial lending in microfinance, with and without market power, compared to a benevolent non-profit maximizing borrower welfare subject to a break-even constraint on these outcome variables. To our knowledge, this is the first paper to formally address the issues that are at the heart of these policy debates. Much of the microfinance literature has shown how joint liability lending can be used by MFIs to leverage borrowers' social capital and local information in order to lend to otherwise unbankable customers and increase their welfare. Using a simple, tractable model we show that when the lender is a for-profit with market power he can instead leverage these to extract higher rents at the borrowers' expense. In particular, borrowers with more social capital may be worse off than those with less. We then show that competition between for-profit lenders can close down this channel, but has an ambiguous effect on borrower welfare as competition undermines borrowers' incentives to repay their loans and thus leads to credit rationing. Lastly, we show that for-profit lenders - both with and without market power - inefficiently *under-use* joint liability relative to the altruistic non-profit benchmark. The latter use joint liability whenever it is socially efficient, but the former use it only if it is profit-maximizing relative to using individual liability, the joint liability is associated with tighter incentive constraints. This result is consistent with the evidence presented in Cull et al. (2009) that non-profits tend to use group-based lending methods, whereas for-profit lenders tend to use individual-based lending methods. It is also consistent with the perceived trend away from the use of JL, to the extent that this coincides with increasing commercialization of

microfinance.

Finally, we simulate the model using parameters estimated from the MIX Market (henceforth, MIX) dataset and existing research. The attempt to bridge theory and policy debates via quantitative analysis is a novel aspect of the paper. We initially expected that the monopolist's ability to leverage borrowers' social capital would have large welfare effects. We find that forcing the monopolist to use JL when he would prefer IL increases borrower welfare by a minimum of 12% and a maximum of 20%. Meanwhile, switching to a non-profit lender delivers a much larger welfare gain of between 54% and 73%. The qualitative sizes of these effects are robust to alternative parameter values. Secondly, we find that despite its effect on undermining repayment incentives, competition delivers similar borrower welfare to the non-profit benchmark. Taking these results together suggests that regulators should be attentive to lenders with market power, but that fostering competition rather than heavy-handed regulation can be an effective antidote. Thirdly, we find that for our parameter values, the non-profit lender would offer JL to all borrowers, irrespective of their level of social capital. The for-profit lenders, with and without market power, only switch to JL lending when borrowers have social capital worth around 15% of the loan size.

Turning to related literature, our model is along the lines of Besley and Coate (1995) who show how JL can induce repayment guarantees within borrowing groups, with lucky borrowers helping their unlucky partners with repayment when needed. They show a trade-off between improved repayment through guarantees, and a perverse effect of JL, that sometimes a group may default *en masse* even though one member would have repaid had they received an IL loan. Introducing social sanctions, they show how these can help alleviate this perverse effect by making full repayment incentive compatible in more states of the world, generating welfare improvements that can be passed back to borrowers. Rai and Sjöström (2004) and Bhole and Ogden (2010) are recent contributions to this literature, both using a mechanism design approach to solve for efficient contracts (neither include the social capital channel). Within the microfinance literature there are various approaches to modeling social capital. For instance Besley and Coate (1995) model an exogenously given social penalty function, representing the disutility an agent can impose on her partner as a punishment. We model social capital in a similar reduced-form way as a sanction worth S that a borrower can impose on a partner in response to a violation of an informal contract, thus social capital in our model is a measure of the

strength of informal contracting.⁶ There are a number of empirical studies of the role of social capital in group borrowing.⁷ Feigenberg et al. (2013) study the effect of altering loan repayment frequency on social interaction and repayment, claiming that more frequent meetings can foster the production of social capital and lead to more informal insurance within the group. It is this insurance or repayment guarantee channel on which our model focusses. They also highlight that peer effects are important for loan repayment, even without explicit JL, through informal insurance, and that these effects are decreasing in social distance.

Following the move by Grameen Bank and BancoSol, among others, to use of IL lending, it has been popularly perceived that use of JL is declining (for instance, see Armendáriz de Aghion and Morduch (2010)) but beyond anecdotal accounts, as yet there is little rigorous evidence that confirms this. There is some suggestive evidence of a moderate decline in the *number of institutions* that use purely group loans, from 22.6% in 2006 to 13.4% in 2009, and a corresponding increase in the number of institutions that use purely individual loans (see Giné and Karlan (2013)). However, what seems to be true is that “solidarity groups” are still widely used at present even though we do not have detailed data on contract types.⁸ In our sample of 715 MFIs from around the world that reported to the Microfinance Information Exchange (MIX) in 2009, the total share of solidarity group lending by *number of loans* is 54%.⁹ There is some emerging evidence on the relative roles of IL and JL. Giné and Karlan (2013) and Attanasio et al. (2011) find no significant difference between group and individual repayment probabilities, although repayment rates are very high under both control and treatment groups. They are not strictly comparable as in the first study groups were retained under IL while in the second groups are not used either under IL or JL.

The plan of the paper is as follows. In section 1 we lay out the basic model and analyze the choice of contracts by a non-profit lender who maximizes borrower

⁶Alternative approaches include Greif (1993), where deviations in one relationship can be credibly punished by total social ostracism. Bloch et al. (2008) and Karlan et al. (2009) Jackson et al. (2011) present models where insurance, favor exchange or informal lending are embedded in social networks such that an agent’s social ties are used as social collateral to enforce informal contracts.

⁷See, for example Cassar et al. (2007), Wydick (1999), Karlan (2007), Giné et al. (2010).

⁸The MIX states that “loans are considered to be of the Solidarity Group methodology when some aspect of loan consideration depends on the group, including credit analysis, liability, guarantee, collateral, and loan size and conditions.”

⁹By total value of loans, however, it is only worth 18%, which reflects the fact that group loans are typically smaller. See the discussion and figure in the online Appendix.

welfare and a for-profit monopolist. In section 2 we analyze the effects of introducing competition to the market. We then simulate the model in section 3, allowing an empirical interpretation of the key mechanisms analyzed. Section 4 concludes.

1 The Model

We assume that there is a set of risk neutral agents or “borrowers”, each of whom has access to a technology costing one unit of output each period that produces R units of output with probability $p \in (0, 1)$ and zero otherwise. Project returns are assumed to be independent. In each period the *state* is the vector of output realizations for the set of borrowers under consideration, so when we consider an individual borrower the relevant state is $Y \in \{0, R\}$, while for a pair of borrowers it is $Y \in \{(0, 0), (0, R), (R, 0), (R, R)\}$. The outside option of the borrower is assumed to be zero. Borrowers do not save and have no assets, so they must borrow 1 unit of output at the start of the period to finance production, and consume all output net of loan repayments at the end of the period. Since they have no assets their liability in any given period is limited to their income in that period. Borrowers have infinite horizons and discount the future with factor $\delta \in (0, 1)$.

Each period, the state is common knowledge for the borrowers but not verifiable by any third party, so the lender cannot write state-contingent contracts. Borrowers can write contingent contracts with each other but these can only be enforced by social sanctions.

There is a single lender who may be a non-profit who is assumed to choose a contract that maximizes borrower welfare subject to a zero-profit condition, or alternatively a for-profit who maximizes profits.¹⁰ The lender’s opportunity cost of funds is $\rho \geq 1$ per unit. We assume (purely for simplicity) that the for-profit lender does not discount, i.e. he chooses the contract to maximize current-period profits only. We also assume that the lender has sufficient capacity to serve all borrowers that want credit.

Since output is non-contractible, lenders use dynamic repayment incentives as in, for example, Bolton and Scharfstein (1990). Following much of the microfinance literature we focus attention on IL or JL contracts. The IL contract is a standard debt contract that specifies a gross repayment r , if this is not made, the borrower

¹⁰We do not explore the organizational design issues that might cause non-profits to behave differently than postulated above, as for example in Glaeser and Shleifer (2001).

is considered to be in default and her lending relationship is terminated. Under JL, pairs of borrowers receive loans together and unless both loans are repaid in full, both lending relationships are terminated. The lender can choose the interest rate and whether to offer IL or JL. Borrowers are homogeneous in the basic model so the lender offers a single contract in equilibrium.

We assume the lender commits to a contract in the first period by making a take-it-or-leave-it offer specifying r and either IL or JL. Borrowers may then agree on an intra-group contract or *repayment rule*, specifying the payments each borrower will make in each possible state of the world.

Throughout the paper we assume the following timing of play. In the initial period:

1. The lender enters the community and commits to an interest rate and either IL or JL for all borrowers.
2. Borrowers may agree a repayment rule.

Then, in this and all subsequent periods until contracts are terminated:

1. Loans are disbursed, the borrowers observe the state and simultaneously make repayments (the repayment game).
2. Conditional on repayments, contracts renewed or terminated.

1.1 Intra-group contracting

Under JL, borrowers form groups of two individuals $i \in \{1, 2\}$, which are dissolved unless both loans are repaid. Once the loan contract has been written the borrowers agree amongst themselves and commit to a repayment rule or repayment guarantee agreement that specifies how much each will repay in each state in every future period.¹¹ In order to prevent the group from being cut off from future finance, a borrower may willingly repay the loan of her partner whose project was unsuccessful. We assume that deviation from the repayment rule is punished by a social sanction

¹¹It is plausible that such agreements could expand to include others outside the group. For simplicity we assume that this is not possible, perhaps because borrowers' output realizations or borrowing and repayment behavior are only observable to other borrowers within their group.

of size S , introduced in 1.2 below.¹² Some examples of possible rules are “both borrowers only repay their own loans,” or “both repay their own loans when they can, and their partner’s when she is unsuccessful.”

The agreed repayment rule can be seen as a device that fixes the payoffs of a two-player “repayment game” for each state of the world. Since the state is common knowledge to the borrowers, each period they know which repayment game they are playing. Either a borrower pays the stipulated amount, or she suffers a social sanction and may also fail to ensure her contract is renewed. The repayments stipulated in the rule must constitute a Nash equilibrium (i.e. be feasible and individually incentive-compatible). We assume that the pre-agreed rule enables the borrowers to coordinate on a particular equilibrium by fixing beliefs about their partner’s strategy. This in turn implies that social sanctions never need to be enacted on the equilibrium path since there will be no deviations from the rule and the state is common knowledge.

For simplicity, we restrict attention to repayment rules that are symmetric (i.e., do not condition on the identities of the players), and stationary (depend only on the current state and social capital). Thus we can focus on a representative borrower with a time-independent value function. Symmetry prevents one borrower from taking advantage of the other using the threat of social sanction as leverage. Furthermore we focus on repayment rules that induce a joint welfare maximizing equilibrium. This implies that the total repayment in any state will be either zero or $2r$, and that social sanctions will not be used on the equilibrium path but only to punish off-equilibrium deviations.

1.2 Social Sanctions

A central theme in the microfinance literature is how the innovative lending mechanisms used by MFIs can harness social capital and local information among borrowers to overcome standard asymmetric information problems that make profitable lending to the poor difficult. With altruistic or competitive lenders the typical result is that the greater the lender’s ability to access these, the better.

In this paper we show how under market power this result is reversed. Specifically, joint liability borrowers with a lot of social capital can be worse off than those with a little. This mirrors recent work on property rights (Besley et al. (2012)) that shows

¹²In a related paper, de Quidt et al. (2011), we show how social sanctions can enable borrowers to guarantee repayments even without an explicit JL clause. In the framework of this paper such behavior will not arise in equilibrium.

that in an insufficiently competitive market, an improvement in borrowers' ability to collateralize their assets can make them *worse off*, in contrast to the standard view of the "de Soto effect." This, however only represents a partial point to the anti-joint liability camp. Banning the use of joint liability would make some borrowers better off, but many would be worse off.

There are many possible ways to model social capital. We adopt a very simple reduced form approach. We model social capital as borrowers' ability to enforce informal contracts amongst themselves. Such contracts specify actions that a borrower must take in certain states of the world, and if she deviated from the agreement she is punished by a sanction worth S in utility terms.¹³ Borrowers in our model form loan guarantee or informal insurance arrangements to assist one another in times of difficulty, backed by social sanctions. With an altruistic or competitive lender, the standard intuition follows: larger social sanctions can support more efficient lending contracts, increasing borrower welfare. When the lender has market power, this is true, but in addition the lender can exploit the borrowers' sanctioning ability to extract more rents, potentially making them worse off.

In the core model we assume that S is observable and homogeneous across borrowers, and explore the comparative statics of varying the borrowers' informal enforcement ability. In an extension in section 1.4, we discuss the consequences of heterogeneity.

1.3 Loan contracts

With a single lender, contract termination means no credit ever again (unlike under competition in section 2, when a borrower cut off by one lender can later obtain a loan from another). Since borrowers must be given a rent for dynamic incentives to be effective, their participation constraint will be satisfied.

If a borrower's contract is renewed with probability π , it must be that her expected per-period repayment is πr . Thus the value of access to credit for a representative borrower is $V = pR - \pi r + \delta\pi V$, which simplifies to:

$$V = \frac{pR - \pi r}{1 - \delta\pi}. \quad (1)$$

¹³This is closely related to the approach of Besley and Coate (1995) and the informal sanctions in Ahlin and Townsend (2007).

We can use (1) to derive the first incentive constraint on the lender. No borrower or group of borrowers will repay a loan if $r > \delta V$, i.e. if the benefit of access to future credit is worth less than the interest payment. This reduces to the constraint $r \leq \delta p R$, which we term Incentive Constraint 1 (IC1). We define r_{IC1} as the interest rate at which IC1 binds:

$$r_{IC1} \equiv \delta p R.$$

When IC1 binds, $V = pR$. This caps the lender's rent extraction: borrowers cannot be made worse off than if they took one loan and defaulted immediately.

1.3.1 Joint liability and social capital exploitation

First we consider joint liability lending. Recall that the lender observes the borrowers social capital, S , then offers a contract.

Suppose the lender offers a contract with interest rate r , satisfying IC1. The borrowers now have to agree a repayment rule to maximize joint welfare. Since IC1 is satisfied, joint welfare is higher when both loans are repaid than when both default, so the optimal rule will repay both loans in all states except $(0, 0)$ (when repayment is not possible). A minimal symmetric rule that achieves this is "both repay own loans in state (R, R) , and the successful borrower bails out her partner in states $(R, 0)$ and $(0, R)$." Under this rule, each loan is repaid with probability $1 - (-p)^2$, which simplifies to:

$$q \equiv p(2 - p).$$

Repayment of own loans in state (R, R) is incentive compatible by IC1 (borrower stands to lose at least δV if she does not repay r when her partner is also repaying r). Now suppose borrower j is called upon to assist i . If she does not, she loses future credit access, worth V , and is socially sanctioned next period, costing S . Thus the following incentive constraint (IC2) must hold: $R - 2r + \delta V \geq R - \delta S$. This reduces to an upper bound on the interest rate, which we call r_{IC2} :

$$r_{IC2}(S) \equiv \frac{\delta[pR + (1 - \delta q)S]}{2 - \delta q}.$$

In addition, a limited liability constraint must hold: $R \geq 2r$. We can ignore this without qualitatively affecting the results by the following parameter assumption:

Assumption 1 $\delta p \leq \frac{1}{2}$.

Now consider a lender offering a JL contract. If he offers $r \leq \min\{r_{IC1}, r_{IC2}(S)\}$, the borrowers will guarantee one another's loans and repay with probability q . If he sets $r \in [r_{IC1}, r_{IC2}(S))$, the borrowers will not be able to help one another with repayment, so will only repay in state (R, R) , which occurs with probability p^2 . Lastly, if he sets $r > r_{IC1}$, the borrowers always default. Clearly the latter cannot be an equilibrium. In addition, as we show when we discuss contract choice, a contract with $r \in [r_{IC1}, r_{IC2}(S))$ will always be dominated by an individual liability contract, so we ignore this possibility and focus on JL contracts under which borrowers repay with probability q .

Consider first a non-profit, altruistic lender offering joint liability loans. Since the repayment probability is q , the zero profit interest rate is $\hat{r} = \frac{\rho}{q}$. Plugging into (1), the equation for borrower welfare under the nonprofit is:

$$\hat{V}^{JL} = \frac{pR - \rho}{1 - \delta q}.$$

Note that \hat{V}^{JL} does not depend on S .

Now consider a for-profit monopolist. The profit-maximizing interest rate binds the slacker of IC1 and IC2. We define the following threshold value of S :

$$\bar{S} \equiv pR.$$

For $S < \bar{S}$, IC2 is tighter than IC1, while for $S \geq \bar{S}$, IC1 is the tightest. Thus we obtain the monopolist's interest rate, \tilde{r}^{JL} , and borrower welfare, $\tilde{V}^{JL}(S)$ as follows.

$$\begin{aligned} \tilde{r}^{JL}(S) &= \min\{r_{IC1}, r_{IC2}(S)\} \\ \tilde{V}^{JL}(S) &= \frac{pR - q \min\{r_{IC1}, r_{IC2}(S)\}}{1 - \delta q} \geq pR. \end{aligned}$$

Note that for $S < \bar{S}$, \tilde{r} is increasing in S , and therefore borrower welfare is decreasing in S , which we state as a proposition.

Proposition 1 *Under joint liability lending a monopolist for-profit lender exploits the borrowers' social capital by charging higher interest rates to borrowers with high social capital. Thus borrower welfare decreases in social capital.*

Another way of viewing this result is that the lender's motivation matters more as the amount of borrower social capital increases, as the difference between borrower

welfare under the nonprofit and for-profit monopolist increases. We will return to this issue later on when we consider equilibrium contract choice.¹⁴

As discussed above, much of the microfinance literature has shown how different aspects of MFIs' lending methodologies can be thought of as leveraging social capital and local information among borrowers to address various asymmetric information or weak enforcement issues. Proposition 1 shows that this not need be a force for good from the perspective of borrowers: a monopolist may be able to use their social capital against them to extract more rents.

We have assumed that S is homogeneous and observable, so that the lender can choose the interest rate accordingly. Why can't the borrowers resist the lender's exploitation by refusing to use their ability to socially sanction one another? The problem is that threatening to do so is not credible. Conditional on the contract offered, the borrowers are better off using their ability to socially sanction to agree the most efficient repayment rule. Refusing to do so makes them less likely to be able to repay their loans and therefore worse off. The lender is a natural Stackelberg leader in this context - he simply commits to a single contract in period zero and the borrowers adjust accordingly. We consider the issue of heterogeneity of S as an extension below.

1.3.2 Individual Liability

Under individual liability the only incentive constraint is the one that ensures a borrower will repay her own loan, IC1. Provided IC1 holds ($r \leq \delta pR$), individual liability borrowers will repay whenever successful.¹⁵ Then borrowers repay with probability p , so the nonprofit charges $\hat{r}^{IL} = \frac{r}{p}$, with borrower welfare $\hat{V}^{IL} = \frac{pR - r}{1 - \delta p}$. The for-profit monopolist chooses r to bind IC1, giving the following interest rate and borrower welfare:

$$\begin{aligned}\tilde{r}^{IL} &= r_{IC1} \\ \tilde{V}^{IL} &= \frac{pR - pr_{IC1}}{1 - \delta p} = pR\end{aligned}$$

It is clear that under the non-profit, borrower welfare under JL exceeds that under

¹⁴The result also follows if we assume a lender that puts weight α on profits and $1 - \alpha$ on borrower welfare (subject to a zero profit condition). By linearity in r of V and lender profits, there is an α threshold above which the lender behaves as a for-profit, and below which as a non-profit.

¹⁵The limited liability constraint, $R \geq r$ is implied by IC1.

IL, due to the higher repayment probability. However, we also obtain a somewhat surprising result:

Proposition 2 *Despite the monopolist's exploitation of their social capital under joint liability, borrowers are still better off than under individual liability.*

Joint liability lending has received some negative press of late, in part due to perceptions of excessive peer pressure among borrowers. Our model captures this in one particular way: a lender with market power can exploit borrowers' ability to socially sanction one another to charge higher interest rates. It is thus surprising that the same lender would make borrowers worse off under individual liability.

The reason is straightforward. Under both contracts, the lender is constrained by IC1: it must be individually rational to repay a loan, at least when the partner is repaying. This constraint puts a lower bound on borrower welfare of pR . Under joint liability, for low levels of social capital the lender faces an additional constraint, IC2, that forces him to cut interest rates below individual liability levels in order to induce borrowers to guarantee one another's repayments. Furthermore, borrowers benefit directly from the higher repayment probability under JL.

One implication of this result is perhaps missed in the policy debates. Our model speaks to any lender with market power, using dynamic incentives to enforce repayment. Regulators should be alert to abuses by standard, IL-using lenders, who may or may not be formally registered as MFIs or even consider themselves to be MFIs.

1.3.3 Equilibrium contracts

So far we have analyzed IL and JL in isolation. Now we turn to the choice of contract in equilibrium. IL lending can earn non-negative profits as long as expected repayment at r_{IC1} , equal to pr_{IC1} , exceeds the opportunity cost of funds, ρ . To use IL lending as a benchmark, we retain this throughout as an assumption.

Assumption 2 $\delta p^2 R > \rho$.

JL can be used profitably provided that expected revenue when the tightest of IC1 and IC2 binds exceeds the opportunity cost of capital, i.e. $q \min \{r_{IC1}, r_{IC2}(S)\} \geq \rho$. This yields a threshold level of social capital, \hat{S} , above which JL lending can break

even. Since borrowers are better off under JL, this is the switching point for the non-profit lender. We obtain:

$$\hat{S} \equiv \max \left\{ 0, \frac{(2 - \delta q)\rho - (2 - p)\delta p^2 R}{\delta q(1 - \delta q)} \right\} < \bar{S}.$$

A simple sufficient condition that we shall make use of throughout for $\hat{S} = 0$ (i.e. JL is always profitable) is $p \leq \delta q$, or

$$1 + \delta p - 2\delta \leq 0. \quad (2)$$

Since the for-profit monopolist lender maximizes per-period profits, $\Pi = \pi r - \rho$, he chooses the contract offering the highest per-period revenue πr . Therefore he offers JL provided $q\tilde{r}^{JL}(S) \geq p\tilde{r}^{IL}$. This gives us a second threshold, above which JL is offered:

$$\tilde{S} \equiv \max \left\{ 0, \frac{p^2 R(p - \delta q)}{q(1 - \delta q)} \right\}.$$

Condition (2), which was sufficient for JL to break even for all S , is *necessary and sufficient* for the monopolist to offer JL for all S . This is because of the following proposition.

Proposition 3 $\tilde{S} \geq \hat{S}$, with the relation holding strictly if $p > \delta q$. Therefore, the for-profit monopolist lender offers JL over a (weakly) smaller range of S than the non-profit lender.

This result is consistent with the current debate over the decline of joint liability lending in microfinance, which goes hand in hand with increasing commercialization of microfinance lending. The for-profit monopolist is less willing to offer joint liability loans than the non-profit, because when social capital is low the need to give borrowers incentives to help one another (IC2) constrains his rent extraction.

Intuitively, the non-profit is willing to offer JL whenever the borrowers have sufficient social capital for JL to break even, which requires $qr_{IC2}(S) \geq \rho$. The for-profit monopolist only offers JL when doing so is more profitable than IL, i.e. when $qr_{IC2}(S) \geq pr_{IC1}$, which is clearly a more restrictive condition. We will find that an analogous result carries over to competitive equilibrium in section 2.

This result is the classic rent-extraction/efficiency tradeoff with market power. We define an efficient contract as one that maximizes $V(S) + \frac{\pi r - \rho}{1 - \delta\pi}$, i.e. discounting

profits at the borrowers' discount rate. The following observation is then straightforward:

Observation 1 *Monopoly for-profit lending is inefficient when $S \in [\hat{S}, \tilde{S}]$.*¹⁶

The use of group lending to leverage borrowers' social capital has been criticized for putting stress on borrowers and suggested as an important motivation for the tendency of some lenders to move toward individual loans.¹⁷ In our model, a monopolist using JL is bad for borrowers, but he is even worse with IL. The problem is market power, not the form of lending, and restricting contract choice without paying attention to this may be bad for both efficiency and equity.

In the simulation section we analyze the welfare implications of market power in detail. However the model allows us to easily make one policy-relevant remark on the effect of interest rate caps (a key component of some of the regulatory efforts, e.g., the Indian Microfinance Bill). The first-order effect is that the lender will be forced to cut his rates, essentially a transfer to the borrowers, increasing borrower welfare. There is a second-order effect on contract choice as well. If the lender is offering JL he will continue to do so. However, if he is offering IL but the cap lies below $\tilde{r}^{JL}(S)$, he will switch to JL, further improving borrower welfare. The reason is that the lender must now charge the same rate under IL and JL, but the JL repayment rate is higher. Thus in our framework, correctly calibrated interest rate caps can be an effective tool for borrower protection.

We have assumed that individual liability borrowers cannot side-contract among themselves to guarantee one another's repayments. However, this may be an overly strong assumption as they have an incentive to do so if this enables them to repay more frequently. We have a related paper on this which we term de Quidt et al. (2012) "implicit joint liability" or IJ.

It turns out that in our simple framework, IJ plays no role. For IJ to enable borrowers to repay more frequently than EJ, there need to be states of the world where one borrower would repay were she under individual liability, but defaults due to the joint liability burden (because she cannot afford to bail out her partner). This does not arise in equilibrium due to the simple production function we use; under

¹⁶The reader might be concerned that this result and Proposition 3 are artifacts of the assumption that the lender is myopic, only maximizing per-period profit. In fact this is not the case as we formally show in the appendix.

¹⁷See, for example, Grameen II at <http://www.grameen.com/>.

EJ either both borrowers succeed and repay, one succeeds and repays both loans, or both fail.¹⁸ In de Quidt et al. (2012) we analyze this contractual form in detail in an environment where IJ can play a role.

1.4 Heterogeneity

The analysis so far assumes that social capital S is homogeneous and observable across borrowers. Suppose that this is not the case. To keep things simple, suppose there are two possible values of S . A fraction $\theta \in (0, 1)$ of borrowers have $S = 0$, and $1 - \theta$ have $S = S_h > 0$. The lender cannot observe social capital so must screen borrowers by offering an appropriate menu of contracts. We will first characterize the candidate pooling and separating equilibria, then solve for the equilibrium contract offer as a function of S_h . Also, to keep things brief, we only consider the monopolist for-profit lender.

In a pooling equilibrium, the monopolist offers a single interest rate r , and either IL or JL. There are three possible pooling equilibria. Equilibrium A uses IL and the interest rate will be $\tilde{r}^{IL} = r_{IC1}$. Equilibrium B uses JL with interest rate $\tilde{r}^{JL}(0)$, in which case all groups are able to guarantee one another's loans. Equilibrium C uses JL and interest rate $\tilde{r}^{JL}(S_h)$, in which case only the high S groups can do so, (in this case, the low S groups will only repay when both are successful, with probability p^2). We show that these are the only possible pooling equilibria in the appendix.

Now we turn to the separating equilibrium. We use the following notational convention. Where the interest rate corresponds to that from the basic model, we retain the same \tilde{r} notation. Where the interest rate function differs, it is denoted by subscript "sep", as in \tilde{r}_{sep} . In a separating equilibrium the lender offers the following menu of contracts: one JL contract at interest rate $\tilde{r}^{JL}(S_h)$, and one IL contract at interest rate $\tilde{r}_{sep}^{IL}(S_h)$. Note that the IL interest rate depends upon the social capital of the high S types. High S borrowers take the JL contract and low S borrowers take the IL contract. When $S_h \geq \bar{S}$, the lender charges the same interest rate under both contracts, namely $\tilde{r}^{JL}(S_h) = \tilde{r}_{sep}^{IL}(S_h) = \tilde{r}^{IL}$, i.e. all borrowers are charged the "maximum" interest rate $\tilde{r}^{IL} = r_{IC1}$. When $S_h < \bar{S}$, we find that $\tilde{r}^{JL}(S_h) < \tilde{r}_{sep}^{IL}(S_h) < \tilde{r}^{IL}$. The lender cannot charge the maximum interest rate to

¹⁸In addition, the incentive constraint for an IJ borrower to help her partner is tighter than the one for an EJ borrower to do so (because there is no pressure from the lender encouraging her to do so). As a result, the lender always prefers to offer a contract conforming to the EJ or IL contracts detailed above, rather than one that might induce the borrowers to engage in IJ.

the JL borrowers any more as they do not have sufficient social capital to guarantee one another. In addition, the truth-telling constraint that induces low- S borrowers to choose IL rather than JL constrains the lender from charging the maximum interest rate to IL borrowers either.

In the appendix we derive the $r_{sep}^{IL}(S_h)$ function, obtaining the following: $\tilde{r}_{sep}^{IL}(S_h) \equiv \phi \tilde{r}^{IL} + (1 - \phi) \tilde{r}^{JL}(S_h)$, where $\phi \equiv \frac{1-p}{1-\delta p^2} < 1$. Note that $r_{sep}^{IL}(S_h)$ is increasing in S_h . The higher is S_h , the higher the interest rate the lender can charge under JL and thus the higher he can charge under IL as well. This gives us an observation analogous to the “exploitation” results earlier:

Observation 2 *In a separating equilibrium with heterogeneous social capital, the interest rate faced by the individual liability borrowers (who have low social capital) is increasing in the social capital of the joint liability borrowers (who have high social capital).*

The main addition to the benchmark model is that now more social capital among one type of borrowers has spillover effects on the other type, enabling the lender to exploit them more as well.

Now we derive the equilibrium contract. As before, the lender maximizes per-period profits, which is equivalent to choosing the contract or menu that yields the highest per-period revenue. When S_h is high, the lender will have a strong incentive to separate borrowers by type, so the separating equilibrium prevails. When S_h is low, we need to check which of the pooling equilibria (A, B or C) will be chosen.

We can immediately rule out pooling equilibrium C (JL with interest rate $\tilde{r}^{JL}(S_h)$). This yields revenue of $(\theta p^2 + (1-\theta)q) \tilde{r}^{JL}(S_h)$, while the separating menu yields strictly larger revenue of $\theta p \tilde{r}_{sep}^{IL}(S_h) + (1-\theta)q \tilde{r}^{JL}(S_h)$, using the fact that $\tilde{r}_{sep}^{IL}(S_h) > \tilde{r}^{JL}(S_h)$. Intuitively, pooling equilibrium C is unattractive as it leads the low S borrowers to default very frequently.

Now note that revenue does not depend on S_h in either of the remaining two pooling equilibria (A or B), so these can be ranked based on model parameters only. Determining which the lender prefers (IL at \tilde{r}^{IL} , or JL at $\tilde{r}^{JL}(0)$) is equivalent to determining whether $\tilde{S} \geq 0$, which reduces to our usual condition (2) or $p \geq \delta q$. Essentially, when $p \geq \delta q$, JL is always attractive so the lender will offer JL in the pooling equilibrium (B), otherwise he offers IL (A). For brevity, we analyze the $p \geq \delta q$ case here, the other is similar and is discussed in the appendix.¹⁹

¹⁹The key qualitative difference between the two cases is that when $p \geq \delta q$, the lender offers IL

If $p > \delta q$, then the IL pooling equilibrium (A) is more profitable than the JL one (B). It is easy to check that for any θ , there exists a threshold $S_h^{p>\delta q}$ for S_h above which the lender offers the separating contracts and below which he offers the pooling contract.²⁰ We have the following result:

Proposition 4 *When $p > \delta q$, for $S_h < S_h^{p>\delta q}$, the lender offers IL at interest rate \tilde{r}^{IL} . For $S_h \geq S_h^{p>\delta q}$ he offers IL at $\tilde{r}_{sep}^{IL}(S_h)$ and JL at $\tilde{r}^{JL}(S_h)$, low S borrowers take the IL contract and high S borrowers take JL. Welfare of both types of borrowers increases discontinuously at $S_h^{p>\delta q}$, and decreases in S thereafter.*

Low S types initially have IL contracts and utility $V = pR$ as usual. When the lender switches to the separating contract, they continue to receive IL loans but their interest rate decreases from \tilde{r}^{IL} to $\tilde{r}_{sep}^{IL}(S_h)$, so they are discontinuously better off. Then, as noted in observation 2, this interest rate increases in S_h thereafter, reducing their welfare. High S types exactly mirror the borrowers in the homogeneous model: they receive IL up to $S^{p>\delta q}$ (as opposed to \tilde{S}), then switch to JL with a lower interest rate, making them better off, but this interest rate subsequently increases in S_h .

Proposition 4 is closely analogous to our earlier results. Enough social capital to induce the lender to offer JL is beneficial: the high S borrowers receive a more efficient JL contract at a lower interest rate, while the low S borrowers continue to receive IL but also benefit from a lower interest rate. However, above $S_h^{p>\delta q}$, Observation 2 kicks in and more social capital makes borrowers worse off.

We see the results in this section as broadly supporting the main conclusion that understanding market structure is critical for how we think about the role of social capital in influencing borrower welfare. With heterogeneity, there are also spillovers: the more social capital held by the high types, the higher the interest rate faced by the low types.

when S_h is low, and welfare discontinuously increases when he switches to the separating equilibrium. When $p < \delta q$ he offers the most favorable JL contract when S_h is low, and therefore welfare for both types discontinuously *decreases* when he switches to the separating contract, and then further decreases in S_h thereafter, by Observation 2. Furthermore, when $p < \delta q$ the lender may always prefer the pooling equilibrium.

²⁰For $S_h = 0$ and $p > \delta q$ the lender earns strictly lower per-borrower revenue from each type in the separating equilibrium than under the IL pooling contract. For $S_h \geq \tilde{S}$, $\tilde{r}_{sep}^{IL}(S_h) = \tilde{r}^{JL}(S_h) = \tilde{r}^{IL} = \delta pR$, so the interest rate is the same under both pooling and separating equilibrium, but the repayment probability is higher under the separating equilibrium, (formally revenue under the separating contract is $[\theta p + (1 - \theta)q]\delta pR$ which is superior to pooling IL). The existence of the threshold $S_h^{p>\delta q}$ then follows by continuity.

2 Competition

The previous section showed how relaxing the assumption of altruistic non-profit lending affects borrower welfare. A for-profit lender with market power charges higher interest rates, inefficiently under-uses joint liability and exploits the social capital of joint liability borrowers by charging higher interest rate to those with more social capital (although some social capital may be beneficial if it leads the lender to use JL). In this section we explore to what extent competition can mitigate these problems.²¹

It turns out that competition is not guaranteed to deliver an improvement in borrower welfare than monopoly lending. Moreover, competitive lenders also inefficiently underuse joint liability, although to a lesser extent than a monopoly for-profit lender. However, competition does eliminate the exploitation of social capital: in a competitive market more social capital unambiguously improves borrower welfare.

Firstly, suppose that competitive lenders share information on defaulting borrowers, for example through a credit bureau, and agree not to lend to any borrower with a bad history. In that case, competition is identical to our nonprofit lender: free entry ensures that lenders break even and all borrowers can access credit. The problem becomes more interesting when we allow for imperfect information sharing among lenders. We do this in the simplest possible way, in a setup analogous to Shapiro and Stiglitz (1984). Entry by competitors imposes an enforcement externality on existing lenders by tightening the borrowers' repayment constraints. This happens because the probability of a defaulting borrower being able to obtain a loan from another lender increases the more lenders operate in the market. The higher is this probability, the weaker the incentive effects of the existing lender's termination threat.

Our framework gives a simple and tractable model of competitive equilibrium in microfinance that allows us to quantify the potential welfare gains from competition. Although competitive lenders earn zero profits, there is always credit rationing in equilibrium to preserve the repayment incentives of existing borrowers. The trade-off

²¹Recent work on competition in microfinance has studied issues of adverse selection and multiple borrowing. For example, in McIntosh and Wydick (2005) competition can be harmful by preventing lenders from cross subsidizing their bad borrowers with profits on good borrowers. In contrast, our framework directs us to focus on enforcement problems created by competition, as in Hoff and Stiglitz (1997). Entry by competitors makes it more difficult for a lender to incentivize his borrowers to repay their loans, since they can more easily obtain credit elsewhere.

between higher interest rates and credit rationing means it is theoretically ambiguous whether borrower welfare will be higher under competition than under the for-profit monopolist. However, in a competitive market social capital is unambiguously beneficial to borrowers. Higher social capital slackens the lenders' enforcement constraints, leading to less credit rationing.

To keep the model as simple as possible, we assume a very large number of lending “branches” that may belong to the same or different lenders, with no information sharing between branches. Therefore defaulters can go on to borrow at another branch, the source of the enforcement problem.²² This assumption means that we do not need to track the credit histories of individual borrower-lender pairs. Each branch is capable of serving two IL borrowers or one JL pair. The population mass of branches is l , while we normalize the population of borrower *pairs* to 1.²³ If $l < 1$ there will be rationing in the credit market: not all borrowers can obtain a loan in a given period. If $l > 1$ then some branches will have excess capacity.

Every borrower has a large number of potential partners, so even after being socially sanctioned a borrower is assumed to be able to form a new group with social capital S .²⁴ At the start of a period, borrowers will be either “matched”, in an existing relationship with a lender, or “unmatched”, waiting to find a lender. Since branches are atomistic the probability of a borrower rematching to a branch at which she previously defaulted is zero, so an unmatched borrower's matching probability does not depend on her history. Unmatched branches post a contract offer and are randomly matched to borrowers until all borrowers are matched or there are no more unmatched lenders. Each period, loans are made according to the contracts agreed, the repayment game is played, and any defaulters have their contracts terminated, rejoining the pool of unmatched borrowers. We note the following:

Observation 3 *There is credit rationing in equilibrium, i.e. $l < 1$.*

If this were not the case, there would be no dynamic repayment incentives, so all borrowers would default. Although formally trivial this result has an interesting

²²Formally, this is identical to assuming a single lender who forgets the credit history of borrowers in the pool of potential customers. We do not consider other, more nuanced approaches to information sharing, which are analyzed in the growing literature on credit bureaus in microfinance, see for instance De Janvry et al. (2010) and references therein.

²³It is conceptually slightly more convenient to think in terms of pairs.

²⁴This assumption means that we do not need to track the social capital level of individual borrowers.

implication. A common response to concern about commercialization is that access to funds from profit-motivated investors will enable much greater outreach.²⁵ By assuming all lenders face the same, constant opportunity cost of capital, we shut down that channel. The opposite message emerges: the enforcement externalities in competitive credit provision lead to *lower* outreach than either under a single non-profit or for-profit lender.

Since there is rationing, every branch will be able to attract borrowers every period. Therefore each branch can act as a local monopolist, offering the more profitable of IL and JL at the highest r that satisfies the (modified) IC1 and IC2.²⁶ In equilibrium, entry occurs until lenders earn zero profits, at the intersection of the zero-profit interest rate and the tightest repayment constraint. We assume that if both IL and JL break even, lenders offer the borrowers' preferred contract, JL, which rules out equilibria in which both IL and JL are offered.²⁷

Suppose that proportion η branches offer IL loans, and $1 - \eta$ offer JL. Therefore there are ηl IL branches²⁸ Each period, fraction $(1 - p)$ of the IL borrowers default, creating vacancies in their respective branches. This is equivalent to there being $(1 - p)\eta l$ vacant IL branches at the beginning of the next period (although note that in general there will be zero, one or two vacancies at a given branch). Similarly, there are $(1 - \eta)l$ JL branches²⁹ Of these, fraction $(1 - q)$ of the borrower pairs will jointly default each period, leaving $(1 - q)(1 - \eta)l$ vacant JL branches at the beginning of the next period. The total proportion of unmatched borrower *pairs* at the beginning of a period is therefore $P \equiv (1 - p)\eta l + (1 - q)(1 - \eta)l + (1 - l)$, so an unmatched borrower matches with an IL branch with probability $\frac{(1-p)\eta l}{P}$, and a JL branch with probability $\frac{(1-q)(1-\eta)l}{P}$. In competitive equilibrium, $r^{IL} = \frac{\rho}{p}$ and $r^{JL} = \frac{\rho}{q}$. We denote

²⁵See for example the letter from Michael Schlein, chief executive of Accion to The New York Times, January 23rd, 2011, available at <http://www.nytimes.com/2011/01/24/opinion/lweb24micro.html>.

²⁶Instant costless replacement of defaulters means that even patient lenders would simply maximize per-period profits.

²⁷There is a single value of S , termed \tilde{S} , at which mixed equilibria could occur so this assumption is innocuous.

²⁸i.e. $2\eta l$ IL borrowers, since we measure in terms of pairs.

²⁹i.e. $2(1 - \eta)l$ JL borrowers.

the utility of an unmatched borrower by U . We obtain:³⁰

$$\begin{aligned}\tilde{V}^{IL} &= \frac{pR - \rho}{1 - \delta p} + \frac{\delta(1 - p)U}{1 - \delta p} \\ \tilde{V}^{JL} &= \frac{pR - \rho}{1 - \delta q} + \frac{\delta(1 - q)U}{1 - \delta q} \\ U &= \frac{(1 - p)\eta l}{P} \tilde{V}^{IL} + \frac{(1 - q)(1 - \eta)l}{P} \tilde{V}^{JL} + \frac{\delta(1 - l)}{P} U \\ &= \chi(l, \eta) \frac{pR - \rho}{1 - \delta}.\end{aligned}$$

The function χ is defined as:

$$\begin{aligned}\chi(l, \eta) &\equiv \frac{(1 - p)(1 - \delta q)\eta l + (1 - q)(1 - \delta p)(1 - \eta)l}{(1 - \delta p)(1 - \delta q)(1 - l) + (1 - p)(1 - \delta q)\eta l + (1 - q)(1 - \delta p)(1 - \eta)l} \\ \chi(l, \eta) &\in [0, 1], \chi_l \geq 0, \chi_\eta \geq 0.\end{aligned}$$

Total welfare from microfinance is the combined welfare of matched and unmatched borrowers, equal to:

$$\begin{aligned}Z &\equiv \eta l \tilde{V}^{IL} + (1 - \eta)l \tilde{V}^{JL} + (1 - l)U \\ &= \left[\frac{\chi(l, \eta)}{1 - \delta} + l(1 - \chi(l, \eta)) \left(\frac{\eta}{1 - \delta p} + \frac{1 - \eta}{1 - \delta q} \right) \right] (pR - \rho)\end{aligned}$$

The modified framework implies that each lender will face a new IC1 (and IC2 under JL). The constraints now reflect the fact that the borrowers' outside option upon default is improved (they become unmatched and may re-borrow in future), and so are tighter than before. As χ , and thus U increases, the tightest of these two constraints becomes tighter. This is the competition effect that constrains existing lenders' interest rates. We derive the constraints in the online Appendix Proposition 9.

³⁰ $\chi_l \geq 0$ and $\chi_\eta \geq 0$ follow from the fact that greater scale or a higher proportion of (more frequently defaulting) IL borrowers increase the matching probability and thus welfare of an unmatched borrower. It is straightforward to check that borrower welfare is (weakly) higher under JL for all χ . Also note that as $\chi \rightarrow 1$, \tilde{V} and U approach $\frac{pR - \rho}{1 - \delta}$, which is the first-best welfare.

2.1 Equilibrium

In equilibrium, it must not be profitable to open a new branch offering either IL or JL. Two key thresholds in the following analysis are $\tilde{S} \equiv \frac{p-\delta q}{\delta q(1-\delta q)}\rho$, and $\bar{S} \equiv \frac{\rho}{\delta q}$. The former is the analog of \tilde{S} , representing the level of social capital at which the competitive market switches from IL to JL lending, and the latter is the analog of \bar{S} , the level of social capital at which IC1 binds under JL (as opposed to IC2). Note also that $\bar{S} > \tilde{S}$.

Proposition 5 *If $\tilde{S} \leq 0$, the competitive equilibrium is JL-only lending, with market scale strictly increasing in S for $S < \bar{S}$, and equal to a constant, \bar{l} for $S \geq \bar{S}$. If $\tilde{S} > 0$, the equilibrium for $S < \tilde{S}$ is IL-only lending at fixed scale \underline{l} . At \tilde{S} , all lending switches to JL at scale $\tilde{l} > \underline{l}$, then increases continuously in S to \bar{l} , at \bar{S} . Welfare, Z , is strictly increasing in scale, l , and therefore weakly increasing in S .*

The proof can be found in the online Appendix Proposition [refprop:competitioninefficientproofappen](#). The intuition of the proof is simple. For a given contract type, lender entry occurs until the tightest repayment constraint (either IC1 or IC2) binds. For low levels of S , IC2 under JL is tight so lenders prefer IL. As S increases, the JL IC2 is relaxed to the point that all lending switches to JL. Thereafter, JL is offered and scale increases in S until IC1 binds. Aggregate welfare from microfinance, Z , is improved as S increases because this enables a relaxation of credit rationing.

Comparing the key S thresholds, we have the following result:

Proposition 6 *$\hat{S} \leq \tilde{S} \leq \bar{S}$, with both inequalities strict when $p > \delta q$. Therefore the competitive market is weakly less likely to offer JL than the non-profit, but more likely than the for-profit monopolist.*

This result is interesting because it is consistent with the (perceived) trend away from JL. Our model predicts that a commercialized microfinance market will exhibit this tendency, whether competition is weak or strong. A common story that is told to explain this trend is that lenders are responding to borrowers' preference for more flexible IL loans. Our model rules this channel out, but yields another: for-profit lenders (competitive or otherwise) benefit from the slacker repayment constraints under IL.

We have already outlined the intuition for why $\hat{S} \leq \tilde{S}$ (see Proposition 3). To see why $\tilde{S} \geq \hat{S}$ note that JL relies on two forms of enforcement. The first is the

lender’s threat of terminating lending, and the second is the partner’s threat to use social sanctions. We can write a generalized form of IC2 as $\delta((V - U) + S) \geq 2r$, noting that with a single lender (monopolist for-profit or non-profit), $U = 0$, while in competitive equilibrium $U \geq 0$ is an increasing function of l , the market scale. The threat of termination (loss of $\delta(V - U)$) is a substitute for social capital. Since the termination threat is weaker under competition than with a single lender, more social capital will be required for lenders to be able to break even in competitive equilibrium than for the non-profit to break even, and hence the non-profit switches to JL for a lower level of S than the competitive market.

Turning to the comparison between competition and monopoly, we note that in both cases, each lender chooses which contract to offer by comparing per-period revenues between the two options (in equilibrium the competitive lender will break even). The monopolist lender’s decision problem is nested in the competitive framework by setting $U = 0$, and an increase in the amount of competition through entry by competitors corresponds to an increase in U . $\tilde{S} \leq \tilde{S}$ implies that for a given level of S , JL is relatively more attractive to a competitive lender than it is to the monopolist lender. An increase in the amount of competition weakens the termination threat under both IL and JL, thus leading to lower interest rates under both. This effect is stronger under IL than JL, because the incentive constraint for IL concerns the repayment of only one loan, so a small decrease in $\delta(V^{IL} - U)$ maps one-to-one into a decrease in r^{IL} . Meanwhile, under JL, IC2 concerns the repayment of two loans, so a small decrease in $\delta(V^{IL} - U)$ leads to a one-to-one decrease in $2r^{JL}$, i.e. r^{JL} only decreases by half that amount. As a result, for a given level of S , JL becomes relatively more attractive as competition increases, which implies that JL will be used for lower levels of S in competitive equilibrium than under monopoly.³¹

Note that Proposition 6 is not quite enough to argue that the lower use of JL by competitive lenders is inefficient. The structure of the market implies that dynamic incentives are somewhat different under competition than in the core model - a defaulting borrower in competition can expect to borrow again in future. In appendix A.7 we extend the basic model to allow the nonprofit to offer a “stochastic renewal” contract that mimics the competitive market, and show that the competi-

³¹A more formal way to see this is to consider the point at which the lender is indifferent between IL and JL. Using the expressions for IC1 and IC2, this occurs when $p\delta(V^{IL} - U) = \frac{1}{2}q\delta((V^{JL} - U) + S)$. The left hand side decreases in U at rate δp , while the right hand side decreases at rate $\frac{\delta q}{2}$. Since $\frac{q}{2} = \frac{p(2-p)}{2} < p$, revenues under JL are less responsive to changes in U than those under IL, and therefore the level of S required to maintain indifference is decreasing in U .

tive market does indeed under-use joint liability. Note also that in the neighborhood of \tilde{S} , aggregate welfare in a JL-only equilibrium is strictly higher than in an IL-only equilibrium.

2.2 Comparing market structures

Lastly, we turn to the question of whether competition is necessarily beneficial for borrower welfare in the presence of weak information sharing as in the framework outlined here:

The following proposition shows that the ranking (by borrower welfare) of the market structures considered in this paper is ambiguous. It is straightforward to see the following result:

Proposition 7 *The ranking of total borrower welfare under competition and monopoly for-profit lending is ambiguous.*

Under the monopolist, all borrowers receive loans in the first period so total welfare is equal to $\tilde{V} \geq pR$. Under the competitive equilibrium, total welfare is W , which depends on the degree of credit rationing in equilibrium. When credit rationing is low (l is close to 1, for example because ρ is small and S is large), Z approaches the first-best welfare $\frac{pR-\rho}{1-\delta}$, and so dominates the monopolist. Meanwhile when credit rationing is high (l is close to zero, for example because ρ is large and S is small), Z approaches zero and is dominated by monopoly lending.

Proposition 7 follows from the observation that when market scale under competition is small, the cost of credit rationing outweighs the benefits of lower interest rates and the potential to borrow again after defaulting. By eliminating the enforcement externality generated by competition, the monopolist solves the credit rationing problem. When scale is large, borrowers are essentially able to borrow every period, so there is no longer the inefficiency generated by dynamic incentives.

Proposition 7 reflects the genuine concern about externalities in uncoordinated competition.³² A key purpose of the simulations performed in the next section is to

³²It is also possible in our simple framework that competition might dominate the non-profit, arises because of the assumption that the non-profit must use strict dynamic incentives, while competition mimics a contract with probabilistic termination on default, akin to Bhole and Ogden (2010). We discuss relaxing the assumption of strict dynamic incentives in online Appendix A.7. We assume strict dynamic incentives in the main analysis because this is what lenders seem to use in practice and because the analysis is much simpler. However, if the non-profit chose to

understand the scope of this ambiguity - we will rank borrower welfare under our key market structures when we under a reasonable parameterization of the model.

2.3 Credit Bureaus

It is worth briefly considering how our results map into the growing literature on credit bureaus in microfinance. Much of the existing work primarily concerns adverse selection issues - credit bureaus help banks to screen out bad types. They also play a role in enforcement frameworks such as ours: credit bureaus enable lenders to damage a borrower's reputation following default, reducing her access to credit from other lenders and thus increasing repayment incentives.

Our single-lender and competitive frameworks represent two extremes of possible forms of information sharing. The competitive environment is one without any form of credit bureau - borrowers reputations are not harmed by default so the only cost of default is that the borrower might be credit rationed for a few periods until a new lender has spare capacity.

The single-lender environment is analogous to one with a strong credit bureau: defaulters cannot borrow again. When the lender is a monopolist, this enables them to extract rents using the strong dynamic incentives invoked. The non-profit equilibrium can be thought of as analogous to a competitive equilibrium with full information sharing, where all lenders commit not to lend to defaulters.

If we take the latter case seriously, our simulations could allow us to calculate the welfare effect of introducing a credit bureau to a competitive market. However, it is worth noting that this is not really an equilibrium. Equilibrium requires lenders to prefer not to lend to former defaulters, i.e. for the commitment to be self-enforcing. This is not the case - former defaulters are no different from non-defaulters (in equilibrium, they are just unlucky) and are no less attractive to lenders. Formally modeling information sharing in this environment requires a number of modifications to the framework along the lines of Greif (1993), which are beyond the scope of this

use stochastic renewal, he could achieve at least the same welfare as competition. For example by choosing the appropriate renewal probability he can mimic the contract faced by the matched borrowers under competition. However, he can do better by offering this contract to all borrowers. Moreover, sometimes the competitive market offers IL when JL would be better for the borrowers. In online Appendix A.7 we analyze a relaxed dynamic incentive, namely, renewing the group's contracts with certainty following repayment and with probability $\lambda \in [0, 1]$ following default. We find that the monopolist and competitive market always set $\lambda = 0$, while the nonprofit does use stochastic renewal, achieving higher borrower welfare than the competitive market.

paper.

2.4 Summary

To summarize, the single non-profit lender is equivalent to perfect competition with full information sharing whereby defaulters can never borrow again. The for-profit monopolist is equivalent to a single (myopic) profit-maximizing lender or cartel with full information sharing. Lastly the competition model represents competition with no information sharing. Although reality will of course be a more complex mixture of these cases, interestingly they are not strictly ordered in a welfare sense. We now simulate the model for real-world parameters to further explore the welfare effects of changing market structure.

3 Simulation

In this section we carry out a simple simulation exercise to get a sense of the order of magnitude of the effects analyzed in the theoretical analysis. We draw on plausible values for the key parameters of the model, mostly estimated using 2009 data from MIXMarket.org, an NGO that collects, validates and publishes financial performance data of MFIs around the world.

Throughout the analysis the numeraire is the loan size, so borrower welfare and social capital are measured in multiples of this. Loan sizes of course vary widely but in South Asia a typical microfinance loan is of the order of \$100-200. The full sample results give a good picture of the basic empirical predictions of the model. The non-profit always offers JL, at a net interest rate of 15.9%, while the for-profit monopolist's interest rate is 38.2% when he offers IL, which occurs for social capital worth less than 0.15. When he switches to JL, the interest rate falls to 34.5%, but this difference is eroded as social capital increases, until eventually IC1 binds at social capital worth 0.40 and IL and JL interest rates equalize. Borrower utility from access to microfinance, V , is 2.76 with a non-profit lender, while the maximum value with a for-profit (at the point of he switching from IL to JL) is only 1.80, reducing to 1.60 under IL or when S is large.

Under competition, IL is offered for social capital worth less than 0.13, and JL thereafter. Market scale varies from 67% of borrowers served under IL, to 78% under JL when S is sufficiently large (note that these predictions should be thought of as

local rather than national or regional market penetration). IL is offered for social capital worth less than 0.13 and aggregate welfare from microfinance, Z (which includes matched and unmatched borrowers) is 2.49. This is higher than welfare under a monopolist, so the welfare effect of credit rationing is clearly not too severe. For social capital worth more than 0.13, JL is offered at increasing market scale, with welfare increasing to a maximum of 2.90 for $S \geq 0.33$, higher even than welfare under the non-profit.

The discussion proceeds as follows. First we modify the model to allow for larger group sizes, and also discuss the possibility that the LLC may bind (which we ruled out for the theoretical discussion for simplicity). Second, we describe the estimation of the model parameters. Third, we discuss the results using the full global sample of MFIs. Fourth, we perform some sensitivity checks and finally we discuss the results when parameters are estimated at the regional level.

3.1 Group size and limited liability condition

We make one modification to the framework, modeling larger groups of size five instead of two.³³ Theoretically, small groups disadvantage JL, since they require very large “guarantee payments” and hence a very tight LLC. For simplicity, we retain the notion of S from the benchmark model - a deviating member loses social capital with the other members worth a total of S . In addition to this, we need to allow for the possibility that the LLC (which also depends on n and m) might be tighter than IC1. This is straightforward to implement in the simulations.

With a group of size n , borrowers will agree to guarantee repayment provided at least some number, m , of members are successful, defining a guarantee payment of $\frac{nr}{m}$ per successful member, so for example if $n = 5$ and $m = 4$, each successful member would repay 1.25 r when one member fails. It is easy to see that the group size does not affect IC1, that is, $\delta pR \geq r$ is still necessary. There will be a different IC2 for each value of m , corresponding to the payment that must be made when only m members are successful. In equilibrium, borrowers will repay for every $m \geq m^*$, where m^* is the smallest m such that repayment is incentive compatible. By reducing the interest rate the lender can increase the number of states of the world in which repayment takes place, generating a (binomial) repayment probability of $\pi(n, m, p)$.

³³Five was the group size first used by Grameen Bank and by other prominent MFIs. An unexplored extension would be to allow the lender to optimally choose the group size.

We discuss the derivation of the constraints in detail in online Appendix A.8.

3.2 Data and Parameter values

The model’s key parameters are R , p , ρ and δ . The numeraire throughout is the loan size, assumed to be identical between IL and JL, and the loan term is assumed to be 12 months. Since social capital and market structure are our key independent variables, we perform the various exercises for the non-profit, for-profit monopolist and competition cases while varying the level of S , computing welfare, interest rates and market scale. Changes in contract choice at the various thresholds of S lead to discontinuous jumps in the value functions, interest rate and market scale. Throughout we use weighted means or regression techniques, weighting by the number of loans outstanding as our unit of analysis is the borrower, thus, assuming one loan per borrower. We work with data from 715 institutions from the MIX to estimate the parameters and perform extensive sensitivity checks. Details of the construction of the dataset can be found in online Appendix C.

Table 1 summarizes parameters in the full sample and across the regions. In addition we report the number of MFIs, number of loans outstanding (million) and the weighted mean interest estimate that was used to calibrate δ . We later compare these interest rate estimates with the non-profit rates predicted by the model. One immediate observation is the extent to which South Asia dominates the sample, comprising 68% of the full sample by number of loans (India comprises 41% of the full sample, and Bangladesh 22%). This observation partly motivates the decision to repeat the exercise by region.

Estimating p We estimate p using cross-sectional data from the MIX on Portfolio At Risk (PAR), the proportion of an MFI’s portfolio more than 30 days overdue, which we use as a proxy for the unobserved default probability. This is not an ideal measure for two reasons. Firstly, PAR probably exaggerates final loan losses, as some overdue loans will be recovered. However, MFIs’ portfolios are typically growing rapidly (see the discussion of the estimation of ρ below). If loans become delinquent late in the cycle, they will be drowned out by new lending, understating the fraction of a cohort that will subsequently default.

We also need to be mindful of the lending methodology, since the model predicts that JL borrowers will repay more frequently than IL borrowers. Our data allows

us to separate the portfolio by lending methodology. Let θ denote the IL fraction of the lender’s portfolio. Then we have $1 - PAR = \theta p + (1 - \theta)\pi(n, m, p)$. We estimate this equation by Nonlinear Least Squares (NLS), obtaining full sample estimates of $p = 0.921$ and $m = 3$.³⁴ Since we do not observe detailed contractual information we treat all “solidarity group” lending as JL, and all individual lending as IL, see the online Appendix for more details.

Estimating ρ We estimate ρ using data from the MIX on administrative (x_a) and financial expenses (x_f). To obtain the cost per dollar lent, we need to divide expenses by the total disbursements of that MFI during the year. Since MIX does not report data on disbursements, we hand-collected disbursement data from annual reports of the largest MFIs listed on MIX, for which the (weighted) mean ratio of disbursements to year-end portfolio was 1.91. Therefore, for MFI i we estimate $\rho_i = 1 + \frac{x_{a,i} + x_{f,i}}{GrossLoanPortfolio * 1.91}$. Our full sample estimate is $\rho = 1.098$. Although we calibrate pR and δ using data in real terms, we do not deflate our estimate of ρ since we do not know the timing of expenses throughout the loan term or year.

Estimating δ Since the lender’s only instrument to enforce repayment is the use of dynamic incentives, the borrowers’ time preferences play an important role in the analysis. Unfortunately, it is not obvious what value for δ to use. Empirical estimates in both developed and developing countries vary widely, and there is little consensus on how best to estimate this parameter (see for example Frederick et al. (2002)). Due to this uncertainty, we calibrate δ as the mid-point of two bounds. We take the upper bound for all regions to be $\delta^U = 0.975$, since in a long-run equilibrium with functioning capital markets $\delta = \frac{1}{1+r^f}$, where r^f is the risk-free real rate of return which we take to be 2.5%, the mean real return on US 10-year sovereign bonds in 1962-2012. For the lower bound we use the model’s prediction that $r \leq \delta pR$ by IC1. We estimate the real interest rate charged by MFIs in the MIX data as $r_i = \frac{RealPortfolioYield}{1-PAR}$. To avoid sensitivity to outliers, we then calibrate $\delta^L = \frac{\bar{r}}{pR}$, where \bar{r} is the weighted mean interest rate. Using our calibrated value for pR of 1.6 (see below), we obtain $\delta^L = 0.753$ in the full sample. The midpoint of δ^U and δ^L

³⁴However, if p varies at the MFI level, contract choice (reflected in θ) may also be a function of p , so the restriction that the underlying p for IL and JL is the same will be violated. An OLS regression of $1 - PAR$ on θ and a constant estimates a separate probability for IL and JL, but ignores the nonlinearity in the the model and sometimes yields estimates of π that exceed one. In practice, both approaches give very similar estimates, so we focus on the NLS results.

gives us $\delta = 0.864$.

Estimating R There are few empirical studies that exploit exogenous variation in microentrepreneurs' capital stocks to estimate the returns to capital. We draw our full sample value for the returns to capital from De Mel et al. (2008). They randomly allocate capital shocks to Sri Lankan micro enterprises, and their study suggests annual expected real returns to capital of around 60%.³⁵ Since expected returns in our model are pR , we use $pR = 1.6$, dividing by our estimate of p to obtain $R = 1.737$.

3.3 Results

Figure 1 graphically presents the results for the baseline simulation, which were discussed in detail in the introduction to this section. The values for the full sample and all regions of the S thresholds, corresponding interest rates, market scale and welfare are reported in Table 2 and Table 3. Table 2 also reports the contracts used by each type of lender, showing that the non-profit exclusively offers JL in the majority of cases, while the monopolist and competitive market typically offer IL for low S and JL for high S , although sometimes only IL is offered, corresponding to cases when the JL LLC is tight.

The first graph depicts borrower welfare, \hat{V} , \tilde{V} and Z , and we also indicate the first-best borrower welfare level, $\frac{pR-\rho}{1-\delta}$. At jumps in the graph the contract switches from IL to JL. The welfare differences between the different market forms are substantial, with the interesting result that competition and non-profit lending are not strictly ordered. As discussed in section 2, this follows from the assumption that the non-profit uses strict dynamic incentives; in our view the key lesson is that non-profit and competition achieve similar performance despite the externality under competition. See also further discussion below.

The second panel depicts the interest rates offered by the monopolist and non-profit (competitive interest rates are not reported, but correspond to the zero-profit interest rate for the relevant contract and value of m). We observe that monopolist rates are substantially higher. Furthermore, leverage of social capital affects the interest rate and borrower welfare for $S \in [0.15, 0.40]$ in the full sample. Moving to

³⁵In a similar study in Ghana, they find comparable figures. Udry and Anagol (2006) find returns around 60% in one exercise, and substantially higher in others.

Table 1: Summary Statistics and Parameter Estimates

MFIs	Loans (m)	% Full Sample	IL share (num) ^a	IL share (value)	Interest rate	p	R	ρ	δ
Full Sample	715	100.0%	46.0%	81.9%	1.206	0.921	1.737	1.098	0.864
Central America	60	2.6%	93.8%	98.8%	1.190	0.881	1.816	1.112	0.860
South America	133	10.6%	97.7%	99.3%	1.237	0.928	1.724	1.102	0.874
Eastern Africa	20	3.7%	38.7%	70.4%	1.152	0.831	1.925	1.115	0.848
Northern Africa	20	2.7%	37.5%	59.2%	1.227	0.984	1.626	1.115	0.871
Western Africa	48	1.8%	60.5%	89.2%	1.306	0.882	1.814	1.173	0.896
South Asia	133	67.6%	34.8%	33.3%	1.180	0.926	1.728	1.083	0.856
South East Asia	85	6.6%	45.7%	68.3%	1.389	0.988	1.619	1.164	0.922
South West Asia	61	1.3%	75.0%	93.8%	1.272	0.967	1.655	1.106	0.885

Notes: IL shares are the fraction of the total number or total value of loans reported as IL loans. The interest rate column reports the weighted mean risk-adjusted portfolio yield, i.e. $r_i = \frac{RealPortfolioYield}{1-PAR}$. ^aFor 10 observations we use the share by value to compute the overall figures in this column.

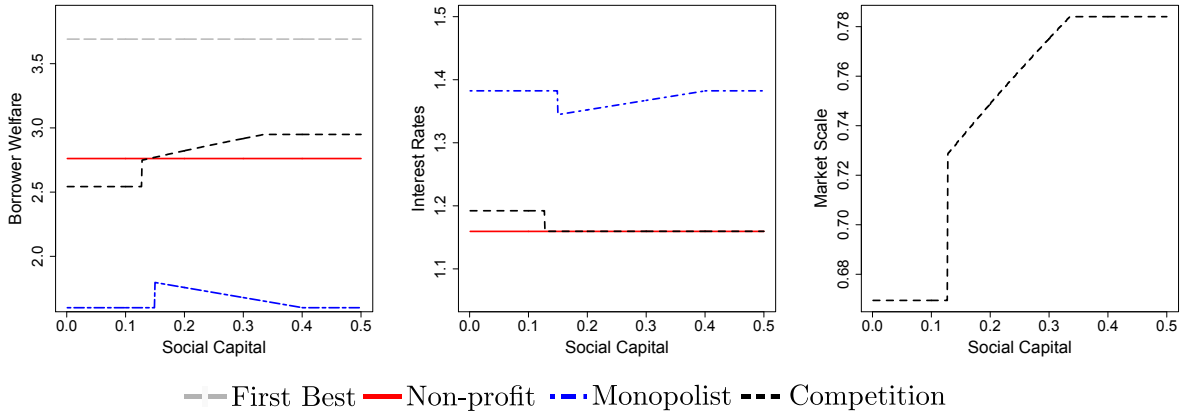


Figure 1: Full Sample Welfare, Interest Rates and Market Scale.

Table 2: Lending methods and S thresholds across regions

	Lending Methods			S thresholds			
	M	NP	C	M	C		
				\tilde{S}	\bar{S}	$\tilde{\tilde{S}}$	$\bar{\bar{S}}$
Full Sample	IL-JL	JL	IL-JL	0.148	0.400	0.126	0.334
Central America	IL-JL	JL	IL-JL	0.333	0.400	0.307	0.363
South America	IL-JL	JL	IL-JL	0.112	0.263	0.097	0.330
Eastern Africa	IL	IL	IL				
Northern Africa	IL	JL	IL-JL			0.188	0.319
Western Africa	IL-JL	JL	IL-JL	0.317	0.400	0.296	0.367
South Asia	IL-JL	JL	IL-JL	0.143	0.400	0.123	0.331
South East Asia	IL	JL	IL-JL			0.146	0.315
South West Asia	IL	JL	IL-JL			0.077	0.315

the third panel, we see how market scale under competition varies with S . Market scale follows the same pattern as the Z function and ranges between 67% and 78%. As previously discussed, this should be interpreted as a measure of local, and not national penetration.

We can now analyze the welfare implications of market power and the lender's choice of contractual form. When the monopolist voluntarily switches from IL to JL at \tilde{S} , borrower welfare increases by approximately 12%. If we go further, forcing the monopolist to always use JL the gain is 20% at $S = 0$ (and declining in S). Switching to a non-profit lender delivers a minimum gain of 54% (at \tilde{S}) and a maximum of 73% for $S < \tilde{S}$ or $S \geq \bar{S}$.³⁶ Thus our results underline the importance of constraining

³⁶Similarly, we can consider the effect of mandating JL under competitive lending, since for $S < \tilde{S}$

market power where it exists.

Table 3: Interest Rates, Market Scale and Borrower Welfare

	Interest Rates			Market Scale		Borrower Welfare			
	M		NP	C		M	NP	C	
	\tilde{r}^{IL}	$\tilde{r}^{JL}(\tilde{S})$	\hat{r}^a	\underline{l}	\bar{l}	$\tilde{V}^{JL}(\tilde{S})^b$	\hat{V}^a	$Z(0)$	$Z(\bar{S})$
Full Sample	1.382	1.345	1.159	0.669	0.784	1.796	2.761	2.543	2.949
Central America	1.376	1.363	1.251	0.432	0.476	1.648	2.074	1.581	1.733
South America	1.398	1.359	1.154	0.712	0.826	1.830	3.016	2.883	3.313
Eastern Africa	1.357		1.342 ^a	0.063			1.642 ^a	0.217	
Northern Africa	1.394		1.118	0.935	0.990		3.698	3.535	3.725
Western Africa	1.434	1.419	1.317	0.399	0.449	1.662	2.116	1.706	1.914
South Asia	1.370	1.331	1.137	0.698	0.813	1.800	2.803	2.573	2.967
South East Asia	1.475		1.166	0.955	0.995		5.498	5.351	5.562
South West Asia	1.416		1.117	0.879	0.963		3.983	3.811	4.150

Notes: ^a This is the JL interest rate or borrower welfare with a non-profit except where annotated with ^a, in which case the values corresponds to the IL case as there is only IL lending in equilibrium. ^b \tilde{V}^{IL} is equal to $pR = 1.6$ in every case, so not reported.

3.4 Sensitivity analysis

We check the sensitivity of the results by varying each parameter over a reasonable range, while holding the others constant. For simplicity we focus on the results for $S = 0$. The results of these exercises are presented in Figure 2. We only plot the parameter regions in which the model predicts any lending, hence at $S = 0$, there is no lending for $\delta < 0.773$, $p < 0.887$, $\rho > 1.273$ and $R < 1.515$.

It becomes clear that welfare under a monopolist lender is not sensitive to any of the parameters, varying little in comparison with the larger effects under competition or non-profit lending (in particular, the monopolist's contract offer does not depend on ρ). For example, as R increases with a non-profit lender, all of the welfare gains are enjoyed by the borrowers. The monopolist, on the other hand, simply increases his interest rate, extracting almost all of the gains. Borrower welfare under competition typically tracks that under non-profit lending quite closely, so our conclusion that non-profit and competition have similar performance seems robust. The large

the market equilibrium is IL only. We find that welfare would increase by 2% at $S = 0$, with this gain increasing as S increases, up to 16% at \tilde{S} . This illustrates one aspect of the inefficiency of the competitive equilibrium discussed in section 3.6. We graph the welfare effects of mandating JL or IL under monopoly and competition in Figure 3 in the online Appendix.

welfare difference between non-profit and monopolist varies in each parameter, but is reasonably robust in the neighborhood of our estimates. It is also interesting to note that for low R , low p and δ welfare may be lower under competition than with a for-profit monopolist, as was theoretically predicted in Proposition 7. The patterns for interest rates are of course similar, and provide a useful check on the results.

In the third row we plot the three key S thresholds, \hat{S} , \tilde{S} , and $\tilde{\tilde{S}}$, at which non-profit, monopolist and competition switch from IL to JL lending. As predicted by Proposition 6, the non-profit is the most likely to use JL, with $\hat{S} = 0$ over most of the parameter ranges. The monopolist is the least likely, and when δ is large abandons JL altogether as the LLC is too tight relative to IC1. Moreover, our predictions for the thresholds vary very little over most of the parameter ranges. The small non-monotonicities under competition arise due to switching between different values of m in the neighborhood of $\tilde{\tilde{S}}$.

Overall, the model gives some fairly robust predictions about contracts offered and the ordering of borrower welfare, and in particular the results highlight the conclusion that market power matters more than contract choice for borrower welfare. The interest rate predictions are more sensitive, but remain reasonable in all cases. With this in mind, we explore the patterns across regions. This allows us to comment on the respective lending types that we would expect to prevail in certain regions and it allows us to comment on the variation in borrower welfare across regions due to different market structures.

3.5 Regional analysis

We now turn to the results at the regional level, presented in Tables 2 and 3. We graph the predicted borrower welfare functions in Figure 5 in online Appendix A.9. We focus on seven regions with at least 1% of the total number of outstanding loans, comprising 94.2% of the total. We first observe that our parameter estimates always satisfy Assumption 2, so the model predicts at least IL lending in every region. However, the pattern of contracts offered depends on the market structure. In Eastern Africa, the model predicts only IL lending under all three market structures; the JL LLC is too tight for JL to even break even in these regions, primarily since the low success probability requires high interest rates. In Northern Africa, South East Asia and South West Asia, the non-profit would always offer JL, while the monopolist always offers IL. The relatively high success probabilities mean that the

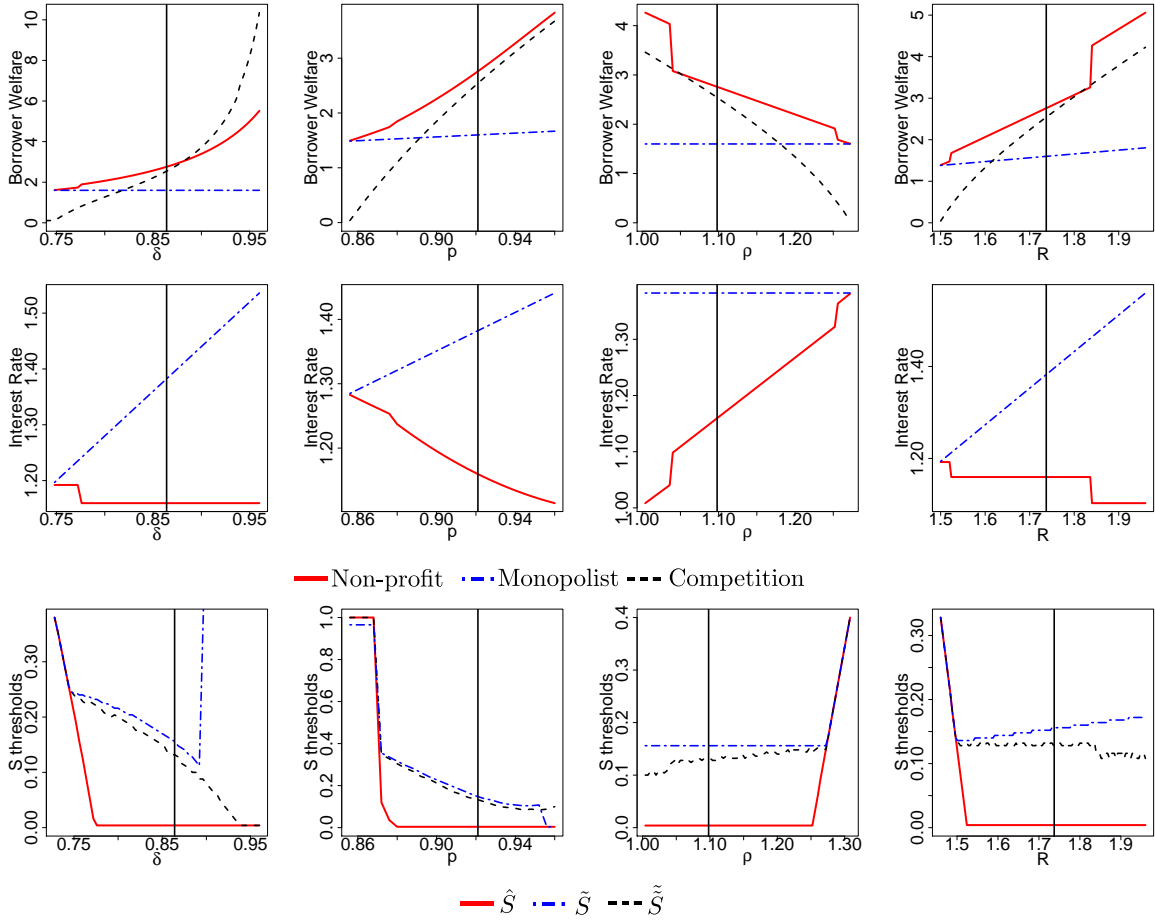


Figure 2: Sensitivity Analysis. Vertical lines indicate full sample parameter estimates.

guarantee effect of JL is small relative to the cost to the lender of lower interest rates. In these cases, uncoordinated competition delivers IL for low S and JL for high S .

In all regions except Central America and Eastern Africa we observe that in welfare terms the non-profit and competition achieve similar outcomes. This observation is highlighted in the sensitivity analysis. In Central America the for-profit monopolist outperforms competition for S sufficiently small. In Eastern Africa, which has a very low success probability rendering repayment guarantees very costly for borrowers, competition performs very poorly, while non-profit and for-profit monopolist are almost identical in welfare terms. In line with Proposition 6, we see that the monopolist is less likely to offer JL than the competitive market.

Finally we compare the interest rates computed from the data (reported in Table

1) to the model predictions.³⁷ The broad pattern we observe is that mean interest rates seem reasonably close to the predicted non-profit rates, suggesting that most MFIs are operating close to their zero-profit constraints. For example, in South Asia the mean observed (net) rate is 18%, while our prediction is 14%. In South America, the difference is larger; the mean rate is 24%, versus a prediction of 15%, and the difference is 11 percentage points in Northern Africa. The results suggest that all three of these have the potential for significant rent-extraction by lenders. South East Asia and South West Asia are the most striking cases, with observed rates 22 and 16 percentage points higher than predicted, respectively. Particularly in South Asia, where Grameen is based, our model predicts that abuse of market power by for-profit lenders would have severe consequences. However, as a whole, interest rates in South Asia are very close to our predictions for a non-profit, suggesting that either competition or pro-borrower motivation of the lenders is constraining this abuse.

3.6 Comparing competition and non-profit lending

A result that emerges from the simulations is that frequently the competitive market dominates the non-profit in welfare terms, despite the enforcement externality that leads to credit rationing. The reason for this is the relatively high repayment probabilities ensure that the population of unmatched borrowers is small, while all borrowers benefit from the ability to reborrow in future. Under the non-profit this is not available due to the assumption that strict dynamic incentives are used.

As we have argued, we do not consider this an unreasonable assumption. However, as mentioned in section 2.2, a benevolent non-profit can deliver at least the same welfare as the competitive market, by renewing borrowers' contracts with probability λ upon default. A simple way to achieve this would be to choose the renewal probability upon default to mimic the competitive outcome. In this case, the value function of the non-profit would be the envelope of the matched utility. We have computed this example and illustrate it in Figure 4 in online Appendix A.7. The welfare-effect is not dramatic; borrower welfare under the non-profit increases from 2.761 with strict dynamic incentives to a maximum of 3.239 with the new contract, a 17% gain. Choosing λ optimally, the non-profit can perform even slightly better. We have simulated this as well and observe, that the only difference arises because

³⁷Note that we cannot compare these values with the monopolist interest rates. To see this, recall that the IL interest rate is δpR . Since δ^L was calibrated from $\frac{\bar{r}}{pR}$, by construction the monopolist IL rate will exceed the mean rate in the data, \bar{r} .

the non-profit would switch to JL for a lower value of S .

3.7 Discussion

Collecting the simulation results, a picture emerges supporting the discussion in the theoretical analysis. The monopolist for-profit lender does exploit the borrowers' social capital and this has economically meaningful effects on interest rates and welfare. However, these are substantially smaller than the change in interest rates and welfare when switching to a large non-profit lender. The severe "mission drift" implied by a switch to for-profit lending with market power has large consequences for borrower welfare, consistent with the concerns of Muhammad Yunus raised earlier.

The competition results are more positive. The theoretical welfare effects of competition are ambiguous, as shown in Proposition 7, due to the trade-offs between credit rationing, lower interest rates and the ability of borrowers to reborrow after an involuntary default. However, for the parameters estimated from our full sample and most regions considered, welfare under competition is approximately the same as under non-profit lending. Despite the negative press and industry concerns about competition in microfinance, here modeled as an enforcement externality, our results suggest a more positive view in which competition is able to mitigate the problems of market power. However, some discussion, particularly surrounding the recent crisis in Andhra Pradesh, India, has centered on multiple borrowing and over-indebtedness. These are important issues but not ones that we can address in our framework, so we leave them to future research.

Lastly, the findings corroborate the theoretical prediction that for-profit lenders are less likely to offer JL than the non-profit. In low social capital areas (S smaller than around 0.13-0.15) our competitive or monopolistic lenders would offer IL, while the non-profit continues to offer JL.

4 Conclusion

Motivated by recent debates about commercialization and the trade-off between the objectives of making profits and alleviating poverty this paper studies the consequences of market power in the context of microfinance. We focus on the consequences for borrower welfare going beyond the usual focus on repayment rates and interest rates. The existing literature on microfinance starts with the premise that

MFI's are competitive or motivated by borrower welfare and in this paper we showed that there are interesting implications for relaxing this assumption. A lender with market power can extract rents from repayment guarantee agreements between his borrowers, but is ultimately constrained from making those borrowers worse off in the process. We compare borrower welfare under a for-profit with market power, a benevolent non-profit, and a competitive credit market. One of the interesting trade-offs that emerge is that of rent extraction under monopoly with the enforcement externality under competition. We simulated the model using empirical parameter estimates, and found that the consequences of market power for borrower welfare are significant, while the choice of lending method itself is somewhat less important. Competitive for-profits typically do not perform much worse than our non-profit benchmark, especially when the level of social capital is high. Furthermore, commercial lenders with or without market power are less likely to use JL than the non-profit lender. Our findings suggest that Yunus appears to be correct to be concerned about abuses by for-profit lenders - particularly in South Asia, where Grameen is based, our model predicts considerable scope for abuse of market power by for-profit lenders. However, as a whole, interest rates in South Asia are very close to our predictions for a non-profit lender, weakening the case for concluding there is systemic abuse in practice in this region.

There are several directions for future work that we believe might be promising. For example, Muhammed Yunus argues that the shift from non-profit to for profit, with some institutions going public, led to aggressive marketing and loan collection practices in the quest for profits to serve the shareholders equity. Our paper does not model coercive loan collection methods by lenders, and allowing this might create an additional channel for for-profit and non-profits to behave differently, in a manner similar to the cost-quality trade-off as in the non-profits literature (see, for example, Glaeser and Shleifer (2001)).

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Appendix to “Market Structure and Borrower Welfare in Microfinance”

For Online Publication

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This appendix contains proofs omitted from the main text, additional figures from the model simulation, information on the simulation methodology and details of the construction of the dataset used.

A Proofs, Derivations and Simulation Results Omitted in the Paper

A.1 Patient monopolist inefficiently under-uses JL

Proposition 3 and Observation 1 point out that the monopolist lender inefficiently under-uses joint liability relative to the non-profit lender. One concern might be that this is due to the fact that the lender is assumed (for simplicity) to be myopic, choosing the contract based only on per-period revenue. JL’s relatively high repayment rate makes it relatively more attractive to a patient lender. However this does not overcome the basic inefficiency result as we show here.

Suppose the lender discounts profits from a given borrower with factor $\beta \in [0, 1]$. Now the lender’s discounted profits per borrower are

$$\Pi = \frac{\pi r - \rho}{1 - \beta \pi}.$$

The only ingredient of the benchmark model that will change is the monopolist lender’s contract choice. The constraints and thus interest rates for a given contract as a function of S remain the same. The monopolist now prefers JL whenever $\frac{q\hat{r}^{JL}(S) - \rho}{1 - \beta q} \geq \frac{p\hat{r}^{IL} - \rho}{1 - \beta p}$. We can solve this condition for a new $\tilde{S}(\beta)$ which is the value of

S at which the lender switches from IL to JL. This is:

$$\tilde{S}(\beta) \equiv \max \left\{ 0, \frac{p^2 R(p - \delta q)}{q(1 - \delta q)} - \frac{\beta(1 - p)(2 - \delta q)(\delta p^2 R - \rho)}{\delta(1 - \beta p)(2 - p)(1 - \delta q)} \right\}.$$

$\tilde{S}(\beta)$ is strictly decreasing in β . Therefore, as intuitively argued above, the monopolist becomes more willing to offer JL as β increases. However, this does not reverse the inefficiency result.

When $p < \delta q$, we know that $\hat{S} = \tilde{S} = 0$ and there is no inefficiency, so we focus on the case where $p > \delta q$. We want to show that the monopolist is less willing to offer JL than the nonprofit. Recall that $\hat{S} \equiv \max \left\{ 0, \frac{(2 - \delta q)\rho - (2 - p)\delta p^2 R}{\delta q(1 - \delta q)} \right\}$. Subtracting the non-zero term in the max in \hat{S} from that in $\tilde{S}(\beta)$ we obtain $\frac{(\delta p^2 R - \rho)(2 - \delta q)(1 - \beta p)}{\delta q(1 - \delta q)(1 - \beta p)}$, which is positive for all β , so we know that $\tilde{S}(\beta) \geq \hat{S}$ for all β , and that this inequality is strict for $\tilde{S}(\beta) > 0$.¹ Therefore the monopolist is less willing to offer JL than the nonprofit, and thus potentially inefficient, even when fully patient ($\beta = 1$).

A.2 Derivation of pooling contract under heterogeneity

Under IL it is obvious that charging $\tilde{r}^{IL} = r_{IC1}$ is optimal from the lender's perspective.

Under JL, if he charges less than $\tilde{r}^{JL}(0)$, repayment will not increase but revenue will be lower than charging $\tilde{r}^{JL}(0)$. If he charges between $\tilde{r}^{JL}(0)$ and $\tilde{r}^{JL}(S_h)$, the low S borrowers will still only repay with probability p^2 and the high S with probability q , and revenue will be lower than charging $\tilde{r}^{JL}(S_h)$. Lastly, charging more than $\tilde{r}^{JL}(S_h)$ results in a repayment probability of p^2 from all borrowers and revenue lower than that attainable under IL.

A.3 Derivation of separating contract under heterogeneity

In a separating equilibrium, it must be that the lender offers one IL and one JL contract.² Define the interest rates as $\tilde{r}_{sep}^{IL}(S_h)$ and $\tilde{r}_{sep}^{JL}(S_h)$ where S_h is the social capital of the high S group.

¹I.e. for $\beta < \frac{\delta p^2 R(p - \delta q)(1 - \delta q)}{\delta p^2 R q(1 - \delta p(1 - \delta q)) - \rho p(1 - p)(2 - \delta q)}$.

²Note that there can be no "screen-out" equilibrium, since the borrowers' participation constraints are slack: a borrower can always obtain utility pR by taking a loan and defaulting. Thus the separating equilibrium must involve a contract offer for both types.

By IC1, the lender will never charge more than δpR under either contract. If he did so under both, all borrowers would default, and if he did so under only one, then all borrowers would take the other contract.

Since a borrower's utility from a *given* JL contract (i.e. when holding r constant) is increasing in S , the high S types must choose JL and the low S types choose IL in equilibrium. Furthermore, since utility from a *given* IL contract does not depend on S , both types value IL equally. Denoting the utility in separating equilibrium of a borrower with social capital S under contract j by $V_{sep}^j(S)$, we have:

$$\begin{aligned} V_{sep}^{IL}(S_h) &= V_{sep}^{IL}(0) \equiv V_{sep}^{IL} \\ V_{sep}^{JL}(S_h) &\geq V_{sep}^{JL}(0) \end{aligned}$$

the truth-telling constraints are:

$$V_{sep}^{JL}(0) \leq V_{sep}^{IL} \quad (3)$$

$$V_{sep}^{JL}(S_h) \geq V_{sep}^{IL}. \quad (4)$$

with one strict. These reduce to $V_{sep}^{JL}(S_h) > V_{sep}^{JL}(0)$ and either $V_{sep}^{JL}(S_h) = V_{sep}^{IL}$ or $V_{sep}^{JL}(0) = V_{sep}^{IL}$.

$V_{sep}^{JL}(S_h) > V_{sep}^{JL}(0)$ requires that $\tilde{r}_{sep}^{JL}(S_h) \leq \tilde{r}^{JL}(S_h)$. Otherwise, the high types would not be able to guarantee one another under JL, so all types would repay with probability p^2 in which case $V_{sep}^{JL}(S_h) = V_{sep}^{JL}(0)$. Similarly, $\tilde{r}_{sep}^{JL}(S_h) > \tilde{r}^{JL}(0)$ since otherwise low types would be able to guarantee under JL which would again mean that $V_{sep}^{JL}(S_h) = V_{sep}^{JL}(0)$. Clearly, then, the lender wants to charge the highest possible interest rate under IL and JL subject to these constraints. This is easy to find. Under JL he charges $\tilde{r}_{sep}^{JL}(S_h) \leq \tilde{r}^{JL}(S_h)$. This minimizes $V_{sep}^{JL}(S_h)$ and $V_{sep}^{JL}(0)$. Then he charges the highest possible interest rate under IL, such that $V_{sep}^{JL}(0) = V_{sep}^{IL}$.

Solving (3), we obtain the following expression for $r_{sep}^{IL}(S_h)$:

$$\tilde{r}_{sep}^{IL}(S_h) = \frac{\delta pR(1-p)}{1-\delta p^2} + \frac{p(1-\delta p)}{1-\delta p^2} \tilde{r}_{sep}^{JL}(S_h)$$

substituting for $\tilde{r}_{sep}^{JL}(S_h) = \tilde{r}^{JL}(S_h)$, $\delta pR = \tilde{r}^{IL}$ and $\phi \equiv \frac{1-p}{1-\delta p^2} < 1$, we obtain

$$\tilde{r}_{sep}^{IL}(S_h) \equiv \phi \tilde{r}^{IL} + (1-\phi) \tilde{r}^{JL}(S_h).$$

This concludes the derivation.

A.4 Equilibrium with heterogeneous social capital and $p \leq \delta q$

If $p \leq \delta q$, the lender prefers the JL pooling contract to the IL one. Moreover, it is not guaranteed that he will ever choose the separating contract. To see this, note that if $S_h > \bar{S}$, revenue in the separating equilibrium is equal to $(\theta p + (1 - \theta)q)\delta p R$. This is only greater than revenue in the pooling equilibrium, $\frac{\delta p q R}{2 - \delta q}$, if $\theta < \frac{(2-p)(1-\delta q)}{(2-\delta q)(1-p)}$, a threshold strictly smaller than one when $p < \delta q$. Hence when the fraction of low S types is large, the lender may never offer the separating contract. Intuitively, in the pooling contract these borrowers receive a JL contract at interest rate $\tilde{r}^{JL}(0)$, while in the separating contract they receive IL, and we know that the former earns higher revenue than the latter when $p \leq \delta q$.

For simplicity, suppose $\theta < \frac{(2-p)(1-\delta q)}{(2-\delta q)(1-p)}$, so that by an analogous argument to that given above (footnote 20) there exists a threshold, $S_h^{p \leq \delta q}$, such that for S_h above the threshold the lender offers the separating contract. We have the following:

Proposition 8 *When $p \leq \delta q$, for $S_h < S_h^{p \leq \delta q}$, the lender offers JL at interest rate $\tilde{r}^{JL}(0)$. For $S_h \geq S_h^{p \leq \delta q}$ he offers IL at $\tilde{r}_{sep}^{IL}(S_h)$ and JL at $\tilde{r}^{JL}(S_h)$, low S borrowers take the IL contract and high S borrowers take JL. Welfare of both types decreases discontinuously at $S_h^{p \leq \delta q}$. Welfare of both types of borrowers further decreases in S thereafter.*

To see why welfare now *decreases* at the switching threshold, simply note that the pooling equilibrium in this case is the most favorable contract the monopolist ever offers the borrowers - it achieves the highest possible repayment probability, q , at the lowest interest rate the lender will ever charge. At the switching point, the low types switch to IL (lower repayment probability) at a higher interest rate, and the high types keep JL but at a higher interest rate. Thereafter, Observation 2 applies as before. Now, higher social capital among high S borrowers is doubly bad for borrower welfare.

A.5 Competition

Consider a repayment probability π . IC1 requires that the value of future access to credit from the current lender, less the repayment amount, exceeds the borrower's

outside option which is to return to the pool of unmatched borrowers. At the zero profit interest rate the condition is:

$$\delta V - \frac{\rho}{\pi} \geq \delta U.$$

Simplifying, we obtain

$$\delta p R \frac{1 - \chi(l, \eta)}{1 - \delta \pi \chi(l, \eta)} \geq \frac{\rho}{\pi}.$$

We denote the left hand side by $r_{IC1}^{IL}(\chi)$ under IL (when $\pi = p$) and $r_{IC1}^{JL}(\chi)$ under JL ($\pi = q$).

Unlike the single-lender case, we have a different IC1 for IL and JL. Note that $r_{IC1}^{JL}(\chi) > r_{IC1}^{IL}(\chi)$, so it is not possible for both IC1s to bind simultaneously. Also note that for all $\chi > 0$, $\frac{dr_{IC1}(\chi)}{d\chi} < 0$ for IL and JL. This is the competition effect through improvements in the borrowers' outside option. Also note that, as before, provided IC1 holds JL borrowers will always be willing to repay their own loans provided their partner is also repaying.

The IC2 under JL requires that repayment of both loans is preferred to losing access to the current lender (rejoining the unmatched pool) and losing the social capital shared with the current partner. The condition is

$$\delta(V + S) - 2\frac{\rho}{\pi} \geq \delta U,$$

which simplifies to

$$\frac{\delta[(1 - \chi(l, \eta))pR + (1 - \delta q)S]}{2 - \delta q - \delta q \chi(l, \eta)} \geq \frac{\rho}{q}.$$

We denote the left hand side by $r_{IC2}(S, \chi)$. $r_{IC2} \leq r_{IC1}^{JL}$ for $S \leq \frac{1 - \chi(l, \eta)}{1 - \delta q \chi(l, \eta)} pR$ (we compute the equilibrium value of this threshold below). $\frac{dr_{IC2}(S, \chi)}{d\chi} < 0$ whenever $\chi > 0$ and IC2 is tighter than IC1.

Therefore, in conclusion, the tighter of $r_{IC2}(S, \chi)$ and r_{IC1}^{JL} is downward sloping in χ . This is the effect of competition on the repayment incentive constraints.

Recall now the two key thresholds, stated in the text and derived below: $\tilde{S} \equiv \frac{p - \delta q}{\delta q(1 - \delta q)} \rho$, the analog of \tilde{S} , representing the level of social capital at which the competitive market switches from IL to JL lending; and $\bar{\bar{S}} \equiv \frac{\rho}{\delta q}$, the analog of \bar{S} , the level of social capital at which IC1 binds under JL (as opposed to IC2). Note also that $\bar{\bar{S}} > \tilde{S}$.

Proposition 9 *If $\tilde{S} \leq 0$, the competitive equilibrium is JL-only lending, with market scale strictly increasing in S for $S < \bar{S}$, and equal to a constant, \bar{l} for $S \geq \bar{S}$. If $\tilde{S} > 0$, the equilibrium for $S < \tilde{S}$ is IL-only lending at fixed scale \underline{l} . At \tilde{S} , all lending switches to JL at scale $\tilde{l} > \underline{l}$, then increases continuously in S to \bar{l} , at \bar{S} . Welfare, Z , is strictly increasing in scale, l , and therefore weakly increasing in S .*

Proof. In equilibrium, at most one of IL and JL breaks even (except for at the switching threshold as discussed below). So for a lender, who takes χ as given, the following condition will hold:

$$\rho = \max\{pr_{IC1}^{IL}(\chi), \min\{qr_{IC1}^{JL}(\chi), qr_{IC2}^{JL}(S, \chi)\}\}.$$

Next note that $pr_{IC1}^{IL}(\chi) < qr_{IC1}^{JL}(\chi)$, so to determine the equilibrium contract, we only need to compare $pr_{IC1}^{IL}(\chi)$ with $qr_{IC2}^{JL}(S, \chi)$. If $\rho = pr_{IC1}^{IL}(\chi) > qr_{IC2}^{JL}(S, \chi)$, only IL will be used in equilibrium, and if $\rho = qr_{IC2}^{JL}(S, \chi) \geq pr_{IC1}^{IL}(\chi)$ only JL will be used (we assume that JL will be offered when both IL and JL break even).

Solving $\rho = pr_{IC1}^{IL}(\chi)$, for χ we obtain the equilibrium value of χ under IL:

$$\tilde{\chi} = \frac{\delta p^2 R - \rho}{\delta p^2 R - \delta p \rho}.$$

Next we solve $pr_{IC1}^{IL}(\tilde{\chi}) = qr_{IC2}^{JL}(\tilde{\chi}, S)$ to find \tilde{S} , the switching threshold value of S at which both IL and JL break even:

$$\tilde{S} = \frac{p - \delta q}{\delta q(1 - \delta q)} \rho \begin{matrix} \geq \\ < \end{matrix} 0.$$

Lastly, we solve $\rho = qr_{IC2}^{JL}(S, \chi)$ to find the equilibrium value of χ under JL when IC2 is binding. This is $\chi = \psi(S)$ where we define $\psi(S)$ as:

$$\psi(S) \equiv \tilde{\chi} + \frac{1 - \delta q}{pR - \rho}(S - \tilde{S}).$$

There is no equilibrium with JL lending for $S < \tilde{S}$, since then $\chi(S) < \tilde{\chi}$, in which case the IL IC1 would be slack and new lenders would enter offering IL. By a symmetric argument there is no equilibrium with IL lending for $S > \tilde{S}$. At \tilde{S} , lending switches from IL to JL, so η changes discontinuously from 1 to 0. This enables us to solve for market scale, using $\chi(\underline{l}, 1) = \chi(\tilde{l}, 0) = \tilde{\chi}$. We obtain the market scale under

IL, equal to

$$\underline{l} = \frac{\delta p^2 R - \rho}{\delta p^2 R - p\rho},$$

and the market scale after the switch to JL, equal to

$$\tilde{\bar{l}} = \frac{(\delta p^2 R - \rho)(1 - \delta q)}{(\delta p^2 R - p\rho)(1 - \delta q) + p(1 - p)(1 - \delta)\rho}.$$

Given that by the definition of \underline{l} and $\tilde{\bar{l}}$, the following condition holds (as shown above): $\chi(\underline{l}, 1) = \chi(\tilde{\bar{l}}, 0) = \tilde{\chi}$, and that $\chi_l > 0$ and $\chi_\eta > 0$ for all $l > 0$, it follows that $\tilde{\bar{l}} > \underline{l}$.³ Intuitively, in a JL equilibrium, borrowers default less frequently, so for a given market scale it is less likely that a “slot” will come available at a lender for a currently unmatched borrower. As a result, for a given value of χ , a higher level of l can be sustained under JL than under IL.

Lastly note that if $\tilde{S} < 0$, there is never IL lending in equilibrium. Even for $S = 0$, the JL IC2 is more slack than the IL IC1 and therefore $\chi = \psi(0) > \tilde{\chi}$. Thus, market scale at $S = 0$ exceeds $\tilde{\bar{l}}$.

Now consider $S > \tilde{S}$. Lending is JL-only (i.e. $\eta = 0$). Since IC2 is relaxed as S increases, entry will occur to compensate, so l and hence χ are strictly increasing in S as long as IC1 is slack. IC2 must then intersect IC1 at some $\bar{S} > \tilde{S}$, where χ reaches a maximum $\bar{\chi}$. For $S \geq \bar{S}$, IC1 is tighter than IC2, and therefore market scale has reached its maximum.

To find \bar{S} and $\bar{\chi}$ we simply need to solve for the values at which IC1 intersects IC2 in competitive equilibrium. In other words, we solve the following condition

$$\rho = qr_{IC1}^{JL}(\bar{\chi}) = qr_{IC2}^{JL}(\bar{S}, \bar{\chi})$$

obtaining:

$$\begin{aligned} \bar{S} &= \frac{\rho}{\delta q} \\ \bar{\chi} &= \frac{\delta pqR - \rho}{\delta pqR - \delta q\rho}. \end{aligned}$$

Lastly, to obtain the maximum scale, \bar{l} , we solve $\chi(\bar{l}, 0) = \bar{\chi}$ yielding $\bar{l} = \frac{\delta pqR - \rho}{\delta pqR - q\rho}$.

³The interested reader may note that there are many mixed equilibria at \tilde{S} , defined by a one-to-one function $l(\eta)$, $\eta \in [0, 1]$, of which $l = \tilde{\bar{l}}$, $\eta = 0$ is the welfare-maximizing case.

For $S \in (\tilde{S}, \bar{S})$, we find the market scale by setting $\chi(l, 0) = \psi(S)$, obtaining equilibrium l equal to $\frac{(1-\delta q)\psi(S)}{(1-q)+q(1-\delta)\psi(S)}$ which is strictly increasing in S . Collecting results, we can write the equilibrium market scale as the following function of S :

$$l(S) \equiv \max \left\{ l, \min \left\{ \frac{(1-\delta q)\psi(S)}{(1-q)+q(1-\delta)\psi(S)}, \bar{l} \right\} \right\}.$$

Where there is IL-only lending for $S < \tilde{S}$ and JL-only for $S \geq \tilde{S}$.

■

A.6 Mandating JL or IL

In section 3.3 we discussed the welfare effects of mandating JL or IL under monopoly or competitive lending. These are illustrated in Figure 3.

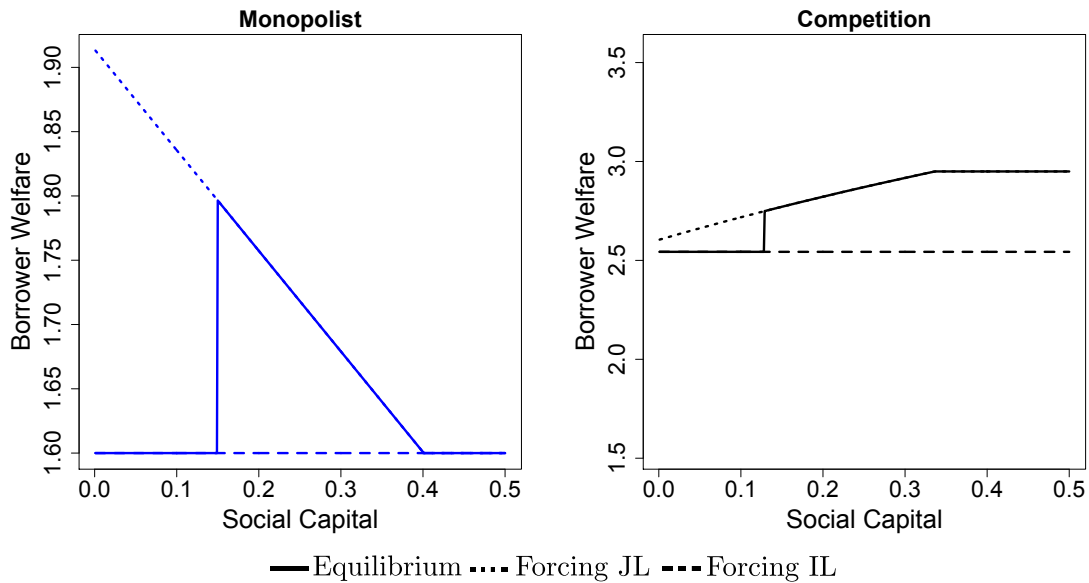


Figure 3: Mandating contractual form. Social capital ranges on horizontal axes, borrower welfare on vertical axes.

A.7 Stochastic Renewal

Suppose the lender offers either JL or IL, but renews the group's contracts with certainty following repayment and with probability $\lambda \in [0, 1]$ following default. One complication immediately arises. Suppose the state is $(R, 0)$ and the interest rate is

r . If borrower 1 defaults, her social capital is lost but the group might survive, so her IC2 is $\delta(V(S, r) + S) - 2r \geq \delta\lambda V(0, r)$. For a given interest rate r , $V(S, r) \geq V(0, r)$, since without social capital repayment guarantees may not be possible. This may be a key reason why such flexible penalties are not widely used - the borrowing group dynamic may be too badly damaged following a default. To retain the basic structure of our benchmark model, we make the simplifying assumption that if the borrowers' contracts are renewed following a default, the group is dissolved and members matched up with new partners with whom they share the same value of social capital. Default is still costly, since it destroys the social capital of the existing group, but does not adversely affect the dynamic of the group if it survives. This assumption is the analogue of the group reformation assumption in the competition framework.

It is easy to see that the stochastic renewal setup closely mirrors the competition framework. Specifically, for a given S , a single lender could offer a the same contract (IL or JL and the same interest rate) as offered under competition, that renews with probability $\lambda = \frac{U(S)}{\tilde{V}(S)}$ following default. The tightest of IC2 and IC1 would bind, and all borrowers would receive utility $\tilde{V}(S)$.⁴ However, the contracts that emerge in equilibrium are quite different, as shown in the following proposition.

Proposition 10 *Consider the following modification to the contracting setup: the lender renews the borrowers' contracts with certainty after repayment, and probability λ following default. Equilibrium contracts are as follows:*

1. *Neither the monopolist nor competitive lenders use stochastic renewal: $\lambda = 0$.*
2. (a) *If $\frac{\delta p^2 r}{\rho} \leq \frac{1-\delta p}{1-p}$, the nonprofit offers JL for all $S \geq \hat{S}$ as before, and $\lambda > 0$ for all S (unless the JL IC2 binds at $S = \hat{S}$, in which case $\lambda = 0$ at \hat{S}).*
 (b) *If $\frac{\delta p^2 r}{\rho} > \frac{1-\delta p}{1-p}$, there is an $\hat{S} \in (\hat{S}, \frac{\rho}{\delta q})$ such that the nonprofit offers IL for all $S < \hat{S}$, JL otherwise, and $\lambda > 0$ for all S .*
 (c) *When JL is used, λ and thus borrower welfare V is strictly increasing in S for all $S < \frac{\rho}{\delta q}$.*

⁴To see this, note that for repayment probability π and $r = \frac{\rho}{\pi}$, $\tilde{V} = pR - \rho + \delta(\pi V + (1 - \pi)U)$, while the stochastic renewal contract yields $V = pR - \rho + \delta(\pi + (1 - \pi)\lambda)V$.

3. *Borrower welfare is always higher with the nonprofit lender than under competition.*

Proof. The key relationship to check is the effect of λ on IC1 and IC2. For a given V , higher λ implies weaker penalty for default. However, higher λ increases V by improving the borrower or group's renewal probability. It turns out that the former effect dominates; the constraints are strictly tighter as λ increases.

First consider the single (non-profit or for-profit) lender case. Borrower utility with stochastic renewal and repayment probability π is

$$V = \frac{pR - \pi r}{1 - \delta(\pi + (1 - \pi)\lambda)}.$$

The LLC is unchanged. The IC1 is $\delta(1 - \lambda)V \geq r$ or

$$\frac{1 - \lambda}{1 - \delta\lambda} \delta pR \geq r.$$

The IC2 under JL is $\delta[(1 - \lambda)V + S] \geq 2r$ or

$$\frac{\delta[(1 - \lambda)pR + (1 - \delta(q + (1 - q)\lambda))S]}{2 - \delta(q + \lambda(2 - q))} \geq r.$$

Both are strictly tighter as λ increases. To see this for IC2, suppose IC2 binds. Rearranging, we obtain $\frac{dr}{d\lambda} = \frac{pR - \pi r}{2 + \pi a(\lambda)} a'(\lambda)$ where $a(\lambda) = \frac{\delta(1 - \lambda)}{1 - \delta(q + (1 - q)\lambda)} > 0$, $a'(\lambda) < 0$. Thus the monopolist always sets $\lambda = 0$, since increasing λ forces him to decrease the interest rate.

With competition, the corresponding constraints are

$$\delta(1 - \lambda)(V - U) \geq r \tag{IC1}$$

$$\delta[(1 - \lambda)(V - U) + S] \geq 2r \tag{IC2}$$

U is exogenous from the lender's perspective, and $V - U > 0$ in equilibrium. Using $V = pR - \pi r + \delta[(\pi + (1 - \pi)\lambda)V + (1 - \pi)(1 - \lambda)U]$, we obtain $\delta(1 - \lambda)(V - U) = a(\lambda)(pR - \pi r - (1 - \delta)U)$, from which it is straightforward to check that both IC1 and IC2 are strictly tighter as λ increases. Thus stochastic renewal is never used in competition. To see this, consider an equilibrium with $U = U^*$ where some lender offers IL with $\lambda^* > 0$ and breaks even. This implies that, for his borrowers,

$\delta(1 - \lambda^*)(V(\lambda^*) - U^*) = \frac{\rho}{p}$. But then an entrant could offer IL with $\lambda' < \lambda^*$ and earn positive profits since $\delta(1 - \lambda')(V(\lambda') - U^*) > \frac{\rho}{p}$. An analogous argument rules out equilibria with stochastic renewal and JL, and rules out entry by lenders using stochastic renewal in an equilibrium with no stochastic renewal.

The non-profit lender will use stochastic renewal whenever the tightest repayment constraint is slack at the zero-profit interest rate, since increasing λ improves borrower welfare without violating the constraint. We first analyze contract choice under IL and JL, then the choice of contract type.

Under IL, the lender chooses λ to bind IC1. The solution to $\frac{1-\lambda}{1-\delta\lambda}\delta pR = \frac{\rho}{p}$ is $\hat{\lambda}^{IL} \equiv \frac{\delta p^2 R - \rho}{\delta p^2 R - \delta \rho}$, which is strictly positive by Assumption 2.

Under JL, the lender chooses λ to bind the tighter of IC1 and IC2. Just as in the competition setup, IC1 and IC2 intersect at $S = \frac{\rho}{\delta q}$. If IC1 is binding, $\hat{\lambda}^{JL}(S) = \frac{\delta p q R - \rho}{\delta p q R - \delta \rho}$. If IC2 is binding, $\hat{\lambda}^{JL}(S) = \frac{\delta q [pR + (1-\delta q)S] - (2-\delta q)\rho}{\delta q [pR + \delta(1-q)S] - \delta(2-q)\rho}$. λ is strictly increasing in S until $S = \frac{\rho}{\delta q}$. However, note that if $S < \hat{S}$, JL is not usable even with $\lambda = 0$, and for $S > \hat{S}$, $\hat{\lambda}^{JL}(S) > 0$. Therefore, we have:

$$\hat{\lambda}^{JL}(S) = \begin{cases} 0 & S < \hat{S} \\ \frac{\delta q [pR + (1-\delta q)S] - (2-\delta q)\rho}{\delta q [pR + \delta(1-q)S] - \delta(2-q)\rho} & S \in [\hat{S}, \frac{\rho}{\delta q}] \\ \frac{\delta p q R - \rho}{\delta p q R - \delta \rho} & S \geq \frac{\rho}{\delta q} \end{cases}$$

The nonprofit chooses JL whenever

$$\hat{V}^{JL}(S, \hat{\lambda}^{JL}(S)) \geq \hat{V}^{IL}(\hat{\lambda}^{IL}).$$

Since the numerator is $pR - \rho$ in both cases, JL is used if and only if

$$1 - \delta(q + (1-q)\hat{\lambda}^{JL}(S)) \leq 1 - \delta(p + (1-p)\hat{\lambda}^{IL})$$

or

$$\hat{\lambda}^{JL}(S) \geq \frac{\hat{\lambda}^{IL} - p}{1-p}.$$

At \hat{S} (i.e. $\hat{\lambda}^{JL}(S) = 0$) this reduces to $\frac{\delta p^2 R}{\rho} \leq \frac{1-\delta p}{1-p}$. If this condition holds, the lender offers JL for all $S \geq \hat{S}$, just as before. Otherwise, he offers JL for $S \geq \hat{S}$, with $\hat{S} < \hat{S} < \frac{\rho}{\delta q}$, defined implicitly by $\hat{\lambda}^{JL}(\hat{S}) = \frac{\hat{\lambda}^{IL} - p}{1-p}$.

To see the last part of the proposition, we have already noted that by mimicking

the competitive market the nonprofit can give utility \tilde{V} to each borrower. However, as he is unconstrained by the market equilibrium conditions, he may be able to offer an alternative contract that yields higher borrower welfare. Secondly, since he uses stochastic renewal instead of credit rationing as a motivating device, this contract can be offered to all borrowers, instead of just the matched borrowers as under competition. ■

Stochastic renewal is more efficient than strict dynamic incentives. Nevertheless we find that the for-profit monopolist and competitive lenders will never use it. As a result, the nonprofit organizational form achieves the highest borrower welfare.⁵ Figure 4 shows borrower welfare and λ under the simulated stochastic renewal contract.

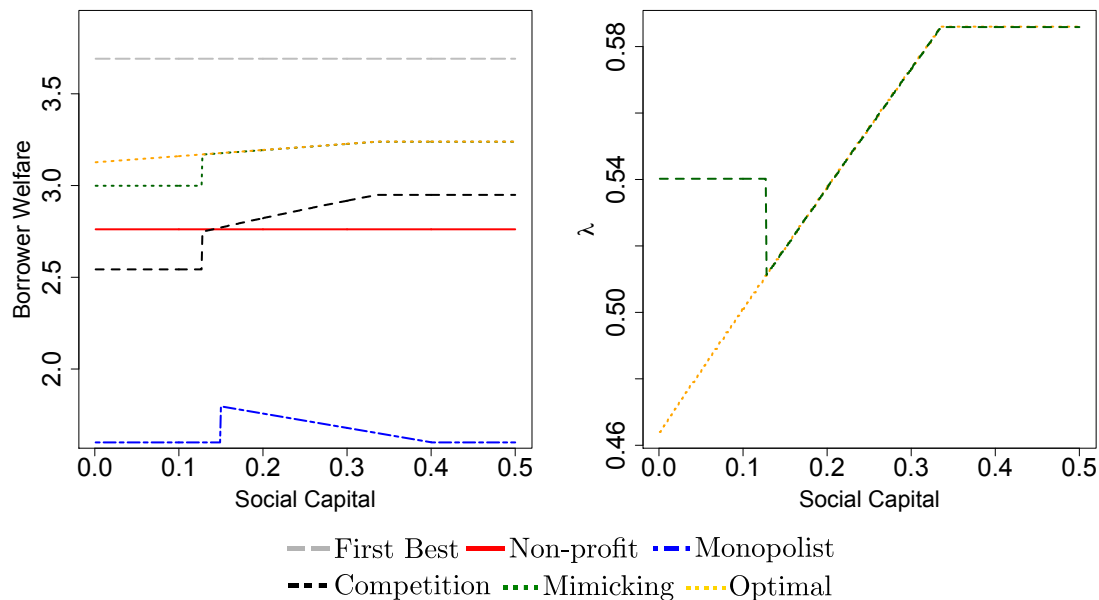


Figure 4: Simulating the stochastic renewal contract. Social capital ranges on horizontal axes, borrower welfare on vertical axes.

⁵If the monopolist also valued future profits from a given borrower (non-myopic), he *would* use stochastic renewal, since there is now a tradeoff between higher interest rates and increasing the renewal probability. The result for the competitive market only relies on free entry and zero-profit equilibrium and therefore does not depend on the lenders' time horizon.

A.8 Group size and binding limited liability condition

Consider a group of size n , and suppose the group's loans are repaid whenever at least m members are successful. Then the repayment probability is

$$\pi(n, m) = \sum_{i=m}^n \binom{n}{i} p^i (1-p)^{n-i},$$

so

$$V = \frac{pR - \pi(n, m)r}{1 - \delta\pi(n, m)}.$$

IC1 is unchanged: $r_{IC1} = \delta pR$. For the successful borrowers to be willing to repay when exactly m are successful, each repaying $\frac{nr}{m}$, we must have $r \leq r_{IC2}(S, n, m)$, which we can derive as:

$$r_{IC2}(S, n, m) \equiv \frac{\delta m [pR + (1 - \delta\pi(n, m))S]}{n - (n - m)\delta\pi(n, m)}.$$

The LLC requires that the m successful borrowers can afford to repay all 5 loans, i.e. $nr \leq mR$ yielding

$$r_{LLC}(n, m) \equiv \frac{mR}{n}.$$

For a given $r \leq r_{IC1}$, borrowers will choose the lowest m such that to IC2 and LLC are satisfied, so equilibrium m^* is determined by

$$\min\{r_{LLC}(n, m^*), r_{IC2}(S, n, m^*)\} \geq r > \min\{r_{LLC}(n, m^* - 1), r_{IC2}(S, n, m^* - 1)\}.$$

This m^* then defines the repayment probability function $\pi^*(S, n, r)$.

The non-profit lender chooses the lowest r such that $\pi^*(S, n, r)r = \rho$. The for-profit chooses r to maximize $\pi^*(S, n, r)r$.

Despite this modification, it may be that LLC at m^* is tighter than IC1, in which case the highest interest rate the lender can charge under JL will now be dictated by the LLC and smaller than r_{IC1} . If this is the case and the lender is a for-profit monopolist, borrowers will be *strictly* better off under JL than IL. However, if the LLC is very tight, JL may never be offered. This has three implications for the simulations. Firstly, the value of \bar{S} , obtained from the point at which the lender can no longer leverage social capital, depends on whether IC1 or LLC are tightest.

Formally, with the group size modification,

$$\bar{S} = \min \left\{ \frac{(n-m)pR}{m}, \frac{[n(1-\delta p) - (n-m)\delta\pi^*]R}{\delta n(1-\delta\pi^*)} \right\}.$$

Secondly, the interest rate and borrower welfare at \bar{S} are be lower and higher respectively than the corresponding values under IL, when $r_{LLC} < r_{IC1}$. Thirdly, if r_{LLC} is very tight for every m there may be no value \tilde{S} at which the lender is willing to offer JL.

A.9 Regional welfare predictions

Figure 5 plots the predicted borrower welfare in each of the regions considered in the simulations, as was discussed in section 3.3.

B Simulation Methodology

This Appendix outlines the algorithm used to simulate the core model. The simulation was implemented in Scilab, an open-source alternative to Matlab. Rather than solving the model explicitly, which becomes increasingly complicated with larger groups, we chose to simulate the optimization problem numerically. As the objective functions are all linear, this is a computationally tractable and simple task.

The simulation consists of two parts. The first part computes the optimal contracts of a non-profit and a monopolist lender, while varying the level of social capital S . The second part computes the competition section.

The section proceeds by presenting annotated pseudo-codes, that illustrates how the code proceeds to arrive at the optimal contracts.

Non-Profit and Monopolist

Here the optimization is very simple, as we do not have to study an entry condition, but just have to evaluate a set of constraints. The optimization procedure is carried out for each level of social capital, which then gives us the value functions we use for the main plots in the paper. Since $n = 5$ throughout we drop the n notation.

For each value of S :

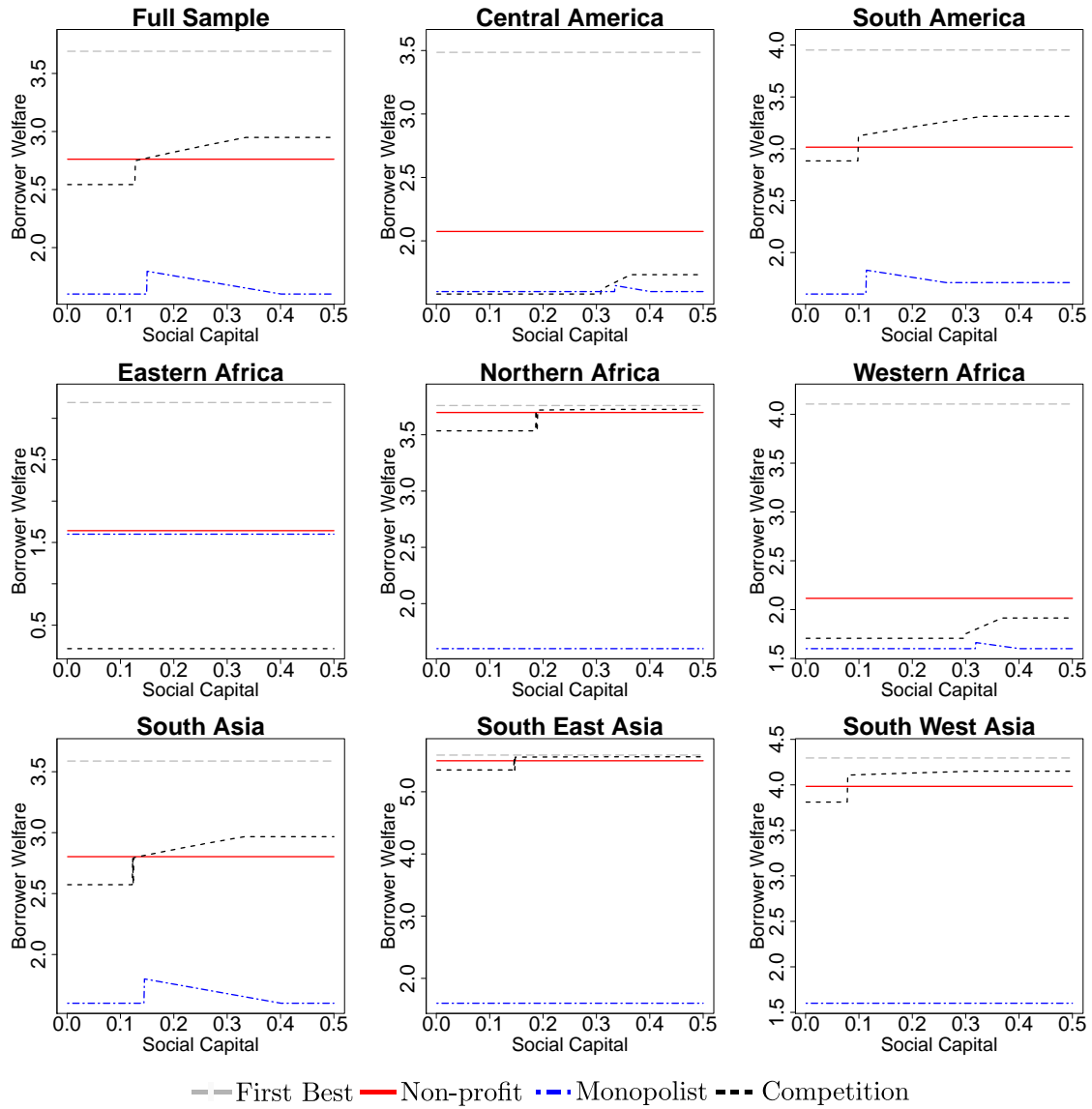


Figure 5: Borrower Welfare: Regional Differences. Social capital ranges on horizontal axes, borrower welfare on vertical axes.

Non-Profit

1. JL: find the set M_{JL}^{ZP} of values for m that satisfy $r_{LLC}(m) \geq \rho/\pi(m)$ and the associated functions $\hat{V}^{JL}(m)$.
2. IL: Find, if it exists, the IL zero-profit equilibrium and the associated \hat{V}^{IL} .
3. Choose the contract (IL/JL), value of m and corresponding interest rate that gives borrowers maximal utility.

Monopolist

1. JL: For each $m \in M_{JL}^{ZP}$ find the maximal interest rate $\tilde{r}(m)$ such that $\tilde{r}_{JL}(m) = \min\{r_{IC2}(m), r_{LLC}(m), r_{IC1}\}$ and compute the associated profits $\tilde{\Pi}(m)^{JL} = \pi(m)\tilde{r}^{JL}(m) - \rho$.
2. IL: Compute the maximal interest rate $\min\{r^{IC1}, r^{LLC}\}$ and compute the associated profits $\tilde{\Pi}^{IL} = p\tilde{r}^{IL} - \rho$.
3. Choose the contract that maximizes profits.

Competition

For the competition model, we simulate the entry condition for lenders. For each value of S and U we check whether an entrant could earn positive profits with some contract (recall that in equilibrium there is always excess demand for credit). This will happen as long as the relevant constraints (see below) are slack at the relevant zero-profit interest rate. Hence, for each S we proceed by iteratively increasing U until the most profitable contract breaks even. The details are provided in the following pseudo-code:

For each value of S :

1. Initialize $U = 0$.
2. JL: for all $m = 1, \dots, n$, check that all three constraints (LLC, IC2, IC1) are satisfied at the zero-profit interest rate.
3. IL: check that IC1 is satisfied at the zero-profit interest rate.

4. If there exists at least one contract such that all relevant constraints are satisfied, increase U by one unit and repeat from step 2. Otherwise, we have found the equilibrium value of U . The equilibrium contract (either IL or JL and the appropriate value of m) is the one for which all three constraints were satisfied in the previous round of iteration. If two or more contracts are feasible, pick the one that delivers the highest borrower welfare.
5. Given the equilibrium contract, solve U for the equilibrium market scale, and thus find Z .

Optimal Contract with Stochastic Renewal

The algorithm to determine the optimal level of λ is very similar to the one that determines the level of U in the competition simulation. The idea is, that a non-profit adjusts λ as long as the relevant constraints are slack. The key difference is that the non-profit finds the binding level of λ for for all different levels of m and then choses the level of m that provides borrowers with maximal utility. Free-entry competition may not yield the welfare-maximizing level of m . The reason is that entry continues until the slackest constraints eventually binds, which gives a single value for U . Under the optimal stochastic renewal contract, we find the optimal λ for each level of m respectively and then let the non-profit chose the welfare-maximizing contract. The details are provided in the following pseudo-code:

For each value of S :

1. Initialize $\lambda = 0$.
2. JL: for all $m = 1, \dots, n$, check that all three constraints (LLC, IC2, IC1) are satisfied at the zero-profit interest rate.
 - (a) if for any m , a constraint is violated, we record the current λ as the optimal one for that particular m .
3. IL: check that IC1 is satisfied at the zero-profit interest rate.
 - (a) if the constraint is violated, we record the current λ as the optimal one for IL.

4. As long as there exists at least one contract such that all relevant constraints are satisfied (either IL or all JL), increase λ by one unit and repeat from step 2.
5. Evaluate the value functions at the respective optimal λ and choose the contract that maximizes utility.

C Data Appendix

The dataset we work with comes from MIXMarket.org, an organization that collects, validates and publishes financial performance data of MFIs around the world. The MIX provides a set of reports and financial statements for each MFI reporting to it. The financial statements and reports were downloaded in March 2011, the relevant data was then extracted into a database using an automated script. The variables we use in this paper come from the MFIs' Overall Financial Indicators, the Income Statement, the Balance Sheet and the Products and Clients report. The Balance sheet and the Income statements are regular financial statements, while the Financial Indicators report variables such as Portfolio at Risk and the Products and Clients report include the number of loans by methodology.

The variables we use from the Balance Sheet are Value of IL Loans, Value of Solidarity Group Loans and overall Gross Loan Portfolio. From the Income statement we use the Operating Expense and the Financial Expense to compute the expense per dollar lent as described in the main text. From the Financial Indicators report, we use the Portfolio at Risk numbers, along with the Real Portfolio Yield to compute the risk adjusted real yields. From the Products and Clients report, we extract the Number of IL Loans and Number of Solidarity Group Loans, which we refer to in the main table and the text.

We work with a sample of 715 institutions for the year 2009. We chose the year 2009 as that is the year for which we have the largest number of institutions reporting lending methodology.⁶

The MIX data does not give us information whether JL is used, but they state

⁶In 2009, 911 (out of a total of 1106) provide some data on lending methodology by volume coming from the Balance Sheets. Of these, we exclude 154 "village banks" for which lending methodology is unclear. Furthermore, we lose 41 observations due to missing data on the key variables used for the simulation: Portfolio at Risk, Operating Expense, Financial Expense and Real Portfolio Yield. Lastly, we drop one MFI that reports PAR greater than 100%.

that “loans are considered to be of the Solidarity Group methodology when some aspect of loan consideration depends on the group, including credit analysis, liability, guarantee, collateral, and loan size and conditions.” We will refer to the share of loans falling into this category as JL share loans.

Sometimes the data on lending methodology by number of loans or by volume does not correspond exactly to the reported total portfolio or number of loans outstanding because of data entry errors, missing data or number of borrowers rather than number of loans reported. In these cases we assume that the errors are not biased toward either IL or JL, so we compute the share from the data we have. For example, if a lender reports \$1m of loans, but \$450k IL and \$450k solidarity group lending, we compute an IL share of 50% and apply this to the whole portfolio. Of the 715 institutions in the sample, 143 have such incompleteness in the value data, 16.7% of the total Gross Portfolio is unaccounted for. As for the number of loans (which are not used in the estimation), 10 have no data so we use the value shares as a proxy, and 222 institutions have incomplete data; a total of 11.4% of the number of loans are unaccounted for. In total 304 institutions have some incompleteness in these data.

The relationship between the two is illustrated in Figure C. Points lying on the 45 degree line correspond to lenders where the IL share by value is the same as the IL share by number. Each point corresponds to an MFI, with those in red, the “portfolio data incomplete”, corresponding to the observations where the methodology breakdown does not exactly match the portfolio figures as discussed in the previous paragraph. From this graph we learn three things. Firstly, the pattern of the data is very similar when we compare “complete” and “incomplete” observations, which suggests we need not be concerned about the incomplete cases. Secondly, most points lie to the north west of the 45 degree line, indicating that IL loans tend to be larger than JL loans (an issue we do not explore in this paper). This has been previously observed in Cull et al. (2007). Thirdly, although we do observe some lenders offering both IL and JL, the majority of lenders use predominantly one or the other. 72% of lenders (accounting for 68% of loans by number and 84% by value) have 95% of their portfolio in either IL or solidarity lending.

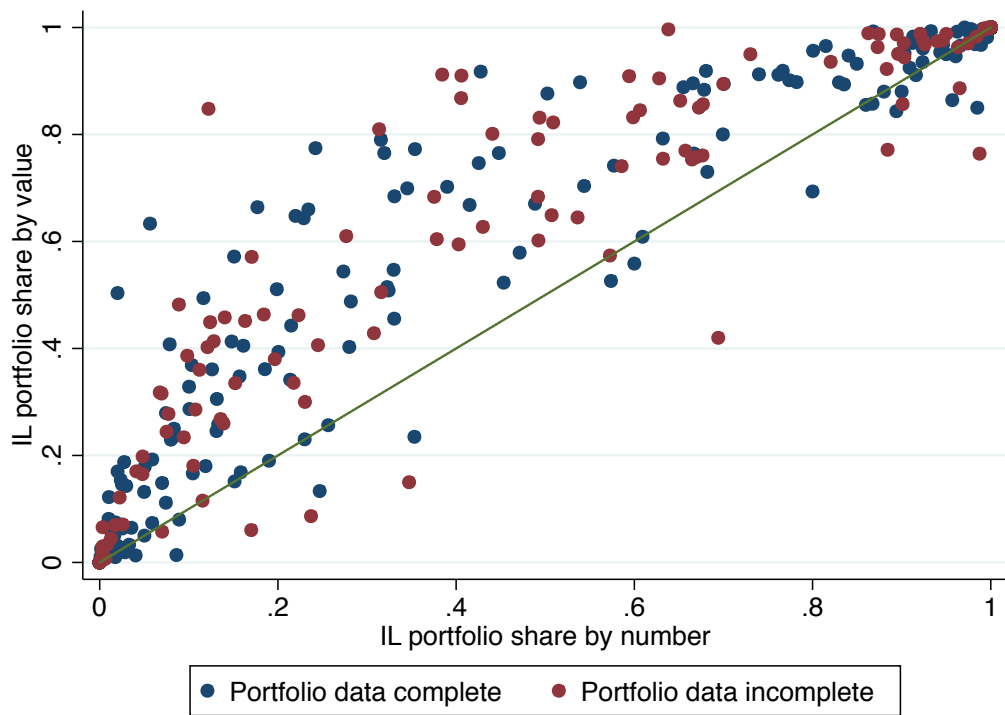


Figure 6: IL Share by Value and by Number