ISSN No. 2454 - 1427

CDE
March 2022

Microfinance institution and moneylenders in a segmented rural credit market

Abhirupa Das
Email: -abhirupa@econdse.org
Department of Economics,
Delhi School of Economics

Uday Bhanu Sinha
Email: -uday@econdse.org
Department of Economics,
Delhi School of Economics

Working Paper No. 324

Centre for Development Economics
Delhi School of Economics
Delhi- 110007

Microfinance institution and moneylenders in a segmented rural credit market*

Abhirupa Das† Uday Bhanu Sinha‡

March 11, 2022

Abstract

The poor heavily rely on informal sources for their capital needs as they lack collateral required by formal institutions. Furthermore, local moneylenders operate in distinct market segments and borrowing opportunities may not be equal for every household. The role of a microfinance institution (MFI) operating in such environment becomes even more crucial. The effectiveness of MFIs in rescuing poor borrowers from 'clutches of' moneylenders has been a much-debated topic over the last few decades. This paper attempts to contribute to this debate by presenting a model of competition between a socially motivated MFI and profit-maximising moneylenders in the presence of market segmentation.

We characterise equilibrium conditions in the presence of market segmentation under scenarios where only moneylenders operate, only MFI operates and finally the case where both co-exist. We find unambiguous benefits arising from the entry of a welfare maximising entity such as an MFI. We also see the values of having local agents like moneylenders on the ground who have information gathering advantages. We conclude that an effective system of both these entities working together can bring about increases in efficiency and welfare.

Keywords: microfinance, market segmentation, collateral substitution, mandatory savings, information asymmetry, moral hazard, adverse selection

JEL Codes: D82, O16

*This work has greatly benefitted from the suggestions of Abhijit Banerji and Soumendu Sarkar. Institutional support from the Department of Economics, Delhi School of Economics and the Centre for Development Economics, Delhi School of Economics is gratefully acknowledged. Comments and feedback from Debasis Mondal (Indian Institute of Technology, Delhi) is gratefully acknowledged.

†Department of Economics, Delhi School of Economics, Delhi 110007, India. Email:abhirupa@econdse.org

‡Department of Economics, Delhi School of Economics, Delhi 110007, India. Email:uday@econdse.org

1 Introduction

With the evolving COVID-19 situation across the globe the worldwide incidence of poverty is increasing. It is estimated that about 120 million additional people are living in poverty as a result of the pandemic and the total is expected to rise to about 150 million by the end of 2021[1]. It is only through collective global action that this crisis can be tackled. Capital needs among the poor remain high and this lack of access to capital is the major factor behind largescale poverty in developing countries (Banerjee and Newman (1993), Mookherjee and Ray (2003), Armendáriz de Aghion and Morduch (2007)). Problems of limited liability, lack of collateral and information asymmetries prohibit the commercial banking network to operate in rural areas with low-income customers (Armendáriz de Aghion and Morduch (2007), Rutherford (2000)). The poor remain underserved by the traditional commercial banks and capital does not reach the poorest of the poor.

Microfinance is an important tool in addressing this. It is needed now, more than ever to lift people out of poverty induced by the pandemic (Zheng and Zhang, 2021). Cash strapped borrowers lack resources to apply for loans in commercial banks and hence rely on local moneylenders who offer unfair terms. Since MFIs are specifically instituted to cater to low-income households, their inability to provide collaterals against loans poses the most important challenge for MFIs. Microfinance institutions around the world use various mechanisms that differ from traditional commercial banks, in order to mitigate this issue, mechanisms such as group lending, dynamic incentives, regular repayment schedules and collateral substitutions have been practised by MFIs (Morduch, 1999).

Group lending had received a lot of attention in early theoretical research on microfinance (Banerjee et al. (1994), Stiglitz (1990), Ghatak (2000), Van Tassel (1999), Laffont and N'Guessan (2000), Armendáriz de Aghion Gollier (2000)). This mechanism was practiced by many microlenders in the beginning (e.g., Grameen Bank[2], BancoSol[3], Kenya Ru-

[1]https://www.worldbank.org/en/topic/poverty/overview
[2]Morduch, 1999
[3]Lal and Lobb, 2016

ral Enterprise Programme (K-REP)[4], Bank for Agriculture and Agricultural Cooperatives (BAAC)[5]). Loans were forwarded to groups of individuals well known to one another. In the absence of collateral, members of the group vouched for one another and was responsible for monitoring others in the group and ensuring repayment of loans. This not only assuaged the lack of collateral issue but also facilitated inexpensive peer monitoring.

Dynamic incentive involves lending small amounts initially and then allowing larger loan amounts upon successful repayment. This increases repayment rates as the incentive of receiving a larger loan in the future pushes borrowers to repay their initial loans (Morduch, 1999). This is termed as "progressive lending" by Hulme and Mosley (1996). Another feature of microfinance loan contracts is that repayment starts almost instantly as loans are disbursed. The Grameen bank model initially had weekly collection of instalment repayments starting just a few weeks after disbursement (Morduch, 1999). Armendáriz de Aghion and Morduch (2007) provides a few explanations as to why the repayment schedule is such. First, this creates an early warning system by allowing credit officers to interact with borrowers frequently and face-to-face and identify any potential repayment problems faced by clients. It also allows the banks to screen out more risky borrowers. Frequent instalments also address the savings problems faced by low-income households. It motivates the borrower to tap into other income flows and utilise them to repay productive loans instead of consuming it away.

Some microfinance institutions have innovated their mechanisms to include some form of collateral substitutions. For example, the Grameen Bank model requires a certain amount of savings gathered by individuals in the group to be kept aside as 'emergency fund' (Morduch, 1999). Other microfinance institutions such as the Bank Rakyat Indonesia (BRI) explicitly required collateral against a loan but were flexible in terms of the type of collateral. Many microlenders also provide ways for borrowers to build up financial assets that could be later collateralized to take out loans. For example, regularly saving for a period of time could be a mandatory requirement in order to take out loans. Regularly saving also displays certain

[4]Mutua, 1996
[5]Fitchett, 1999

desirable characteristics of borrowers such as financial discipline and money management skills (Armendáriz de Aghion and Morduch, 2007). In our paper we focus on this mechanism and allow the MFI to introduce a mandatory savings requirement against loans as a collateral substitution.

The literature suggests that in a scenario where an MFI enters the rural credit market, the introduction of an MFI triggers a competition between the formal and informal sectors (Bell et al. (1997), Bose (1998), Andersen and Malchow-Møller (2006), Mookherjee and Motta (2016)). Of course, the literature also emphasises that the nature of interaction between the formal and informal sectors may not necessarily be that of competition. In certain setups, the formal and informal institution loans may complement one another. Jain and Mansuri (2003) present a model where moneylenders provide 'bridge-loans' to the entrepreneurs to assist them in keeping up with the regular repayment schedules of the microfinance institution. Madestam (2014) and Surender (2020) formulate models where the formal institution not only provides loans to the entrepreneurs, they also fund the informal lenders. In this present work, however, we present the moneylenders as being in direct competition with the MFI for providing loan to the potential borrowers.

Over the years arguments have risen both for and against the effectiveness of MFI when it comes to rescuing poor borrowers from 'clutches of' moneylender (Mookherjee and Motta (2016)). Several findings corroborate the beneficial aspects of an MFI entry into the rural credit market. From reduction in overall usurious interest rates charged to enhancing financial inclusion among the poor, MFIs can have a positive impact on overall welfare ((Jain (1999), Andersen and Malchow-Møller (2006)). However, evidence also exists supporting the other side of the debate which either points to the ineffectiveness of MFIs or the general counterproductivity of the same. Some studies have found the entry of an MFI can lead to a negative spill-over effect on interest rates in the residual market not served by the MFI (Demont (2010)). Others point to the fact that MFI loans are often used for unproductive purposes.

In this paper we develop a model which explores the themes discussed above. Most of the literature has focused on the mechanism of joint-liability lending (Ghatak (2000), Demont (2010), Roy Chowdhury (2007a, 2007b)). On the other hand, this paper examines the effectiveness of the collateral substitution mechanism often used by microfinance institutions[6]. It further explores the results from competition between a welfare maximising entity (MFI) and profit maximising entities such as the moneylenders. We operate with the notion of market segmentation. This is the case where more than one moneylender operates in the same region, sometimes competing among themselves. Udry (1990), Aleem (1990), Siamwalla et al. (1993) and Khanna and Majumdar (2020) provide empirical evidence of market segmentation from Nigeria, Pakistan, Thailand and India, respectively.

With the market being segmented, moneylenders hold certain informational and enforcement advantages in segments where they are the sole operators. Segmentations within the market denote smaller ecosystems defined either spatially or based on economic and/or social transactions that occur between the residents (Mookherjee and Motta (2016)). These advantages ensure low default rates as lending occurs between known associates. Thus, moneylenders hold monopoly power here, as other lenders would be apprehensive to lend to unknown associates (Banerjee, 2003). In other segments where more than one moneylender operates, they not only compete between themselves, but they hold lesser advantage while doing so.

Market segmentation is modelled similar to the setup provided in Basu and Bell (1991). They point out that fragmented oligopolies may arise, in trades where there is a problem of asymmetric information and moral hazard is high. This seminal paper goes on to elaborate on the properties of a fragmented duopoly and embed this market structure and analyse it in the context of labour and credit markets in backward agrarian economies. Formally, we adopt the concept of captive and contested segment from Basu and Bell (1991) with a slight

[6]SafeSave in Dhaka required clients to hold a savings account and actively save before any loan product is forwarded to them (Armendáriz de Aghion and Morduch (2007) and Rutherford (2000). This can act as collateral against loans.

change in the nature of advantages allowed in the captive vis-à-vis the contested segment. Due to this variation, we have termed these segments as *captive and non-captive segments*.

In our model the rural economy is set up with two profit-maximising moneylenders operating across three segments. Each moneylender having their own captive segment where only they can operate and a non-captive segment where both moneylenders can enter and conduct business.

The other entity, the MFI, is *socially motivated* such that it concerns itself with improving the payoffs of the borrowers while breaking even itself (Dam and Roy Chowdhury (2014), Mookherjee and Motta (2016)). In our model the MFI can operate and extend contracts across all segments. Information asymmetry is modelled in two forms: *adverse selection* and *moral hazard*. Adverse selection in terms of the type of borrowers, who can either be good or bad depending on their level of entrepreneurial capabilities. This distinction is not apparent until the borrower embarks on an investment.[7] Moral hazard problem has two sources: whether the borrower invests the loan amount or diverts it for private consumption (where returns are unverifiable) and whether the borrower voluntarily defaults or not (ex-post moral hazard). In order to mitigate the issues created by these information asymmetries, the MFI offers contracts in such a manner that borrowers are provided with loans only when a *mandatory savings* amount is kept with the MFI as collateral (Dasgupta (2017) and Ghosh and Van Tassel (2008)).

To understand the effect of competition better, we first explore the benchmark case where only the moneylenders operate and offer loans in the market. The added advantages within the captive segment for the moneylender is contrasted with the relative disadvantage and competition in the non-captive segment. When the MFI operates in isolation, we explore the contracts that it can offer to improve welfare under a variety of circumstances. The model answers questions such as whether the MFI would decide to offer a pooling or a separating contract? What are the conditions for implementing such a contract? We find that in certain

[7]Uncertainty of the borrower regarding their own abilities is consistent with evidence from Ross and Savanti (2005), Valdivia and Karlan (2006) and Drugov and Macchiavello (2008)

cases the MFI itself faces a risk of default and therefore cannot operate sustainably. This further explains the reasons for which we see a large number of MFIs generate losses and are ultimately deemed not sustainable (Bateman and Chang (2009), Bateman et al. (2012)).

The competition between the MFI and moneylenders is uniquely captured across the captive and non-captive segments. The subtle idea this model operates under is that initially, without the MFI, there may not be equal opportunities for every household and every borrower. The borrowers from the captive and non-captive segments do not have equal terms when applying for a loan. However, the MFI offers a single contract to all these borrowers from all segments and operates with an objective function that is vastly different from that of the moneylender, which is to improve welfare. Does the MFI indeed, in this case, succeed in improving the welfare as compared to the benchmark case? Who would therefore be finally operating as the lender in captive vis-à-vis the non-captive segments? Briefly, the findings from this present work reveal the overall positive benefits of an MFI entry. The results also point to a case where the MFI is rendered ineffective as well when certain conditions prevail in the market.

Next, we turn towards policy instruments that can be explored. We see that in certain cases, under the separating MFI contract, the amount of mandatory savings demanded by the MFI is too high for the good entrepreneur to submit in order to secure a loan. In other words, the cost of separating is too high for the good entrepreneur to bear. In such cases, the MFI acting alone can only do as much as offer an inferior pooling contract. If instead, the MFI employs the services and informational advantages of the moneylenders in the captive segment, we find that they can manage to induce a welfare superior equilibrium.

To the best of our knowledge, this is the first work to evaluate the competition between MFI and moneylenders under the framework of captive and non-captive segments with a mandatory savings requirement acting as a collateral substitution. The rest of the paper is organised in the following manner: We provide the basic framework and assumptions of the model before proceeding to the benchmark case of only moneylenders operating. Next,

we look at the case with only MFI operating, after which, we present the full setup of both MFI and moneylenders operating and competing. We follow up with a section on policy instruments and finally conclusion.

2 Model

2.1 Set Up

There are three types of players in the economy: a population of entrepreneurs distributed uniformly across three segments, a microfinance institution (MFI) and two moneylenders. The market is segmented into two captive segments and one non-captive segment where each of the moneylenders serve in their own captive segments and both moneylenders serve in the non-captive segment. The MFI as a more extensive coverage serves in both the captive as well as the non-captive segments.

All players live for two periods, t = 1, 2. Entrepreneurs and moneylenders have a discount rate $\delta < 1$ between the two periods and the MFI is assumed to have a discount rate of $\delta = 1$. Each entrepreneurs needs one unit capital loan at the beginning of each period to invest into a project where the returns are equal to R. To realise the returns R, the entrepreneur has to put in effort. They are protected by limited liability. The entrepreneurs themselves do not possess this unit capital and hence must approach the moneylenders or MFI for a loan.

After obtaining the loan, entrepreneurs must choose to either invest in the project or divert the funds in order to derive a private benefit equal to b. However, if the funds are diverted, then the project fails and returns are equal to zero. Moneylenders in both the captive as well as the non-captive segment have the necessary power to verify returns and enforce repayment in case the loan is invested but not when it is diverted. MFI cannot assert this enforced repayment in either case. *Further, we have an important assumption that entrepreneurs cannot transfer wealth from one period to another apart from using a savings*

option provided by the MFI.[8] All amounts not saved is consumed by the entrepreneur in that particular period. If the agent does not borrow, she takes her outside option $u > 0$.

Entrepreneurs can be of two types: good or bad. Good entrepreneurs are assumed to be naturally endowed with entrepreneurship capabilities and have a cost of effort equal to 0. Bad entrepreneurs need to incur a cost of effort equal to $e > 0$ for the project to succeed. Initially both borrowers and lenders are unaware of the type of the entrepreneur but have a common prior probability ρ of the entrepreneur being good. Each entrepreneurs privately learn their own type once the investment into the project is made. If the agent is from a captive segment, the operating moneylender from that segment also obtains the information regarding the type of the entrepreneur. The MFI never gets to possess this information. Therefore, all lenders in the non-captive segment remain unaware of the type of agents throughout the game and only the moneylender operating in the captive segment has this informational advantage here.

The cost of capital for the MFI is lesser than that of the moneylenders and the former is normalised to be equal to zero and the cost of lending for the moneylenders is equal to $B > 0$. Therefore, the MFI has a cost advantage over the moneylenders.

To summarize, in our framework, the main differences between the MFI and moneylenders operating in captive and non-captive segments are:

Information: The moneylender operating in the captive segment is the only entity apart from the agent who learns the type of the agent once investment is made in period 1. The MFI and moneylenders in the non-captive segment remain unaware of this information.

Cost of capital: The cost of capital is lower for the MFI than the moneylenders and is normalized to 0. This is possible as the MFI has access to subsidized funds or donor funds which cannot be accessed by the moneylenders.

Enforcement: The moneylenders due to their social capital can enforce repayment if the funds are invested and returns are generated not if they are consumed as private benefit.

[8] This is an important assumption and will play a crucial role in establishing a pooling equilibrium later on.

On the other hand, the MFI cannot enforce repayment even if funds are invested. However, it offers savings opportunities for the borrowers. Given this setup, at the beginning of the game, the entrepreneurs would have to make the decision whether to apply for a loan or go for their outside option. Further, if they choose to apply for a loan and can secure it, they also need to decide whether to invest it or divert it to earn a private benefit. Below we present a few assumptions:

At t = 0,

The payoff of agent from investing in period 1 = $\rho R + (1 - \rho)(R - e) = R - (1 - \rho)e$.

Assumption 1: $R - (1 - \rho)e > b$

This assumption ensures that without knowing their own type, all agents have their expected payoff from investing greater than private benefit from diverting. Hence, all agents at the beginning of the game would want to obtain the loan to invest in the project. They are incentivized to undertake this investment in order to find out whether they are a good entrepreneur or a bad one.

Assumption 2: $u > R - e$

The cost of effort is substantially high and therefore a bad entrepreneur prefers to take his payoff from outside option over investing and spending effort to obtain R from the project.

Assumption 3: $b > u$

For agents it is always better to obtain a loan and divert the money to attain a private benefit over taking their outside option. This introduces a moral hazard problem into the model where entrepreneurs can be incentivized to approach lenders for a loan without any intention of investing.

In the following section we describe the baseline characteristics of the model where the microfinance institution has not entered the market and only the two moneylenders operate in different segments. In the next section we will focus on the scenario when only the MFI is in operation for an effective comparison that leads up to the section when both lending institutions are functioning together.

Table 1: Decision variables and parameters

Notation	Interpretation
δ	Discount factor between two periods
R	Project returns
b	Private benefit
u	Payoff of entrepreneur from her outside option
e	Cost of applying effort
ρ	Probability of the entrepreneur being good
B	Cost of capital for moneylenders
r_{C1}	Rate of interest charged by moneylenders in the captive segment in the first period
r_{C2}	Rate of interest charged by moneylenders in the captive segment in the second period
r_{NC1}	Rate of interest charged by moneylenders in the non-captive segment in the first period
r_{NC2}	Rate of interest charged by moneylenders in the non-captive segment in the second period
r_b	Rate of interest charged by MFI on borrowed amount
r_s	Rate of interest given by the MFI on amount saved with the MFI
S	Mandatory savings amount to be kept with MFI to get second period loans

3 Only moneylenders operating

Segmentations within the market denote smaller ecosystems defined either spatially or based on economic/social transactions that occur between the residents. Individuals are assumed to know a lot about each other within these segments based on repeated social and/or economic interactions as is the case in Mookherjee and Motta (2016). Further, with two moneylenders and three segments we have a captive segment for each of the moneylenders where they have an informational advantage and a non-captive segment where there is no informational advantage.

3.1 Timeline

The following are the sequence of events and outcomes for when only moneylender is operating in captive segment and we denote this game as G_C^M:

At time period t=0,

Stage 1: Moneylenders offer single period loan contracts in the captive as well as the non-captive segments. All agents choose to either accept or reject these contracts.

In the **captive segment**:

At time period t=1,

Stage 2: In case the agent accepts the contract, she has to make a choice to either invest or divert the loan funds and returns are realised based on investment having taken place. If diversion takes place, the agent gets her private benefit in period 1 and settles for her outside option in period 2. If investment is done, both agents as well as moneylenders learn the agent's type and repayment is enforced.

At time period t=2,

Stage 3: Loans are not forwarded to bad agents in period 2 and they settle for their outside option. Loans are forwarded to the good agents only.

Stage 4: Good agents who receive the loan decide whether to invest or divert the borrowed capital. In case there is diversion, agents receive their private benefit. If there is investment, then returns are realised and repayment of loans is enforced by the moneylender.

Similarly, we can represent the game with moneylender in the **non-captive segment** G^M_{NC} as following:

At time period t=1,

Stage 2: In case the agent accepts the contract, she has to make a choice to either invest or divert the loan funds and returns are realised based on investment having taken place. If diversion takes place, the agent gets her private benefit in period 1 and settles for her outside option in period 2. If investment is done, only agents learn their own type. Moneylenders **will remain uninformed**.

At time period t=2,

Stage 3: Loans are forwarded to both types of agents as the moneylenders do not know their type.

Stage 4: Bad agents always divert the borrowed capital and earn their private benefit in period 2. Good agents who receive the loan decide whether to invest or divert the borrowed capital. In case there is diversion, agents receive their private benefit. If there is investment, then returns are realised and repayment of loans is enforced by the moneylender.
The stages can be represented by Figure 1 for the captive segment and Figure 2 for the non-captive segment.

Please note the difference between games G_C^M and G_{NC}^M in figure 1 and 2 respectively. In the captive segment (Figure 1) when investment is made, states are realised and become known to both agents as well as moneylenders. Further, the bad agent is not forwarded loans in the second period, and they would have to settle for their outside option. However, in the non-captive segment (Figure 2), after investment states are realised and only become known to agents and the moneylenders remain uninformed about the state. Therefore, in period 2 loans are forwarded to both good and bad agents and the bad agents always diverts this loan to attain her private benefit.

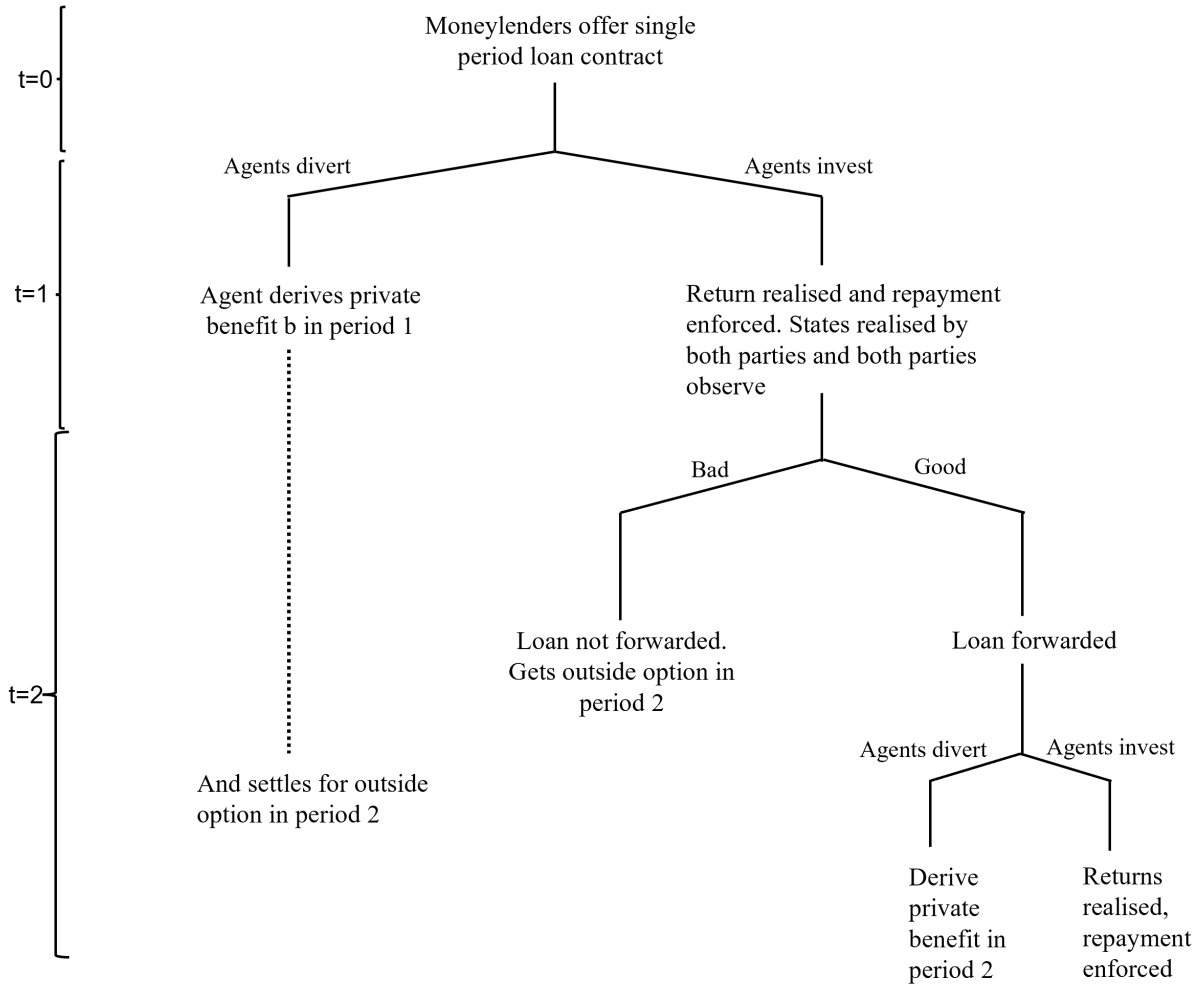

Figure 1: Brief sketch of the game: captive segment and only moneylender operating G_C^M

3.2 Captive Segment

Let us start with the analysis of the captive segment. Here, in order to finance their project, agents can approach only the moneylender operating there. The moneylender possesses both informational advantages viz-a-viz. the type of entrepreneur as well as the power or ability to enforce repayment in case the borrowed capital is not diverted. Therefore, the moneylender in the captive segment holds monopoly power.

Assumption 4: $\boldsymbol{R - e(1 - \rho) - b - 1 > B}$

This assumption ensures the existence of a moneylender in the market. The left-hand side is the maximum interest that the moneylender can charge at the beginning of period 1

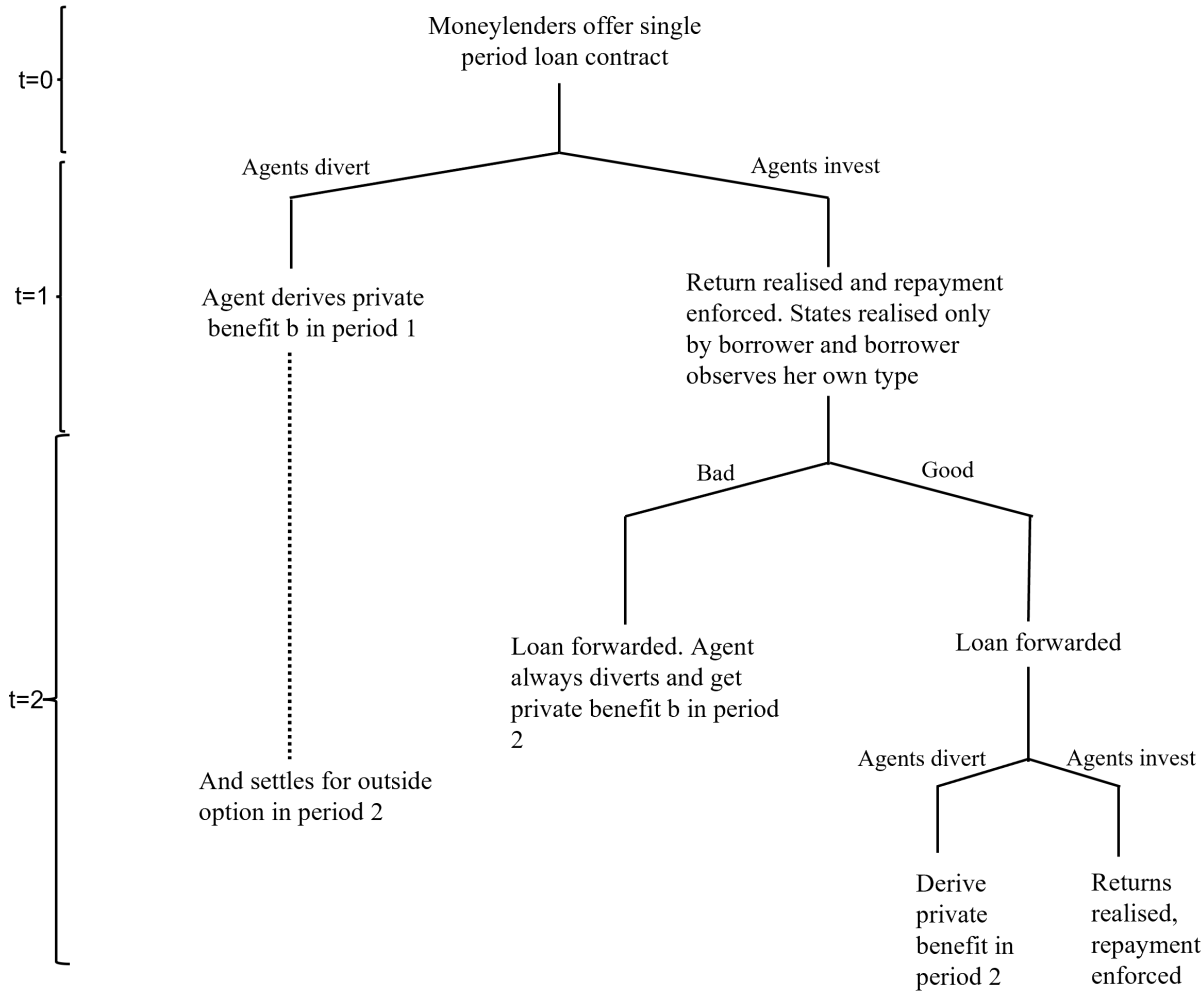

Figure 2: Brief sketch of the game: non-captive segment and only moneylender operating G_{NC}^{M}

which extracts all surplus from the agent. The assumption ensures that this value is greater than the cost of capital for the moneylender. If this is not true, then the moneylenders cannot operate in this market.

In our model, note the outcome when there is an informational advantage given to the moneylenders. In this case, the loan is not forwarded to the bad entrepreneurs in period 2. Hence, with this added informational advantage the moneylender in the captive segment can avoid taking any risks when forwarding loans in the second period. They also can end up charging exploitative rates of interest in both periods being the sole lender. The main results for when only the moneylender is operating the captive segment can be summarized

in the following lemma:

Lemma 1: *The moneylenders in the captive segment in the absence of MFI offers a loan contract at the beginning of period 1 to all agents:* {1, R - e(1 - ρ) - b - 1} *where 1 unit of capital is loaned at a rate of interest* r_{C1} = R - e(1 - ρ) - b - 1. *This extracts all surplus from the agents. Further, in period 2, loans are extended to only good entrepreneurs via the contract* {1, R - b - 1} *where 1 unit of capital is loaned at the interest rate* r_{C2} = R - b - 1. *Borrowers will earn no surplus.*

Proof: The moneylender is a profit maximiser and therefore his objective function in the first period would be:

$$Maximise_{r_{C1}} r_{C1}$$

subject to:

$$\rho[R - r_{C1} - 1] + (1 - \rho)[R - e - r_{C1} - 1] \geq b \tag{1}$$

$$r_{C1} \geq B \tag{2}$$

(1) is the agent's incentive compatibility constraint (IC) and (2) is the moneylenders' participation constraint (PC). Since agents do not have any other source of borrowing, the moneylender would optimise by equalizing the IC constraint and therefore r_{C1} = R - e(1 - ρ) - b - 1.

In the second period, the moneylenders in the captive segments will have information regarding the type of the borrower. From Assumptions 2 and 3 they would be aware that the bad entrepreneurs would have no incentive to invest and would always divert the loan capital to earn private benefit. Therefore, moneylenders would extend loans to only the good entrepreneurs such that the moneylenders,

$$Maximise_{r_{C2}} r_{C2}$$

subject to:

$$R - r_{C2} - 1 \geq b \tag{3}$$

$$r_{C2} \geq B \tag{4}$$

Again, the moneylenders would optimise by equalizing the constraint and charging r_{C2} = R - b - 1. The participation constraint for the moneylender is satisfied as long as Assumption 4 holds. □

3.3 Non-captive Segment

In the non-captive segment both moneylenders are operating and the agent is free to choose from which moneylender she will take the loan from. Further, in the non-captive segment, the moneylenders do not possess the informational advantage that they do in their own captive segments. They cannot separate out the good entrepreneurs from the bad type at the beginning of period 2. Therefore, in this segment both moneylenders are in competition with each other to capture the market and since they cannot separate out the types, both good and bad entrepreneurs will approach them for loans in the second period. However, recall, as in the captive segment, moneylenders here can enforce repayment in case the borrowed capital is invested.

Lemma 2: *The moneylenders in the non-captive segment in the absence of MFI extends a loan contract at the beginning of period 1 to all agents:* {1, B} *, where 1 unit of capital is loaned at a rate of interest* r_{NC1} = B. *In period 2, if* ρ(R - b) - 1 $\geq$ B , *loans are extended via contract*: {1, $\frac{B+1}{\rho}$ - 1} *where 1 unit of capital is loaned at the interest rate* $r_{NC2} = \frac{B+1}{\rho}$ - 1.

Proof: At the beginning of period 1, moneylenders would have the following objective function:

$$Maximise_{r_{NC1}} r_{NC1}$$

subject to:

$$\rho[R - r_{NC1} - 1] + (1 - \rho)[R - e - r_{NC1} - 1] \geq b \tag{5}$$

$$r_{NC1} \geq B \tag{6}$$

Condition (5) is the agent's incentive compatibility constraint (IC) and (6) is the moneylenders' participation constraint (PC). Due to competition between the two moneylenders, each moneylender will be interested to undercut the rate of interest in order to attract borrowers. This process would continue till the moneylenders are operating at cost. Therefore, r_{NC1} = B. The agent's IC would be satisfied by Assumption 4.

At the beginning of period 2, the moneylenders know that both good as well as bad entrepreneurs will be seeking loans. Further, the moneylenders cannot offer a separating contract as the bad moneylenders would be willing to take up the loan at any rate of interest with the intention of diverting it to earn her private benefit. Hence, the objective function for moneylenders become:

$$Maximise_{r_{NC2}} r_{NC2}$$

subject to:

$$R - r_{NC2} - 1 \geq b \tag{7}$$

$$\rho(r_{NC2}) - (1 - \rho) \geq B \tag{8}$$

The IC constraint is only taken for the good entrepreneur so that she is not motivated to divert. The bad entrepreneur always diverts. Again, due to competition between the two moneylenders, each moneylender will be interested to undercut the rate of interest in order to attract borrowers. This would continue till the moneylenders are operating at cost and their participation constraints are satisfied with equality. Therefore, $r_{NC2} = \frac{B+1}{\rho}$ - 1. At this rate of interest, the agent's IC is satisfied if ρ(R - b) - 1 $\geq$ B. □

From the above discussion we arrive at our first proposition:

Proposition 1: *In the absence of the MFI an equilibrium exists whereby, in the captive*

segment the monopolistic moneylender will set rate of interest as r_{C1} = R - e(1 - ρ) - b - 1 *and* r_{C2} = R - b - 1 *in the first and second period respectively. In the non-captive segment, the rate of interest charged by both moneylenders will be* r_{NC1} = B *in the first period and conditional on cost of capital being sufficiently low, i.e.,* ρ(R - b) - 1 $\geq$ B, *the moneylender will operate in the second period in the non-captive segment and charge* $r_{NC2} = \frac{B+1}{\rho}$ - 1. *Based on this the payoff for the enterpreneur at the beginning of the game at t = 0, would be:*

In the captive segment: $L_{ML_C} = \delta$b + δ^2 [ρb + (1 - ρ)u]

In the non-captive segment: $L_{ML_{NC}}$= δ[R - 1 - B - (1 - ρ)e] + δ^2 [ρ(R - $\frac{B+1}{\rho}$)+(1 - ρ)b]

Also, payoff of the entrepreneur in the non-captive segment is greater than captive segment from the entrepreneur's IC condition in the second period in the non-captive segment and Assumption 4.

3.4 Comparison between rates of interest in different segments

The rate of interest charged in each of the segments in each period can be summarised in Table 2:

Table 2: Rate of interest charged in captive vs non-captive segments

Time Period	**Captive Segment (C) rate of interest**	**Non-captive segment (NC) rate of interest**	**Difference (C-NC)**
t = 1	R - e(1 - ρ) - b - 1	B	R - e(1 - ρ) - b - 1 -B
t = 2	R - b - 1	$\frac{B+1}{\rho}$ - 1	R - b - $\frac{B+1}{\rho}$

From Assumption 4 we know that in period 1, the rate of interest charged in the captive segment is greater than that charged in the non-captive segment. Therefore, the difference (C-NC) is positive. In period 2, we see that interest rates across both segments increases.

In the captive segment, this is due to moneylenders only extending loans to the good entrepreneur and therefore having more surplus to extract. In the non-captive segment both moneylenders remain uninformed about the type of entrepreneur and therefore extend loans to both types. They end up charging more interest rate as they undertake a certain degree of risk by serving both good and bad entrepreneurs as compared to the case when they are informed about the type of the entrepreneur and extend loans only to good entrepreneur who will always invest. From proposition 1, we find that the moneylenders operate in the non-captive segment in the second period provided their cost of capital is sufficiently low i.e., $\rho(R-b)-1 \geq B$. This implies that the rate of interest charged in the non-captive segment is again, lower than that charged in the captive segment.

Remark 1: *In both periods, the rate of interest charged in the captive segment is higher than that charged in the non-captive segment. This can be attributed to the monopoly power and informational advantage held by moneylenders in their own captive segments.*

4 Only MFI operating

From only moneylenders operating we move on to the case when only microfinance institution operates in the market. The microfinance institution does not possess any informational advantage or enforcement advantage. However, it does possess a cost advantage over the moneylenders. The MFI therefore does not distinguish between captive or non-captive segments and lends to all segments at the same rate of interest.

The MFI, in order to mitigate the moral hazard problem posed in this model demands a mandatory savings amount (S) from the borrowers at the end of the first period to be held as collateral against the loan forwarded by the MFI at the beginning of the second period. The MFI in turn provides a rate of interest on this amount saved with itself. The savings in this case not only serves as a means to assuage any hidden actions such as diverting, it also serves as a means to the borrower to transfer wealth from period 1 to period 2. This is a

crucial feature of our model that the MFI is the only channel of transferring wealth from the first to the second period. In reality, MFIs often act as a bank to deposit savings in rural economies as well as a lending institution. This increases the interactions between the MFI and borrowers, improves trust between the two entities and reduces chances of voluntary defaults. Further the saving with the MFI improves financial security and might lead to poverty reduction (Bergsma (2011) and Tavanti (2013)).

The MFI is a welfare maximiser unlike the moneylenders. Hence, it will seek to maximise the payoff of the agents while breaking even itself. Therefore, the MFI would offer a two-period loan contract: $\{1,\ r_b,\ \text{S},\ 1,\ r_s\}$ where one unit of capital loan is extended by the MFI at the beginning of the first period against a rate of interest r_b. In order to obtain the one-unit loan in the second period, all agents must save a mandatory amount S with the MFI in addition to paying back the loan and interest amount for the first period. At the end of period 2, the agent pays the loan back along with interest r_b to retrieve the amount saved along with interest r_s on the saved amount.

4.1 Timeline

The following are the sequence of events and outcomes for the case when only MFI is operating. We define this game as G^I:

At time period t=0,

Stage 1: The MFI offers either a pooling or a separating two-period contract. All agents accept this contract as they are motivated to find out their own type as per Assumption 1.

At time period t=1,

Stage 2: Agents choose to invest or divert the loan funds and returns are realised based on investment having taken place. If diversion takes place, the agent gets her private benefit in period 1 and settles for her outside option in period 2. If investment is done, only agents learn their own type. MFI remains uninformed.

Stage 3: At the end of t=1, agents choose to repay or default on the loan. If there is default,

then the agent is not forwarded a loan in the next period and would have to settle for her outside option in period 2. If agents choose to repay the loan and submit the mandatory savings amount with the MFI, they receive another loan in the next period.

At time period t=2,

Stage 4: In case the agent chose to repay the loan and save with the MFI at the end of period 1, she receives another loan at the beginning of the second period. A bad agent will always divert this loan and obtain her private benefit. A good agent will invest the borrowed capital in t=2.

Stage 5: At the end of period 2, if investment has taken place, agents decide whether to repay or voluntarily default on the loan. If they default, they forgo the savings amount kept with the MFI. If they choose to repay, then they received back their savings along with interest.

The stages can be represented by Figure 3.

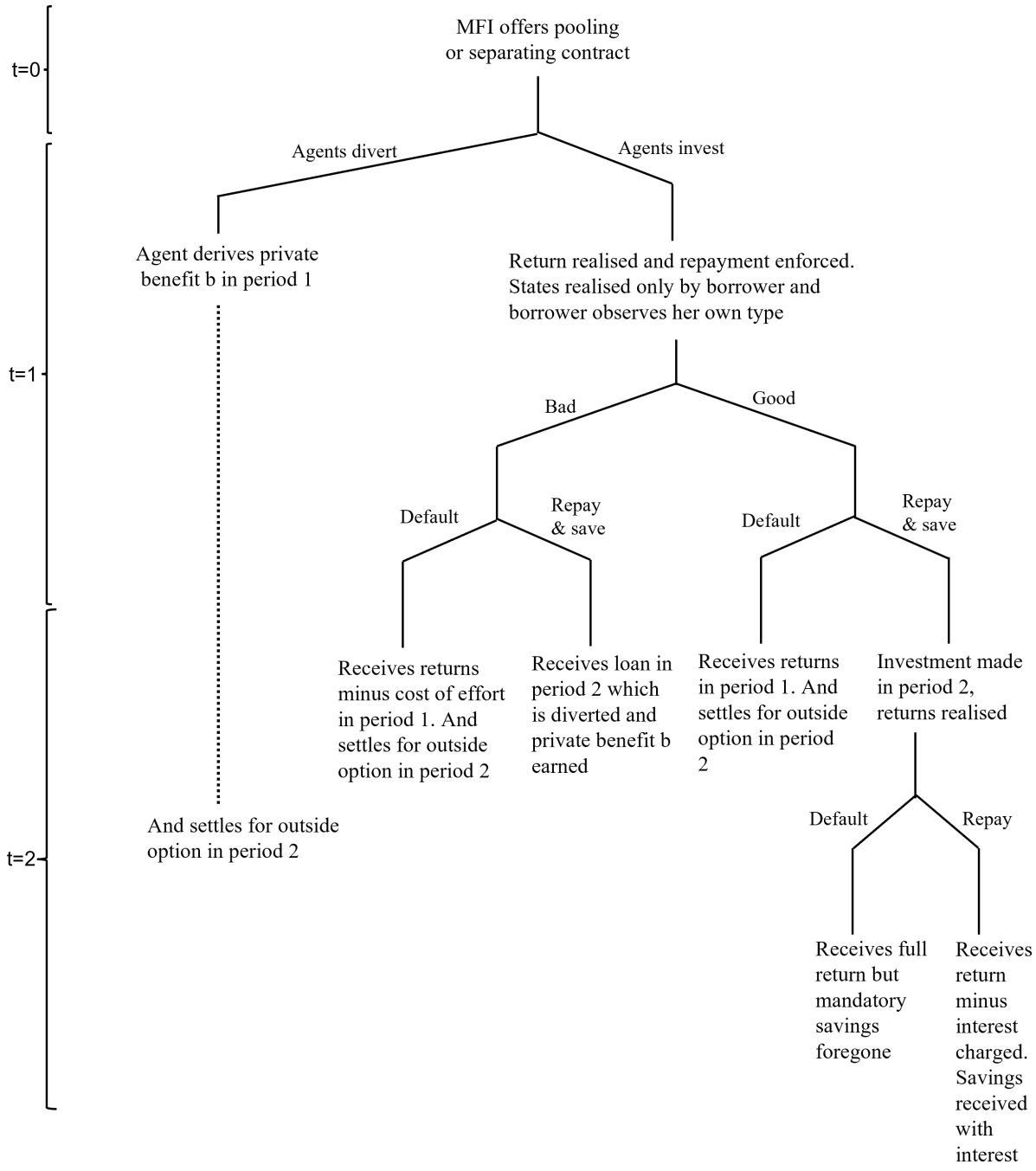

Figure 3: Brief sketch of the game: only MFI operating G^I

Lemma 3: *The MFI has to set r_b, r_s and S such that it is incentive compatible for the good entrepreneur to fulfil her contract. Therefore r_b, r_s and S should be such that, to avoid a default in the last period, $(1 + r_s)S > 1 + r_b$ and to avoid a default at the end of period 1, $\delta[R - u] + \delta r_s S > (1 + \delta)(1 + r_b) + (1 - \delta)S$*

Proof: Under this contract, the payoff to the good entrepreneur at the end of period 2 depends on his decision to repay or to default.

Payoff, if she repays the loan = R - 1 - r_b + (1 + r_s)S

Payoff if she defaults = R

To make repayment by the good borrower incentive compatible,

R < R - 1 - r_b + (1 + r_s)S

Or,

$$(1 + r_s)S > 1 + r_b \tag{9}$$

At the end of period 1, the good entrepreneur also needs to make a similar decision:

Payoff from defaulting = R + δu

Payoff from continuing and fulfilling the contract = R - 1 - r_b - S + δ[R - 1 - r_b + (1 + r_s)S]

Again, to make it repaying incentive compatible,

R + δu < R - 1 - r_b - S + δ[R - 1 - r_b + (1 + r_s)S]

Or,

$$\delta[R - u] + \delta r_s S > (1 + \delta)(1 + r_b) + (1 - \delta)S \tag{10}$$

Similarly, the bad entrepreneur's payoff depends on whether he chooses to reveal his type or pretend to be a good E. This decision is taken at the end of t = 1.

At t = 1, payoff from revealing type = R - e + δu

At t = 1, payoff from mimicking good E = R - e - 1 - r_b - S + δb. □

In this section, we establish the incentive compatibility constraints for the good entrepreneur. These must be fulfilled by the MFI contract as the objective of the MFI is to at least cater to the capital needs of the good entrepreneurs. We also establish payoffs for the bad entrepreneur in both cases where either she reveals her type or pretends to be a good entrepreneur. This would then be the basis for formulating a pooling contract or a separating contract from the perspective of the MFI.

4.2 Pooling Equilibrium

The MFI can choose to cater to both good and bad entrepreneurs instead of separating. If the MFI chooses to induce such a pooling equilibrium, then it would set r_b, r_s and S such that it is better for the bad type agent to not reveal its type and to induce the bad type agent to also accept the contract.

Lemma 4: *A pooling equilibrium exists if R - 2 - e(1 - ρ) > 0 and δb - δu > 2. Under such a pooling equilibrium, S $\rightarrow$ 0,$r_b^* = 1$ and as S$\rightarrow$ 0, no agent will have an incentive to repay loans in the last period and would default voluntarily. Payoff for the agents at t = 0 under this equilibrium is:*

$L_p = \delta$[R - 2 - e(1 - ρ)] + δ^2[ρR + (1 - ρ)b].

Proof: Under a pooling equilibrium the MFI sets r_b, r_s and S such that it is better for the bad type agent to not reveal its type. Therefore,

R - e + δu < R - e - 1 - r_b - S + δb

Or,

$$S < \delta b - \delta u - 1 - r_b \tag{11}$$

The objective of the MFI is to maximise the welfare of the agents while breaking even itself. Hence, it will:

$$Maximise\, \delta[R - (1 + r_b) - S - e(1 - \rho)] + \delta^2[\rho(R - (1 + r_b) + (1 + r_s)S) + (1 - \rho)b] = L$$

Subject to its break-even constraint:

$$r_b + (1 - \rho)S + \rho r_b = (1 - \rho) + \rho r_s S \tag{12}$$

And (11)

The MFI breaks even by equating the rate of return it receives from both good and bad agents in the first period, the rate of return from only good agents in the second period and

the savings amount forgone by the bad agents with the value loaned to the bad agents who default in the second period and the rate of interest on the saved amount provided by the MFI to the good agents.

From the breakeven condition, we get: $S = \frac{(1+\rho)r_b+\rho-1}{\rho r_s-1+\rho}$

And S $\geq$ 0 if $r_s \geq \frac{1-\rho}{\rho}$ and $r_b \geq \frac{1-\rho}{1+\rho}$

Plugging the value of savings from the break-even constraint into (11) we get:

$r_s > \frac{(1-\rho)(\delta b-\delta u)+2\rho r_b+2\rho-2}{\rho(\delta b-\delta u-1-r_b)}$

From the objective function, $\frac{\Delta L}{\Delta r_b} < 0$ and $\frac{\Delta L}{\Delta r_s} > 0$ as $\delta < 1$. Since objective function decreases in r_b, MFI would set r_b as low as possible. So, $r_b = \frac{1-\rho}{1+\rho}$ and $S = 0$. However, as $S = 0$ no agent will have incentive to repay loan in period 2. From MFI's breakeven constraint, $r_b^* = 1$ and S = 0. Therefore, at t = 0, the payoff for the agents under a pooling equilibrium is:

$L_p = \delta$[R - 2 - e(1 - ρ)] + δ^2[ρR + (1 - ρ)b]

According to this payoff function, the first period payoff has to be greater than zero to sustain this equilibrium. Thus, R - 2 - e(1 - ρ) > 0. Further, to ensure (11) holds, δb - δu > 2.

From Lemma 3, to ensure that the contract fulfils the good agent's incentive compatibility constraint at the end of period 1, δR - δu > 2 . This is satisfied if δb - δu > 2 holds as R > b. The project returns must be greater than the private benefit from diverting. This is directly implied by Assumption 1.

At the end of period 2, the good agent's incentive compatibility constraint need not be satisfied as under this equilibrium, both good and bad agents will choose to default.

This implies that under a pooling equilibrium, in order to keep rate of borrowing as low as possible to benefit the agents, the MFI will charge a rate of interest in the first period equal to the loan amount in the second period. This is the only way the MFI can safeguard its risks while charging zero mandatory savings as collateral. □

The intuition behind this result comes from the fact that the MFI undertakes a certain

degree of risk when forwarding loans to both good and bad entrepreneurs knowing full well that the bad entrepreneurs will divert the borrowed capital for private use. In order to save itself from facing defaults and running into losses, the MFI charges an interest rate in the first period that is exactly equal to the value of loan forwarded in the next period. In the absence of a savings institution, the entrepreneurs consume their earnings in each period and therefore cannot themselves fund their next period ventures. Hence, the MFI in this case essentially facilitates the transfer of wealth from one period to the next, even though saving is not mandatory by contract design.

4.3 Separating Equilibrium

Under a separating equilibrium, the MFI will try to screen out the bad borrowers from the good ones at the end of period 1. This is done so that loans are extended to only good borrowers in period 2. If the MFI chooses to induce such a separating equilibrium, then it would set r_b, r_s and S such that it is better for the bad type agent to reveal its type.

Lemma 5: *Separating equilibrium exists if* $R > \frac{(\rho b - \rho\delta b + \rho\delta u + 1 + \rho)}{\rho}$ *and* $b - u > \frac{(1+\rho)}{\rho\delta}$. *Under such an equilibrium,* $S = \frac{2\rho r_b^* + \rho - 1}{\rho r_s^*}$, *and* $r_s^* = \frac{2\rho r_b^* - 1 + \rho}{\rho(\delta b - \delta u - 1 - r_b^*)}$. *Thus, multiple combination of values of* r_s *and* r_b *can be set by the MFI so long as* $r_s^* = \frac{2\rho r_b^* - 1 + \rho}{\rho(\delta b - \delta u - 1 - r_b^*)}$ *and* $r_b^* \geq r_s^*$. *Under this equilibrium, bad agents will break the contract with the MFI at the end of period 1 by defaulting and opt for their outside option in period 2 whereas the good agents will continue and fulfil their contracts with the MFI. Payoff for the agents at t = 0 under this equilibrium is:* $L_s = \delta[R - (\delta b - \delta u)] + \delta^2[R + (\delta b - \delta u) - 1 - \frac{1}{\rho}]$

Proof: Under a separating equilibrium the MFI sets r_b, r_s and S such that it is better for the bad type agent to reveal its type at the end of period 1. Therefore,

R - e + δu > R - e - 1 - r_b - S + δb

Or,

$$S \geq \delta b - \delta u - 1 - r_b \tag{13}$$

Since the bad agents default on their loans at the end of first period and are not eligible for loans in the second period, the MFI's objective will be to maximise the good agent's payoff while breaking even itself. Therefore, the objective function for the MFI is to:

$$Maximise\, \delta[R-(1+r_b)-S]+\delta^2[R-(1+r_b)+(1+r_s)S]=L$$

Subject to its break-even constraint:

$$\rho r_b+\rho r_b=1-\rho+\rho r_s S \tag{14}$$

And (13)

The MFI breaks even by equating the rate of return it receives from good agents in both periods with the loss it makes by offering loan to the bad agents in period 1 and the rate of interest on savings it has to transfer to the good agents at the end of period 2.

From the break-even constraint we get: $S=\frac{2\rho r_b+\rho-1}{\rho r_s}$

And $S\geq 0$ if $r_b\geq\frac{1-\rho}{2\rho}$ for all positive values of r_s

Plugging the value of savings from the break-even constraint into (13) we get:

$r_s\leq\frac{2\rho r_b-1+\rho}{\rho(\delta b-\delta u-1-r_b)}$

From the objective function, $\frac{\Delta L}{\Delta r_s}>0$ and $\frac{\Delta L}{\Delta r_b}<0$ as $\delta<1$. Since objective function increases in r_s, MFI would set r_s as high as possible. Therefore, the highest rate of savings the MFI can set is:

$r_s=\frac{2\rho r_b-1+\rho}{\rho(\delta b-\delta u-1-r_b)}$

When we insert this function of r_s into the objective function, we get:

$L_s=\delta[R-(\delta b-\delta u)]+\delta^2[R+(\delta b-\delta u)-1-\frac{1}{\rho}]$

Since updated objective function is a function of parameters, MFI can set multiple combinations of r_s and r_b so long as:

$r_s^*=\frac{2\rho r_b^*-1+\rho}{\rho(\delta b-\delta u-1-r_b^*)}$ and $r_b^*\geq r_s^*$

From Lemma 3, to ensure that the contract fulfils the good agent's incentive compatibility

constraint at the end of period 2, $b-u > \frac{(1+\rho)}{\rho\delta}$. To ensure that the good agent has no incentive to default at the end of period 1, $\delta[R-u] + \delta r_s S > (1+\delta)(1+r_b) + (1-\delta)S$. Substituting the values for r_s^*, r_b^* and S we get:

$R > \frac{\rho b - \rho\delta b + \rho\delta u + 1 + \rho}{\rho}$ □

$This implies that the total return from the project must be sufficiently high for the good type to bear the initial co$

4.4 Pooling vs Separating Equilibrium

Given the equilibrium values of payoff of the entrepreneur under pooling and separating equilibrium, the MFI being a welfare maximiser would have to choose which equilibrium to induce.

Lemma 6: *The MFI would induce a separating equilibrium if the project returns are high enough, or* $R > \frac{\delta(2-\delta-\rho)b - \delta(1-\delta)u - (1-\rho)e + \frac{\delta}{\rho} + \delta - 2}{\delta(1-\rho)}$ *otherwise, a pooling equilibrium is induced by the MFI.*

Proof: The agent's payoff at t=0 under a separating equilibrium contract must be greater than the payoff under a pooling equilibrium for the MFI to induce a separating equilibrium.

$L_p = \delta$[R - 2 - e(1 - ρ)] + $\delta^2[\rho$R + (1 - ρ)b]

$L_s = \delta[R - (\delta b - \delta u)] + \delta^2[R + (\delta b - \delta u) - 1 - \frac{1}{\rho}]$

$L_s > L_p$ if

$R > \frac{\delta(2-\delta-\rho)b - \delta(1-\delta)u - (1-\rho)e + \frac{\delta}{\rho} + \delta - 2}{\delta(1-\rho)}$ □

In figure 4, pooling equilibrium is the welfare superior outcome under the curve BCD. In regions above BCD, ($R = \frac{\delta(2-\delta-\rho)b - \delta(1-\delta)u - (1-\rho)e + \frac{\delta}{\rho} + \delta - 2}{\delta(1-\rho)}$) separating is welfare superior. However, in regions below EFG ($R = \frac{\rho b - \rho\delta b + \rho\delta u + 1 + \rho}{\rho}$) the incentive compatibility constraint of the good type is not satisfied in order to induce a separating equilibrium. Therefore, in the shaded region A, though a separating equilibrium is welfare superior, it cannot be induced when the MFI is acting alone as the cost of separating is too high for the good entrepreneur to bear and the MFI is forced to pool.

The discussion in this section can be effectively summarised under the following proposition:

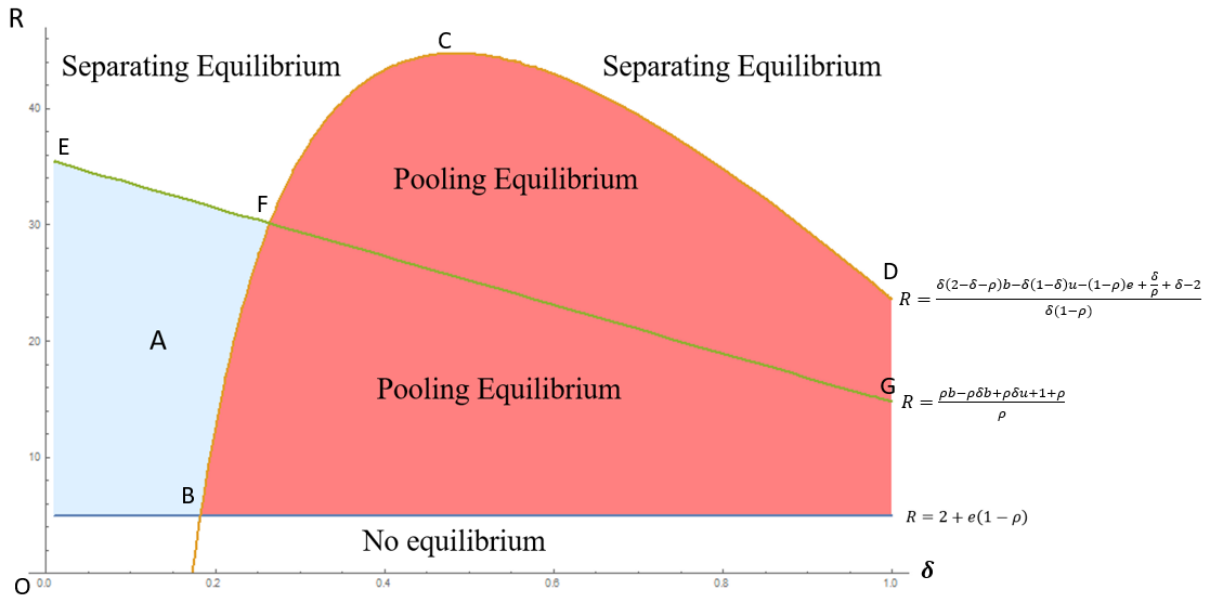

Figure 4: Equilibrium characteristics for different values of project return (R)
We have used Wolfram Mathematica to plot the diagram with the following values: $\rho = 0.75$, $u = 13.2$, $b = 32$ and $e = 9$

Proposition 2: *The MFI can choose between a pooling and a separating equilibrium. Under a pooling equilibrium,* $r_b^* = 1$, $S^* = 0$. *In the absence of a collateral on loans provided, the MFI saves itself from incurring a loss by financing the agents in the second period through the rate of interest charged in the first period. Under this equilibrium, both agents default at the end of period 2. A pooling equilibrium exists if* R - 2 - e(1 - ρ) > 0 *and* δb - δu > 2. *Alternatively, there are multiple separating equilibria where multiple combinations of values of* r_s *and* r_b *can be set by the MFI so long as* $r_s^* = \frac{2\rho r_b^* - 1 + \rho}{\rho(\delta b - \delta u - 1 - r_b^*)}$ *and* $r_b^* \geq r_s^*$. *Under such an equilibrium the bad agents are incentivised to default on their loans at the end of the first period and loans are only provided to good agents in the second period. Again, such an equilibrium exists if* $R > \frac{(\rho b - \rho\delta b + \rho\delta u + 1 + \rho)}{\rho}$ *and* $b - u > \frac{(1+\rho)}{\rho\delta}$.

Furthermore, the MFI chooses to induce a separating equilibrium if the project value is high enough, i.e.,

$R > \frac{\delta(2-\delta-\rho)b-\delta(1-\delta)u-(1-\rho)e+\frac{\delta}{\rho}+\delta-2}{\delta(1-\rho)}$

5 MFI and moneylenders co-exist

Finally, we arrive at the case where MFI and moneylenders co-exit and there is competition between the two in the captive and the non-captive segments. From the outset, we know that without the MFI, moneylenders in their captive segment will exert their monopoly power and extract all surplus from the agents. So, the entry of MFI into the market should definitely improve the payoff of the agents in the captive segment. In the non-captive segment, the moneylenders are already in competition with each other to capture the market before the MFI arrives. Thus, they are operating at cost. Upon the arrival of the MFI, the agents are at least as better off with its presence than they were before. Payoffs for agents are also dependant on whether the MFI induces a pooling or a separating equilibrium.

The MFI offers a two-period contract. By this virtue itself, the agent cannot approach the MFI for a loan at the beginning of period 2 if she had not taken a loan from the MFI in the first period.

In the captive segment, the moneylenders learn the type of the agent at the end of period 1 and only extend loans to the good entrepreneur in period 2. Thus, in the captive segment at the beginning of the game the agent can either approach the moneylender or the MFI for a loan. If she chooses the moneylender, then she cannot approach the MFI in the second period for a loan. If she chooses the MFI at the beginning of the first period then she has no incentive to switch to the moneylender in the second period as the moneylender would charge a high rate of interest that would extract all her surplus. Therefore, agents do not switch between lenders between the two periods.

In the non-captive segment, the agent, at the start of the game can choose between the two moneylenders or the MFI to approach for a loan. If she chooses either of the moneylenders for the first period loan, then she cannot switch over to the MFI for the second period. She also cannot switch over to the other moneylender as that would send a signal that the agent is a defaulter and the other moneylender would refuse to serve the agent. Similarly, if she chooses the MFI in the first period, she cannot approach either of the moneylenders for the

second period loan. They would be certain that the agent is of bad type and not extend the loan.

Therefore, in both captive and non-captive segments, agents cannot switch between lenders from the first period to the second period. The above discussion can be summarised in the following remark:

Remark 2: *Agents cannot switch from one lender to another in between the two periods. More precisely, if the agent takes a loan from the moneylender in the first period, she will have to take a loan from the same moneylender in the second period if she chooses to apply for a loan. Similarly, if an agent engages with the MFI for the first period loan, then the second period loan must be from the MFI, if she chooses to apply for it.*

5.1 Timeline

When both MFI and moneylenders co-exist, we can look at the sequence of events by combining the above two cases, i.e., when only moneylenders exist and when only MFI exists. There is only one additional stage at time period t=0; the MFI first offers either a pooling or a separating two-period contract based on lemma 6 and in the next stage the moneylenders observe the MFI rates, compete and offers single period loan contracts in the captive as well as the non-captive segments. From the point that the agent makes a choice between the MFI and moneylender contract, the game branches out in either of the scenarios explained in sections 1 and 2 and hence proceeds as G^I and G^M_C or G^M_{NC}. The entire game can be represented by Figure 5 for the captive segment and Figure 6 for the non-captive segment.

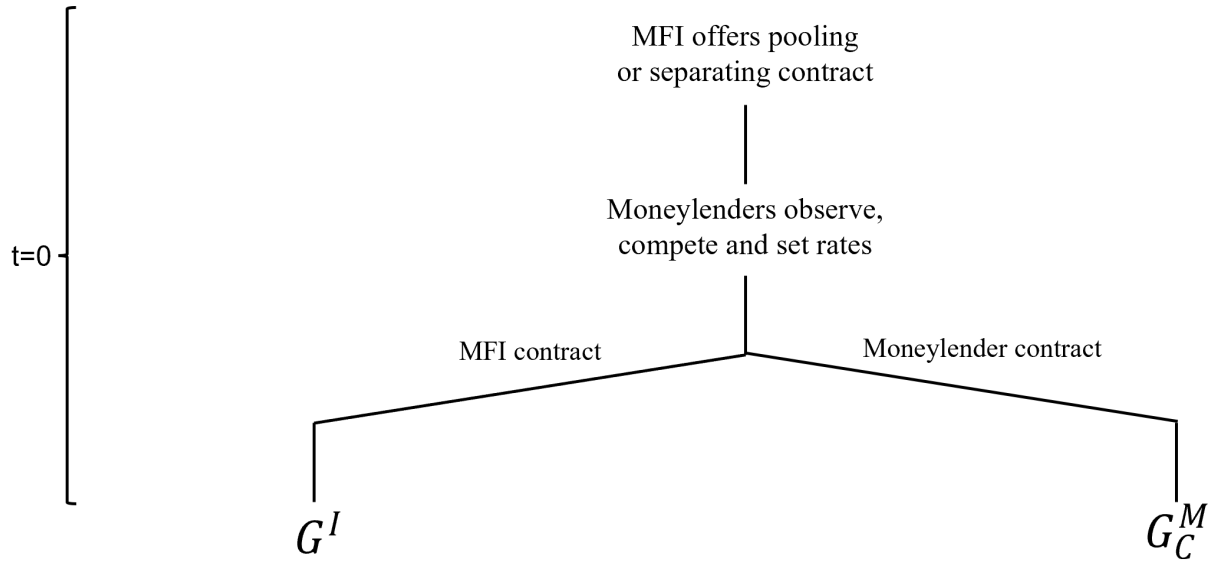

Figure 5: Brief sketch of the game: captive segment

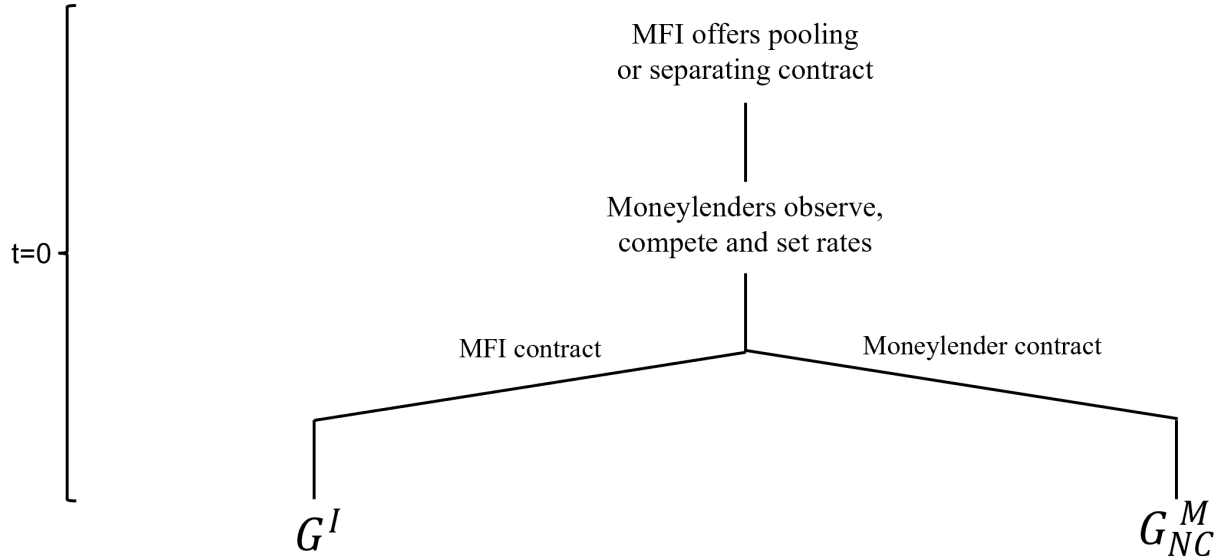

Figure 6: Brief sketch of the game: non-captive segment

Let us define the following terms for the pooling equilibrium analysis:

Definition 1: $X_p = \frac{1-\delta}{1+\delta}$, $Y_p = 1-\delta[\rho(R-b)+(1-\rho)(b-u)]$ and $R_p = \frac{2+(1+\delta)(1-\rho)u-(1+\delta)(1-2\rho)b}{\rho(1+\delta)}$

Now, equilibrium conditions under a pooling equilibrium in the presence of moneylenders can be stated under the following lemma:

Lemma 7: *When MFI sets a pooling equilibrium contract, if* $R < R_p$ *, there can be 3 scenarios:*

- $B \geq Y_p \geq X_p$ *: Moneylenders operate in neither captive nor non-captive segments*
- $Y_p \geq B \geq X_p$ *: Moneylenders operate only in the captive segment and not the non-captive segment*
- $Y_p \geq X_p \geq B$ *: Moneylenders operate in both captive and non-captive segment*

Alternatively, if $R > R_p$*, there can be 3 scenarios:*

- $B \geq X_p \geq Y_p$ *: Moneylenders operate in neither captive nor non-captive segments*
- $X_p \geq B \geq Y_p$ *: Moneylenders operate only in the non-captive segment not the captive segments*
- $X_p \geq Y_p \geq B$ *: Moneylenders operate in both captive and non-captive segment*

Proof: The agent's payoff at t = 0 from the MFI contract under pooling equilibrium:

$L_p = \delta$[R - 2 - e(1 - ρ)] + δ^2[ρR + (1 - ρ)b]

That from the contract offered by the moneylenders in the non-captive segment is:

$L_{ML_{NC}} = \delta$[R - 1 - B - (1 - ρ)e] + δ^2 [ρ(R - $\frac{B+1}{\rho}$)+(1 - ρ)b]

Now, both these contracts are provided when MFI and moneylenders are operating at cost. Therefore, they cannot make a better offer to counter each other. Whether or not the presence of the MFI pushes the moneylenders out of the non-captive segment depends on if $L_p > L_{ML_{NC}}$.

δ[R - 2 - e(1 - ρ)] + δ^2[ρR + (1 - ρ)b] > δ[R - 1 - B - (1 - ρ)e] + δ^2 [ρ(R - $\frac{B+1}{\rho}$)+(1 - ρ)b]

Or,

B > $\frac{1-\delta}{1+\delta}$

The RHS has been defined by X_p.

Now, in the captive segment, the moneylender is initially extracting all surplus through the rate he charges. When the MFI enters, the moneylender has capacity to reduce the rate he charges in order to compete with the MFI. Moneylender would compete with MFI with the rate of interest offered in the first period. In the second period moneylender will offer a

rate that would extract all surplus as the entrepreneur cannot switch to the MFI. Thus, the entrepreneur will charge a rate that equalizes the agent's payoff with that he receives from the MFI contract.

Therefore, moneylender will set r_{C1} such that

$\delta r_{C1} = \delta - \delta^2[\rho(R-b) + (1-\rho)(b-u)]$

Or, $r_{C1} = 1 - \delta[\rho(R-b) + (1-\rho)(b-u)]$

The RHS has been defined by Y_p.

Now, $r_{C1} \geq B$ is the participation constraint for the moneylender. Therefore, $Y_p >$ B for the moneylender to operate in this market.

Comparing Y_p and X_p: $Y_p > X_p$ if

$1 - \delta[\rho(R-b) + (1-\rho)(b-u)] > \frac{1-\delta}{1+\delta}$

Or, $R < \frac{2+(1+\delta)(1-\rho)u-(1+\delta)(1-2\rho)b}{\rho(1+\delta)}$

Therefore, we have $Y_p > X_p$ if $R < \frac{2+(1+\delta)(1-\rho)u-(1+\delta)(1-2\rho)b}{\rho(1+\delta)}$ and $Y_p < X_p$ if $R > \frac{2+(1+\delta)(1-\rho)u-(1+\delta)(1-2\rho)b}{\rho(1+\delta)}$. Furthermore, if B $> X_p$, the moneylenders cannot compete with the MFI contract in the non-captive market as their cost of capital B would be too high. Similarly, the moneylenders cannot compete with the MFI in the captive segment if B $> Y_p$. From this we can derive the scenarios as stated in lemma. □

The following figure provides a visual representation of the regions of operation of the moneylenders and the MFI when the MFI offers a pooling equilibrium contract.[9]

In figure 7, in regions left of the vertical line, $Y_p > X_p$ and to the right, $Y_p < X_p$. Whether moneylenders operate in the captive or non-captive segments depends on the value of B.

Let us define the following terms for the separating equilibrium analysis:

Definition 2: $X_s = \frac{1}{1+\delta}[\delta b - \delta u - 1 - e(1-\rho)] - \frac{\delta}{1+\delta}[(1-\rho)R + b(\rho+\delta-1) - \delta u - \frac{1}{\rho}]$, $Y_s = [\delta b - \delta u - 1 - e(1-\rho)] - \delta[R + (\delta-\rho)b - (1+\delta-\rho)u - 1 - \frac{1}{\rho}]$ and $R_s = \frac{(\delta+2\rho+\delta\rho-1-\delta^2)b+(1+\delta^2-\rho-\delta\rho)u-(1-\rho)e+\frac{\delta}{\rho}+\delta}{\delta+\rho}$

Equilibrium conditions under a separating equilibrium in the presence of moneylenders

[9]Dotted line B represents a symbolic value of cost of capital B. Corresponding to that all scenarios explained above can be mapped across this line.

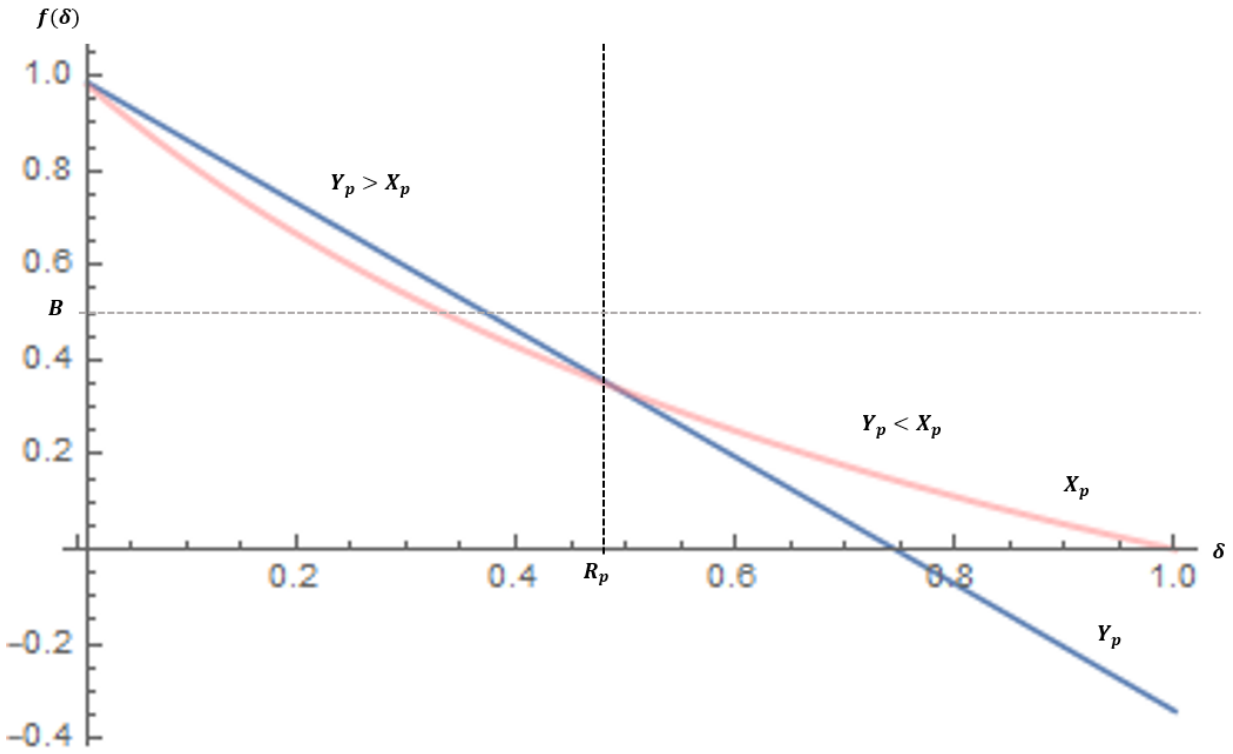

Figure 7: Moneylenders' regions of operation based on their cost of capital (B) under a pooling equilibrium

We have used Wolfram Mathematica to plot the diagram with the following values: $\rho = 0.09$, $u = 16.4$, $b = 17.4$ and $R = 22.2$

are stated under the following lemma:

Lemma 8: *When MFI sets a separating equilibrium contract, if $R < R_s$, there can be 3 scenarios:*

- $B \geq Y_s \geq X_s$ *: Moneylenders operate in neither captive nor non-captive segments*
- $Y_s \geq B \geq X_s$ *: Moneylenders operate only in the captive segment and not the non-captive segment*
- $Y_s \geq X_s \geq B$ *: Moneylenders operate in both captive and non-captive segment*

Alternatively, if $R > R_s$, there can be 3 scenarios:

- $B \geq X_s \geq Y_s$ *: Moneylenders operate in neither captive nor non-captive segments*

- $X_s \geq B \geq Y_s$ *: Moneylenders operate only in the non-captive segment not the captive segments*

- $X_s \geq Y_s \geq B$ *: Moneylenders operate in both captive and non-captive segment*

Proof: The proof is similar to that under the pooling equilibrium.

The agent's payoff at t = 0 from the MFI contract under separating equilibrium:

$L_s = \delta[R - (\delta b - \delta u)] + \delta^2[R + (\delta b - \delta u) - 1 - \frac{1}{\rho}]$

That from the contract offered by the moneylenders in the non-captive segment is:

$L_{ML_{NC}}$= δ[R - 1 - B - (1 - ρ)e] + δ^2 [ρ(R - $\frac{B+1}{\rho}$)+(1 - ρ)b]

Again, both these contracts are provided when MFI and moneylenders are operating at cost. Therefore, they cannot make a better offer to undercut each other. Whether or not the presence of the MFI pushes the moneylenders out of the non-captive segment depends on if $L_p > L_{ML_{NC}}$.

$\delta[R - (\delta b - \delta u)] + \delta^2[R + (\delta b - \delta u) - 1 - \frac{1}{\rho}] > \delta$[R - 1 - B - (1 - ρ)e] + δ^2 [ρ(R - $\frac{B+1}{\rho}$)+(1 - ρ)b]

Or, B > $\frac{1}{1+\delta}[\delta b - \delta u - 1 - e(1-\rho)] - \frac{\delta}{1+\delta}[(1-\rho)R + b(\rho + \delta - 1) - \delta u - \frac{1}{\rho}]$

The RHS has been defined by X_s. Hence, $B > X_s$

Like before, in the captive segment, the moneylender is initially extracting all surplus through the rate he charges. When the MFI enters, the moneylender has capacity to reduce the rate he charges in order to compete with the MFI. Moneylender would compete with MFI with the rate of interest offered in the first period. In the second period moneylender will offer a rate that would extract all surplus as the entrepreneur cannot switch to the MFI. Thus, the moneylender will charge a rate that equalizes the entrepreneur's payoff with that she receives from the MFI contract.

Therefore, moneylender will set r_{C1} such that

$\delta r_{C1} = \delta[\delta b - \delta u - 1 - e(1-\rho)] - \delta^2[R + (\delta - \rho)b - (1 + \delta - \rho)u - 1 - \frac{1}{\rho}]$

Or, $r_{C1} = [\delta b - \delta u - 1 - e(1-\rho)] - \delta[R + (\delta - \rho)b - (1 + \delta - \rho)u - 1 - \frac{1}{\rho}]$

The RHS has been defined by Y_s.

Now, $r_{C1} \geq$ B is the participation constraint for the moneylender. Therefore, $Y_s > B$ for the moneylender to operate in this market.

Comparing Y_s and X_s: $Y_s > X_s$ if

$[\delta b - \delta u - 1 - e(1-\rho)] - \delta[R + (\delta - \rho)b - (1 + \delta - \rho)u - 1 - \frac{1}{\rho}] > \frac{1}{1+\delta}[\delta b - \delta u - 1 - e(1-\rho)] - \frac{\delta}{1+\delta}[(1-\rho)R + b(\rho + \delta - 1) - \delta u - \frac{1}{\rho}]$

Or, $R < \frac{(\delta+2\rho+\delta\rho-1-\delta^2)b+(1+\delta^2-\rho-\delta\rho)u-(1-\rho)e+\frac{\delta}{\rho}+\delta}{\delta+\rho}$

Therefore, we have $Y_s > X_s$ if $R < \frac{(\delta+2\rho+\delta\rho-1-\delta^2)b+(1+\delta^2-\rho-\delta\rho)u-(1-\rho)e+\frac{\delta}{\rho}+\delta}{\delta+\rho}$ and $Y_s < X_s$ if $R > \frac{(\delta+2\rho+\delta\rho-1-\delta^2)b+(1+\delta^2-\rho-\delta\rho)u-(1-\rho)e+\frac{\delta}{\rho}+\delta}{\delta+\rho}$. Furthermore, if B $> X_s$, the moneylenders cannot compete with the MFI contract in the non-captive market as their cost of capital B would be too high. Similarly, the moneylenders cannot compete with the MFI in the captive segment if B $> Y_s$. From this we can derive the scenarios as stated in lemma. □

The following figure provides a visual representation of the regions of operation of the moneylenders and the MFI when the MFI offers a separating equilibrium contract.[10]

In figure 8, in regions left of the vertical line, $Y_s > X_s$ and to the right, $Y_s < X_s$. Whether moneylenders operate in the captive or non-captive segments depends on the value of B.

The above discussion along with lemmas 7 and 8 help us to state our results of this section:

Proposition 3: *Agents cannot switch from one lender to another in between the two periods. Further, regions of operation vis-à-vis captive and non-captive segments for the moneylenders and the MFI depends on (i) whether the MFI offers a pooling or a separating contract and (ii) the return from investment R in comparison to R_p (R_s) depending on whether a pooling (separating) contract is offered by the MFI and (iii) the cost of capital B for the moneylenders.*

5.2 Policy instruments

Next, we focus on the policy instruments available that can be useful in screening of borrowers and inducing a welfare optimizing equilibrium. Policies that aim to penalise borrowers for

[10]Dotted line B represents a symbolic value of cost of capital B. Corresponding to that all scenarios explained above can be mapped across this line.

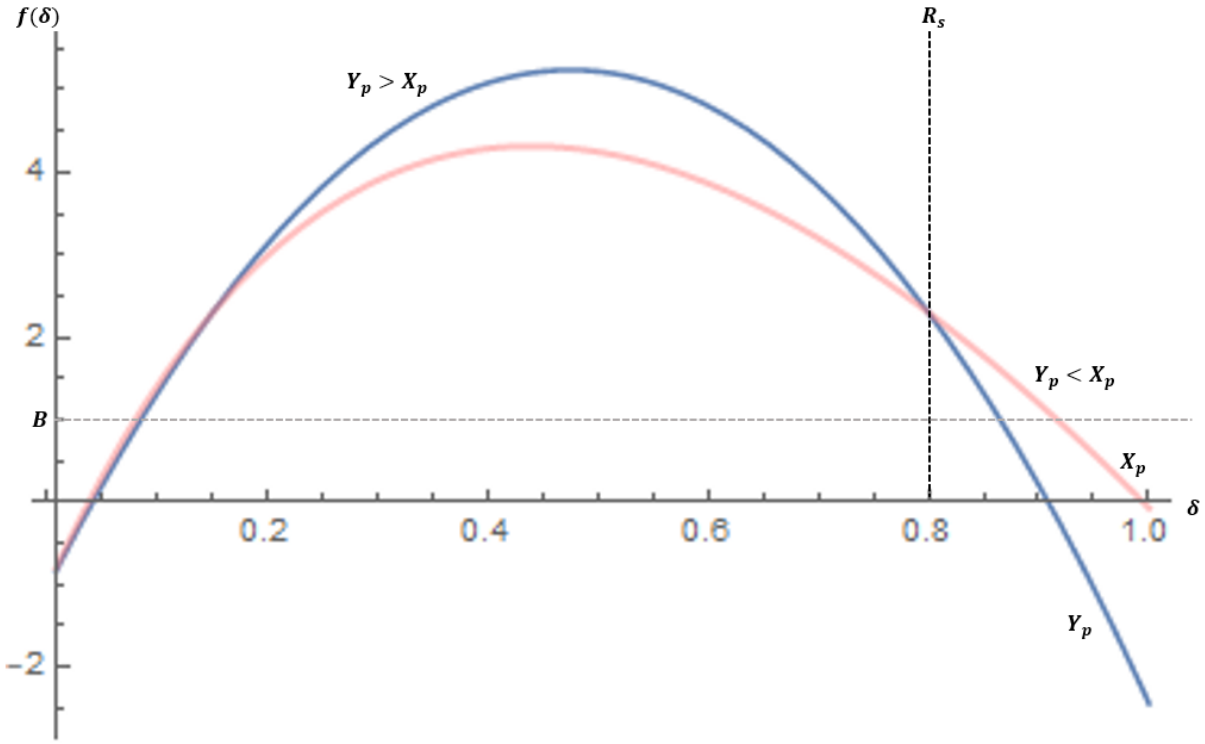

Figure 8: Moneylenders' regions of operation based on their cost of capital (B) under a separating equilibrium

We have used Wolfram Mathematica to plot the diagram with the following values: $\rho = 0.95$, $u = 2$, $b = 30$, $R = 32$ and $e = 2$

diverting can potentially lead to a situation where the MFI can screen borrowers more effectively. Welfare, as mentioned above denotes the payoff of the borrowers.

In our model we will proceed to find out whether this is true.

Lemma 9: *With a reduction in the benefit from diverting, it is unambiguously easier for the MFI to screen out the bad entrepreneurs from the good ones, so long as* $b - u > \frac{(1+\rho)}{\rho\delta}$.

Proof: To prove this, we shall return to the condition which the MFI uses to decide whether to induce a pooling or a separating equilibrium. The MFI chooses to induce a separating equilibrium if:

$$R > \frac{\delta(2-\delta-\rho)b-\delta(1-\delta)u-(1-\rho)e+\frac{\delta}{\rho}+\delta-2}{\delta(1-\rho)}$$

The coefficient of b is $\frac{\delta(2-\delta-\rho)}{\delta(1-\rho)}$. With $0 < \delta < 1$ and $0 < \rho < 1$, it is apparent that the coefficient of b is always positive. Therefore, with a reduction in b, the LHS falls and

it is easier to induce a separating equilibrium. However, from Lemma 5, we know that $b - u > \frac{(1+\rho)}{\rho\delta}$ for a separating equilibrium to be sustained. Thus, with a reduction in b, it is easier to induce a separating equilibrium so long as $b - u > \frac{(1+\rho)}{\rho\delta}$. □

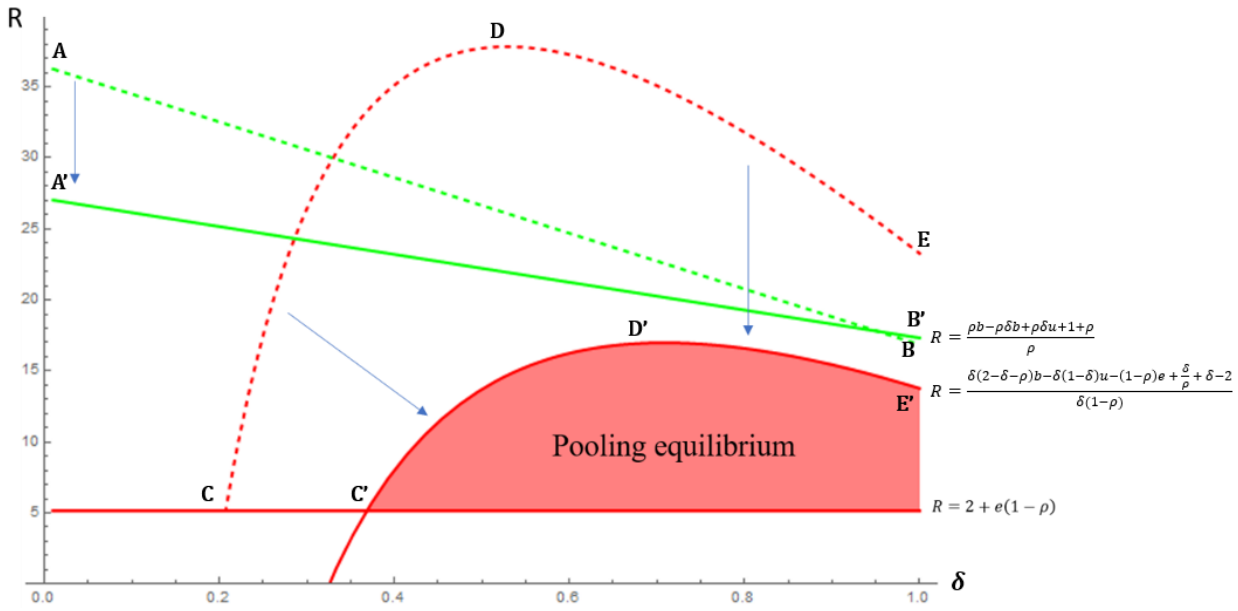

Figure 9: Change in equilibrium conditions with a decrease in private benefit from diversion (b)

We have used Wolfram Mathematica to plot the diagram with the following values: $\rho = 0.72$, $u = 14.8$, $b = 33$ and the shift from CDE to C'D'E' is due to the reduction in b to $b = 24$. Other parameters remaining constant.

In figure 9, chances of a pooling equilibrium decrease with a reduction in private benefit from diversion. The MFI is more easily able to separate the good agent from the bad one.

Next, we see whether there is any benefit in making information gathering easier for the moneylenders. Lack of information leads to moneylenders in the non-captive segment seeking higher rent as they need to be compensated for taking risk by lending to both good and bad agents. If information regarding the type of entrepreneur can be easily gathered in a costless manner, is society better off?

Lemma 10: *If the cost of gathering information in the non-captive segment is 0 and both moneylenders acquire information on the type of entrepreneur, then loan is extended for only*

productive purposes and at a lower rate of interest.

Proof: If moneylenders have access to knowledge regarding the type of entrepreneur in the second period, then loan would be forwarded only to good entrepreneurs. Therefore, resources would not be wasted for unproductive purposes by extending loans to the bad entrepreneurs who divert. Further, the competition between the moneylenders in the non-captive segment would confirm that both moneylenders operate at cost ($r_{NC2} = B$). Now, $B < \frac{B+1}{\rho} - 1$, so the rate of interest charged in the non-captive segment under free information is lower than when the moneylenders hold no informational advantage. From the moneylenders' perspective, before they could only operate in the non-captive segment in the second period if their cost of capital was sufficiently low, i.e., $\rho(R-b) - 1 \geq B$. This no longer would be a constraint and they would be able to operate so long as Assumption 4 is satisfied. □

Please refer to the discussion under lemma 6. We found that when $\frac{(\rho b - \rho\delta b + \rho\delta u + 1 + \rho)}{\rho} >$ R $> \frac{\delta(2-\delta-\rho)b - \delta(1-\delta)u - (1-\rho)e + \frac{\delta}{\rho} + \delta - 2}{\delta(1-\rho)}$, separating is the welfare superior equilibrium. However, the cost of separating is too high for the good entrepreneur to bear. In other words, the way the good entrepreneur can separate itself from the bad ones is by submitting the mandatory savings amount with the MFI. Now, if this amount is too large, then the good entrepreneur would have to forgo her present consumption by a large amount. This can disincentivise the good entrepreneur from submitting the mandatory savings amount. In such a case, even though separating leads to greater payoff for the agents, the MFI acting alone cannot induce this in this range. Since the moneylenders in the captive segment have access to information that the MFI does not, it might be possible to induce the separating equilibrium by reducing the cost of capital for the moneylenders.

The following lemma states the conditions under which the policymaker can achieve this welfare superior equilibrium by utilising the informational advantage possessed by local moneylenders.

Lemma 11: *When* $\frac{(\rho b-\rho\delta b+\rho\delta u+1+\rho)}{\rho} > R > \frac{\delta(2-\delta-\rho)b-\delta(1-\delta)u-(1-\rho)e+\frac{\delta}{\rho}+\delta-2}{\delta(1-\rho)}$ *the separating equilibrium is welfare superior to pooling. However, the MFI cannot induce that through contracting as the cost is too high for the good entrepreneur to signal its type. If this is the case, then in the non-captive segment, if B is decreased such that* $B = X_s$ *then the welfare superior separating equilibrium payoff can be achieved. In the captive region if the cost of capital for the moneylenders, B, is lowered by* $2+\delta(1-\rho)R+e(1-\rho)+(\delta+\delta\rho-\delta^2-\delta^2\rho)u-(2-\delta-\delta\rho)b-\delta-\frac{\delta}{\rho}$ ***conditional*** *on them setting an appropriate* r_{C1}*, given the rate charged by the moneylenders are observable and verifiable, then it is possible for the separating equilibrium payoffs to be induced, resulting in higher welfare.*

Proof: In the **non-captive segment**, the actual cost of capital can be such that either $B \geq X_p$ or $B < X_p$. If it is the former then the moneylender does not operate in this market as its cost is too high and the welfare inferior pooling equilibrium contract is opted by the agents. If it is the latter, then the moneylenders operate in the non-captive segment and charge a rate of interest that leads to agent's expected payoff at t = 0 being:

$L_{ML_{NC}}$= δ[R - 1 - B - (1 - ρ)e] + δ^2 [ρ(R - $\frac{B+1}{\rho}$)+(1 - ρ)b]

Now, we know that $L_s > L_p$ in this region i.e.,

$\frac{(\rho b-\rho\delta b+\rho\delta u+1+\rho)}{\rho}$ > R > $\frac{\delta(2-\delta-\rho)b-\delta(1-\delta)u-(1-\rho)e+\frac{\delta}{\rho}+\delta-2}{\delta(1-\rho)}$ and MFI is trying to induce L_s. So, there can be two cases where $L_{ML_{NC}} > L_s$ or $L_{ML_{NC}} \leq L_s$. If it is the former, then the agent is already getting a payoff that is better than the welfare superior equilibrium. However, if it is the latter, then if the cost of capital, B can be reduced then $L_{ML_{NC}}$ increases such that $L_{ML_{NC}} = L_s$. Similarly, if $B \geq X_p$, and the cost of capital for moneylenders can be reduced, such that $L_{ML_{NC}} = L_s$ can be achieved. For $L_{ML_{NC}} = L_s$,

δ[R - 1 - B - (1 - ρ)e] + δ^2 [ρ(R - $\frac{B+1}{\rho}$)+(1 - ρ)b] = $\delta[R-(\delta b-\delta u)]+\delta^2[R+(\delta b-\delta u)-1-\frac{1}{\rho}]$

Or, B = $\frac{1}{1+\delta}[\delta b-\delta u-1-e(1-\rho)]-\frac{\delta}{1+\delta}[(1-\rho)R+b(\rho+\delta-1)-\delta u-\frac{1}{\rho}]$

Or $B = X_s$

Now, in the **captive region**, the reduction in cost of capital must be conditional on the moneylenders charging a lower r_{C1} , given rates charged by the moneylenders are both

observable and verifiable. Otherwise the moneylenders will have full incentive to charge the old r_{C1} and take the excess surplus generated as their own profits.

r^s_{C1} under the separating equilibrium $= [\delta b - \delta u - 1 - e(1-\rho)] - \delta[R + (\delta - \rho)b - (1 + \delta - \rho)u - 1 - \frac{1}{\rho}]$

r^p_{C1} under the pooling equilibrium $= 1 - \delta[\rho(R-b) + (1-\rho)(b-u)]$

When $\frac{(\rho b - \rho\delta b + \rho\delta u + 1 + \rho)}{\rho} >$ R $> \frac{\delta(2-\delta-\rho)b - \delta(1-\delta)u - (1-\rho)e + \frac{\delta}{\rho} + \delta - 2}{\delta(1-\rho)}$, $L_s > L_p$, therefore $r^s_{C1} < r^p_{C1}$

Hence, r^p_{C1} - B $> r^s_{C1}$ - B

So, the total gains for the moneylenders in the captive region is higher if the pooling equilibrium rates are charged. If their cost, B is reduced by r^p_{C1} - r^s_{C1}, then the separating equilibrium payoffs can be achieved.

r^p_{C1} - $r^s_{C1} = 1 - \delta[\rho(R-b) + (1-\rho)(b-u)]$ - $[\delta b - \delta u - 1 - e(1-\rho)] - \delta[R + (\delta - \rho)b - (1 + \delta - \rho)u - 1 - \frac{1}{\rho}]$

Or, r^p_{C1} - $r^s_{C1} = 2 + \delta(1-\rho)R + e(1-\rho) + (\delta + \delta\rho - \delta^2 - \delta^2\rho)u - (2 - \delta - \delta\rho)b - \delta - \frac{\delta}{\rho}$

Thus, if B is reduced by $2 + \delta(1-\rho)R + e(1-\rho) + (\delta + \delta\rho - \delta^2 - \delta^2\rho)u - (2 - \delta - \delta\rho)b - \delta - \frac{\delta}{\rho}$ conditional on r^s_{C1} charged then the welfare superior equilibrium can be achieved. □

This shows that despite moneylenders being profit maximisers, it is useful to have them operate from a welfare increasing point of view. They possess ground-level information that allows policymakers to induce a welfare superior equilibrium by using appropriate instruments which otherwise would not be possible.

Some of these instruments are direct, whereas others are indirect or not so actionable. Trying to induce a welfare superior equilibrium by paying local moneylenders is a direct/actionable policy instrument that the policy maker can adopt. Other instruments such as reducing the cost of diversion or reducing the cost of gathering information in the community are more indirect approaches and are not directly actionable by the policy maker.

The policy instruments discussed in the sub-section can be summarised by the following proposition:

Proposition 4: *Policymakers can induce a welfare-superior equilibrium by:*

- *Reducing the benefit arising out of diversion by incorporating penalties for diversion. This would enable lenders to screen out bad borrowers.*

- *Reducing the cost of gathering information in the non-captive segment as the loan is then extended for only productive purposes and at a lower rate of interest.*

- *There exists a subsidy scheme that effectively utilises the informational advantage that local moneylenders possess through direct actions that involve lowering cost of capital for these informal lenders.*

6 Conclusion

There is much ambiguity with respect to the overall effects of the entry of a social entity such as an MFI in the rural credit market. While some findings propagate a positive outcome in terms of less dependency on informal loans (Berg et al. (2013), Banerjee et al. (2021)) others point towards a negative impact on informal interest rates (Mallick (2012), Berg et al. (2013)). Through this paper we have tried to contribute to this debate using a two-period model that include elements of competition between formal and informal sectors and a mandatory savings requirement by the MFI as a collateral substituting mechanism. We study the results in the context of a captive and non-captive segment to see the overall impact of the MFI entry where borrowers differ in terms of their borrowing opportunities.

First, we establish a benchmark scenario where only moneylenders are operating within market. We find that due to the added competition as well as the informational disadvantage, moneylenders operate at cost in the non-captive segment. They can easily separate out the types of entrepreneurs within their own captive segments and due to their monopoly power, they end up charging usurious interest rates. Due to their informational advantage, loans are only forwarded to good entrepreneurs in the second period.

Next, we turn towards the case when only the MFI operates in the market. The MFI has an option of offering a pooling contract where loans are forwarded to both good and bad entrepreneurs in the second period, or it can choose to separate and offer a contract which only the good type accepts. Under a pooling equilibrium, the MFI undertakes a large

amount of risk because lending to the bad type is never profitable as the borrower would always default. The only way the MFI can safeguard itself and manage to break-even is by asking for a mandatory savings at the end of the first period equal to the loan amount in the second period. So, the amount that is kept with the MFI as savings at the end of the first period is ultimately loaned to the borrower in the next period. The MFI chooses to induce the welfare superior equilibrium.

Now, when the MFI and moneylenders are both present in the market, we see different effects in the captive and the non-captive segments. In the non-captive segment, the moneylenders are already operating at cost. So, the entry of the MFI could displace the moneylenders from this segment if their operating costs are high. If they are low, they continue to operate in this segment. Either way, we see that the entrepreneurs are benefitted. In the captive segment, in order to compete with the MFI contract, the moneylenders have to charge lesser interest rates. It may so happen that they are unable to operate in this segment as well if their operating costs are high enough. We see that entrepreneurs from captive segment are unambiguously better off with the entry of the MFI.

Certain nuances are brought forth by this model in terms of the value of information. We see that if the MFI can harness the informational advantage that the moneylenders possess in the captive segments, then they can induce a superior equilibrium which otherwise could not have been implemented if the MFI acted alone. Further, if the cost of gathering information is reduced and moneylenders can acquire knowledge regarding the type of entrepreneurs in the non-captive segment, then separating becomes easier in this segment and loans are not forwarded for unproductive purposes. Competition ensures that usurious rates of interest are not charged by the moneylenders.

The findings are also corroborated by those of Straub (2005) who suggests better institutional mechanisms increases the attractiveness of formal finance and thereby overall efficiency, Andersen and Malchow-Møller (2006) who find that lowering costs for formal institutions would drive informal players out of the market and De Quidt et al. (2018) who suggest an

overall benefit arising from the competition. Similar findings from Laha (2019) suggest expansion of formal credit can reduce informal interest rates in the contested segment. This is backed by empirical evidence from All India Debt and Investment Surveys. Another empirical study that corroborates our findings comes from Wang (2019) who evaluate the impact of Million Baht Village Fund program. The findings imply that more productive households benefitted from the expansion of credit access.

The results of the present study are consistent with the empirical findings of Bell (1990) and Siamwalla et al. (1993) in the sense that switching of lenders does take place, but it has to be done slowly and may involve some costs and risks to the borrower. Bell (1990), aligning with the present findings suggests formal institutions to acquire private lenders as agents. This is put forth as a solution to the formal institution's informational and enforcement problems.

Our findings are in parts consistent with Ghosh and Van Tassel (2008) in that a high degree of subsidization of the formal institution can make a private lender worse off, and thus, generate conflict between the two lenders. However, it does not align with the finding that a private lender with a monopoly over a credit market will actually prefer to have a poverty minimizing MFI enter and offer subsidized loans. Demont (2010) finds evidence of two opposing forces that arise from the entry of an MFI: the competition effect which lowers prevailing interest rates (consistent with our findings) and a composition effect which increases interest rates due to the worsening of the pool of borrowers (contrary to our findings). The findings of our model agree in parts to that of Mookherjee and Motta (2016) who establish that MFI entry is Pareto improving for borrowers, irrespective of effects on informal interest rates but they do not provide evidence of an increase in the informal interest rates as shown by the authors.

Our results differ from those of Hoff and Stiglitz (1998), who present models that find government-subsidized formal credit have not improved the terms offered by moneylenders. They also disagree with the findings from Bose (1998) who shows that the policy of providing

cheap credit through the formal sector can generate adverse 'composition effects' which worsen the terms of credit and the availability of loans in the informal sector.

Through this model of interaction between formal and informal players in the rural credit system we try to lend to the overall debate that has occurred throughout the last few decades on the matter. We find unambiguous benefits arising from the entry of a welfare maximising entity such as an MFI. We also see the values of having local agents like moneylenders on the ground who have information gathering advantages. An effective system of both these entities working together can bring about increases in efficiency and welfare.

References

Aleem, I., 1990. Imperfect information, screening, and the costs of informal lending: a study of a rural credit market in Pakistan. The World Bank Economic Review, 4(3), pp.329-349.

Andersen, T.B. and Malchow-Møller, N., 2006. Strategic interaction in undeveloped credit markets. Journal of Development Economics, 80(2), pp.275-298.

Armendariz, B. and Gollier, C., 2000. Peer group formation in an adverse selection model. Economic Journal, 110(465), pp.632-643.

Banerjee, A., Breza, E., Chandrasekhar, A.G., Duflo, E., Jackson, M.O. and Kinnan, C., 2021. Changes in social network structure in response to exposure to formal credit markets (No. w28365). National Bureau of Economic Research.

Banerjee, A.V. and Newman, A.F., 1993. Occupational choice and the process of development. Journal of political economy, 101(2), pp.274-298.

Banerjee, A.V., 2003. Contracting constraints, credit markets, and economic development. Econometric Society Monographs, 37, pp.1-46.

Banerjee, A.V., Besley, T. and Guinnane, T.W., 1994. Thy neighbor's keeper: The design of a credit cooperative with theory and a test. The Quarterly Journal of Economics, 109(2), pp.491-515.

Basu, K. and Bell, C., 1991. Fragmented duopoly: theory and applications to backward agriculture. Journal of Development Economics, 36(2), pp.145-165.

Bateman, M. and Chang, H.J., 2009. The microfinance illusion. Available at SSRN 2385174.

Bateman, M., Sinković, D. and Skare, M., 2012. The contribution of the microfinance model to Bosnia's post-war reconstruction and development: How to destroy an economy and society without really trying. ÖFSE Working Papere, (36).

Bell, C., 1990. Interactions between institutional and informal credit agencies in rural India. The world bank economic review, 4(3), pp.297-327.

Bell, C., Srintvasan, T.N. and Udry, C., 1997. Rationing, spillover, and interlinking in credit markets: the case of rural Punjab. Oxford Economic Papers, 49(4), pp.557-585.

Berg, C.N., Emran, M.S. and Shilpi, F., 2015. Microfinance and moneylenders: long-run effects of MFIs on informal credit market in Bangladesh. Available at SSRN 2677316.

Bergsma, K., 2011. Does offering microsavings make sense for microfinance institutions?. The American Economist, 56(2), pp.15-27.

Bose, P., 1998. Formal–informal sector interaction in rural credit markets. Journal of Development Economics, 56(2), pp.265-280.

Chowdhury, P.R., 2007a. Group-lending with sequential financing, contingent renewal and social capital. Journal of development Economics, 84(1), pp.487-506.

Dam, K. and Roy Chowdhury, P., 2014. Incentives and competition in microfinance. Dasgupta, D., 2017. Essays on the Dynamics of Credit Contracts (Doctoral dissertation, Indian Statistical Institute, Kolkata).

De Aghion, B.A., Armendáriz, B. and Morduch, J., 2007. The economics of microfinance.

De Quidt, J., Fetzer, T. and Ghatak, M., 2018. Market structure and borrower welfare in microfinance. The Economic Journal, 128(610), pp.1019-1046.

Demont, T., 2010. The impact of microfinance on the informal credit market: An adverse selection model (No. 1005).

Fitchett, D., 1999. Bank for agriculture and agricultural cooperatives (baac), thailand (case study). Washington DC: Consultative Group to Assist the Poorest (CGAP) Working Group on Savings Mobilization.

Ghatak, M., 2000. Screening by the company you keep: Joint liability lending and the peer selection effect. The Economic Journal, 110(465), pp.601-631.

Ghosh, S. and Van Tassel, E., 2008. Microfinance, subsidies and dynamic incentives. Florida

Atlantic University, mimeo.

Hoff, K. and Stiglitz, J.E., 1998. Moneylenders and bankers: price-increasing subsidies in a monopolistically competitive market. Journal of Development Economics, 55(2), pp.485-518.

Hulme, D. and Mosley, P. (1996) Finance against Poverty, 1 and 2. Routledge, London.

Jain, S. and Mansuri, G., 2003. A little at a time: the use of regularly scheduled repayments in microfinance programs. Journal of development Economics, 72(1), pp.253-279.

Jain, S., 1999. Symbiosis vs. crowding-out: the interaction of formal and informal credit markets in developing countries. Journal of Development Economics, 59(2), pp.419-444.

Khanna, M. and Majumdar, S., 2020. Caste-ing wider nets of credit: A mixed methods analysis of informal lending and caste relations in Bihar. World Development Perspectives, 20, p.100265.

Laffont, J.J. and N'Guessan, T., 2000. Group lending with adverse selection. European Economic Review, 44(4-6), pp.773-784.

Laha, A., 2019. Interaction between the Formal and Informal Financial Sectors and its Implications on Monetary Policy: Experiences from Indian Economy. In The Impacts of Monetary Policy in the 21st Century: Perspectives from Emerging Economies. Emerald Publishing Limited.

Lal, R. and Lobb, A., 2016. BancoSol and Microfinance in Bolivia. Harvard Business School Publishing (Case 516005-PDF-ENG).

Madestam, A., 2014. Informal finance: A theory of moneylenders. Journal of Development Economics, 107, pp.157-174.

Mallick, D., 2012. Microfinance and moneylender interest rate: Evidence from Bangladesh. World development, 40(6), pp.1181-1189.

Mookherjee, D. and Motta, A., 2016. A theory of interactions between MFIs and informal lenders. Journal of Development Economics, 121, pp.191-200.

Mookherjee, D. and Ray, D., 2003. Persistent inequality. The Review of Economic Studies, 70(2), pp.369-393.

Morduch, J., 1999. The microfinance promise. Journal of economic literature, 37(4), pp.1569-1614.

Mutua, K., Nataradol, P., Otero, M. and Chung, B.R. (1996), The view from the field: Perspectives from managers of microfinance institutions. J. Int. Dev., 8: 179-193. https://doi.org/10.1002/(SI
1328(199603)8:2¡179::AID-JID371¿3.0.CO;2-Q

Roy Chowdhury, P., 2007b. Borrower Empowerment and Savings: A Two-stage Microfinance Scheme.

Rutherford, S., 2000. The poor and their money. New Delhi: Oxford University Press.

Siamwalla, A., Pinthong, C., Poapongsakorn, N., Satsanguan, P., Nettayarak, P., Mingmaneenakin, W. and Tubpun, Y., 1993. The Thai rural credit system: A description and elements of a theory. In World Bank Conference on Agricultural Development Policies and Theory of Rural Organization, Annapolis, Maryland 1989.

Stiglitz, J.E., 1990. Peer monitoring and credit markets. The world bank economic review, 4(3), pp.351-366.

Straub, S., 2005. Informal sector: the credit market channel. Journal of Development Economics, 78(2), pp.299-321.

Surendra, V., 2020. The Moneylender as Middleman: Formal Credit Supply and Informal Loans in Rural India. Job Market Paper, pp.1-68.

Tavanti, M., 2013. Before microfinance: The social value of microsavings in Vincentian poverty reduction. Journal of business ethics, 112(4), pp.697-706.

Udry, C., 1990. Credit markets in Northern Nigeria: Credit as insurance in a rural economy. The World Bank Economic Review, 4(3), pp.251-269.

Van Tassel, E., 1999. Group lending under asymmetric information. Journal of Development Economics, 60(1), pp.3-25.

Wang, F., 2019. An empirical equilibrium model of formal and informal credit markets in developing countries. Available at SSRN 3316939.

Zheng, C. and Zhang, J., 2021. The impact of COVID-19 on the efficiency of microfinance institutions. International Review of Economics Finance, 71, pp.407-423.