Working Paper No. 35

How Does Microcredit Work?
A Review of the Theories of Microcredit

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Abstract

The remarkable speed at which the reach of microcredit has expanded around the world in the last three decades has piqued the curiosity of practitioners and theorists alike. While assessing the impact of microcredit on the lives and livelihoods of the poor remains a contentious issue, there is no disputing the fact that there is something novel, something special, about microcredit that has allowed an altogether new mode of financial intermediation to emerge, providing credit to millions of hitherto 'unbankable' poor without breaking the lender's back. That is an extraordinary achievement in itself. Theorists have been keen to unearth the secrets behind this remarkable achievement. In particular, they have tried to understand why is it that the special features of microcredit seem to work, at least in terms of embracing those who were previously excluded from the formal credit market, without compromising the financial viability of the lenders. This has led to an enormous outpouring of theoretical speculations, often drawing upon the latest theoretical advances in economics and finance. The ideas and tools developed in the economic theories of imperfect information, and in the related theories of screening, incentives and mechanism design – which are themselves of fairly recently origin – as well as the tools of game theory, have been enthusiastically applied by a new generation of economists to unearth the secrets of microcredit. The present paper tries to present the main contours of this theoretical journey in a relatively accessible manner. As a backdrop to microcredit theories, the paper begins by reviewing the old and new theories of the rural credit market. The major theories of microcredit are then reviewed under three different themes depending on the nature of market imperfection that a particular theory is concerned with - namely, *ex ante* moral hazard, adverse selection and strategic default or the enforcement problem.

How Does Microcredit Work?
A Review of the Theories of Microcredit

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1. Introduction

The remarkable speed at which the reach of microcredit has expanded around the world in the last three decades has piqued the curiosity of practitioners and theorists alike. To what extent this explosion of microcredit has actually transformed the lives of the people it has touched remains a contentious issue. But there can be no doubting the fact that there is something novel, something special, about microcredit that has allowed an altogether new mode of financial intermediation to emerge, providing credit to millions of hitherto 'unbankable' poor without breaking the lender's back. That is an extra-ordinary achievement in itself.

Practitioners want to know what is that something special about microcredit, so that they too can practice it in their own environment, with necessary adaptations. Theorists want to know why is it that the special features of microcredit seem to work, at least in terms of embracing those who were previously excluded from the formal credit market, without compromising the financial viability of the lenders. This has led to an enormous outpouring of theoretical speculations, often drawing upon the latest theoretical advances in economics and finance. The ideas and tools developed in the economic theories of imperfect information, and in the related theories of screening, incentives and mechanism design – which are themselves of fairly recently origin – as well as the tools of game theory, have been enthusiastically applied by a new generation of economists to unearth the secrets of microcredit.[1] This paper will try to present the main contours of this theoretical journey in a relatively accessible manner.[2]

The paper is organized as follows. As a backdrop to microcredit theories, section 2 reviews the old and new theories of the rural credit market. The major theories of microcredit are then reviewed in the next three sections under three different themes depending on the nature of market imperfection that a particular theory is concerned with - namely, *ex ante* moral hazard (section 3), adverse selection (section 4) and strategic default or the enforcement problem (section 5).

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[1] It should be emphasized that the relationship between economic theory and microcredit has by no means been a one-way traffic. Several strands of mainstream economic theory have also been deeply influenced by the insights gleaned from the practice of microcredit, and of Grameen Bank in particular. For example, one of the earliest theoretical papers dealing with the interface between economic theory and microcredit was motivated not so much by the desire to unearth the secret of microcredit as to learn how to enrich the mainstream theories of monitoring, incentive and screening by using the principles of group lending innovated by the Grameen Bank (Varian 1990).

[2] Given the generally high level of mathematical rigour of most of these theories, however, it would be impossible to give a real flavour of their insights without occasionally allowing some technical expositions to creep in; but in all such cases, we have tried to keep the algebra to the minimum and to rely more on the use of diagrams and, even more so, on verbal explanations of the underlying intuition.

2. The Rural Credit Market

Since the objective of microcredit theories is to explain how the practice of microcredit has succeeded in overcoming many of the failures and limitations of the rural credit market in developing countries, a good starting point is a brief overview of the nature of the rural credit market itself, on which microcredit has been superimposed. A few stylized facts about the nature of the rural credit market have become part of folklore. It is commonly believed, for example, that (a) rural people have very little access to the formal banking system, (b) they try to meet their credit needs mainly by taking recourse to the informal credit market, (c) the informal credit market has two main strands – a network of friends and families which works as a mutual support system based on reciprocity, and a group of moneylenders and other professionals who lend money for profit, and (d) those who lend for profit usually charge exorbitantly high interest rates, often exceeding 100 per cent per annum. Anecdotal evidence in support of these propositions has existed for centuries; systematic empirical research is of relatively recent origin, but it by and large validates the earlier perceptions.

However, explanations of some of the observed phenomena have remained shrouded in controversy. The most contentious issue has been the explanation of very high rates of interest charged by moneylenders. The folklore has it that unscrupulous moneylenders charge exploitative interest rates by exercising monopoly power over the rural poor, who are often in desperate need of credit but are bereft of any power to bargain for a better deal. A dissident view has claimed that high interest rates actually reflect the high level of risk the moneylenders have to take while offering unsecured loan to the poor people, many of whom are likely to default. At the theoretical level, the greedy monopolist view has been formalized most elegantly by Bhaduri (1973, 1977) and the risk-of-default view by Bottomley (1975).[3]

Bhaduri's moneylender is a manipulative villain whose real objective is not to earn interest income that accrues from lending but to grab whatever assets (in particular, land) the poor people happen to hold. He showed that so long as the asset is valued more highly by the lender than by the borrower, the lender would be able to use his monopoly power to set the interest rate at such a high level that the borrower would be obliged to default and the asset would pass over to the lender. Bhaduri used this idea of a 'debt trap' as part of a general theoretical framework to offer an elegant neo-Marxist explanation of how rural backwardness is perpetuated in a semi-feudal environment (Bhaduri 1983).

Bottomely, by contrast, demonstrated that monopoly and greed need not be invoked to explain high interest rates. Even in a competitive market, high risk of default may provide an adequate explanation. For example, if it is assumed that the moneylender's opportunity cost of capital is 10 per cent per annum (which, say, obtains in the formal credit market) and that about half his potential borrowers are likely to default, his breakeven rate of interest turns out to be as high as 120 per cent per annum, a common enough informal interest rate observed around the developing world (Ray 1998, p.345).

[3] Ray (1998), chapter 14, provides simple expositions of these models, as well as a very good overview of the empirical features of and theoretical explorations into the rural credit market.

Despite their elegance and early appeal, both these lines of theorizing have come under increasing criticism, on both theoretical and empirical grounds. Bhaduri's model, for example, turns out to be characterized by a rather unstable equilibrium, as even a small effort by the borrower to save out of current income can enable him to escape the debt trap (Srinivasan 1979).[4] At the empirical level, Bardhan and Rudra (1982) have shown from a careful study of rural credit markets in West Bengal, India, that the premises and the conclusions of Bhaduri's model do not on the whole fit the facts. The problem with Bottomley's model is primarily empirical. Most fundamentally, there is no convincing evidence of high default rates in rural credit markets. On the contrary, Timberg and Aiyar (1985) found in India that for the cases they studied the average default losses for the moneylenders ranged between 0.5 per cent and 1.5 per cent of working funds. Similarly, in a much-quoted study from Pakistan, Aleem (1990) found the default rate to be less than 5 per cent in most cases he studied. An additional problem with Bottomley is that his assumption of competitive market does not fit the facts either. Almost all the evidence shows the existence of highly segmented rural credit markets in which individual moneylenders do enjoy at least a local monopoly power.[5]

A new view of rural credit market is now emerging which sees both monopolistic elements and risk of default as important features of the market but not as simple determinants of interest rates as envisaged by earlier theorists. This new view starts from the premise that informal lenders face the same problems of asymmetric information and imperfect enforcement as do the formal lenders but what they try to do in order to overcome these problems is very different from the response of formal lenders. Problems of information and enforcement do entail a serious risk of default but unlike the formal lenders, who tend to wash their hands off poor rural borrowers, informal lenders actually try to devise ways and means of lending that minimize this risk. Thus, it is not the high actual rate of default as such but the mechanisms that are devised to minimize default that can explain high interest rate. More generally, according to this new view, the clue to explaining the observed features of rural credit markets lies in understanding the manner in which informal lenders try to deal with the problems of information and enforcement and the consequences that arise from their actions.[6]

One set of actions moneylenders take is to screen out the risky borrowers by trying to acquire as much personal information about the potential clients as they can, and then confining lending to a selected few. Quite often, they further minimize the risk of default by keeping an eye on how the borrowers utilize the loan and by threatening them with various kinds of unpleasant consequences if they tried to default. The actual rate of default is thus minimized, but the whole process may still culminate in a high rate of interest, partly because of the local monopoly power the lender comes to acquire over the clients about whom he has superior personal knowledge

[4] For more on this theoretical debate, see Bandopadhyay and Ghatak (1982).

[5] See the evidence provided for, for example, by the papers in a special issue of the *World Bank Economic Review,* 1990, edited by K. Hoff and J. Stiglitz, and also neat summaries of these and other evidence presented, *inter alia*, by Ray (1998), Banerjee (2003), and Conning and Udry (2007).

[6] For forceful expositions of this view, see Hoff and Stiglitz (1990), Besley (1994), Ray (1998) and Banerjee (2003).

compared to other lenders and partly because of the transaction costs incurred in the process of screening, monitoring, etc.[7]

A somewhat different set of actions may be undertaken by those lenders who also happen to interact with their clients in other capacities such as landlords, employers, or traders. For them, linking the terms of contract in the credit market with the terms of contract in other markets (e.g., land, labour, or commodities, as the case may be) may provide a way of minimizing the problems of imperfect information and enforcement that may otherwise make a credit transaction unviable. For example, a landlord-cum-moneylender can threaten a tenant-cum-borrower with eviction from tenancy as an enforcement mechanism for preventing loan default. Or, a trader-cum-lender may offer a farmer-cum-borrower lower prices on agricultural inputs in order to encourage the latter to use more of these inputs so that he is not compelled to default on loan owing to poor yield.[8]

It is also interesting to observe that faced with the pervasive problems of imperfect information and enforcement, it is not just the lenders who try to devise mechanisms for overcoming them; the borrowers too can take remedial actions. Example of institutions devised for this purpose are borrowers' self-help groups such as credit co-operatives and rotating savings and credit associations (ROSCA) which have existed in various forms all over the world for a very long time.[9]

An important lesson that emerges from this new way of looking at the rural credit market is that any interventions designed to improve upon the workings of the existing market must improve upon, or at least substitute, the actions that market has already undertaken – from the sides of both lenders and borrowers – in response to the underlying problems of information and enforcement. As it happens, this lesson has mostly been lost on the interventions in rural credit market made by governments of many developing countries. Launched with the best of intentions – to improve the rural poor's access to credit and to break the moneylender's stranglehold on them – most of these interventions have failed to deliver the goods. These interventions have usually taken the form of compelling state-run institutions to enter the rural credit market, often combined with the directive of reserving a minimum proportion of advances for the so-called 'priority sectors' and offering loans at heavily subsidized interest rates. A series of systematic assessment of the impact of these interventions has come to the uncomfortable

7 In what can be seen as a precursor of the modern view, a perceptive British colonial officer made the following observation about the rural moneylender of Punjab in the early 20th century: "He is always accessible, even at night; dispenses without troublesome formalities, asks no inconvenient questions, advances promptly, and if interest is paid, does not press for repayment of principal. He keeps in close personal touch with his clients, and in many villages shares their occasions of weal or woe. With his intimate knowledge of those around him he is able, *without serious risk*, to finance those who would otherwise get no loan at all."(Darling 1925; emphasis added).

8 Illuminating analyses of such interlinked transactions can be found, inter alia, in Bardhan (1984), Basu (1987), Braverman and Srinivasan (1981), Braverman and Stiglitz (1982, 1986) and Mitra (1987). A simple intuitive analysis of the underlying logic behind inter-linkage is offered by Ray (1998), chapter 14.

9 For modern theoretical treatments of these institutions from the perspectives of information and enforcement, see Banarjee *et al*. (1994) on credit co-operatives and Besley *et al*. (1993) on ROSCAs.

conclusion that on the whole they did more harm than good.[10] On the one hand, they caused financial repression by discouraging savings and led to inefficient use of credit owing to administratively guided, as opposed to market-determined, allocation of credit across sectors. On the other hand, cheap credit did not help the poor borrowers as the benefits were cornered by the wealthy borrowers.[11] Finally, since such interventions directly undermined the financial viability of the lending institutions, they resulted in either widespread bankruptcies or open-ended drain on the government budget.

It should be emphasized that not all the interventions failed totally. For instance, there is substantial evidence of important positive impacts on agricultural output and farmer welfare in rural Thailand following the Bank of Thailand's decision to set targets for commercial banks to lend to the agricultural sector (Fitchett 1999). Similarly, in their careful analysis of directed credit in India, Burgess and Pande (2005) conclude that the policy had the intended effect of expanding rural bank branching and that this lowered poverty and expanded non-agricultural rural output. However, the general point that government interventions in the rural credit market in the developing world have failed to achieve their objectives remains valid.

The fundamental reason for this failure lies in not realizing that the moneylenders' power and the rural poor's lack of access to affordable credit stem from some basic problems of the rural credit market involving imperfect information and enforcement. No intervention will work without first addressing those underlying problems. As Hoff and Stieglitz (1990, p.238) observe: "… the moneylenders' power is unlikely to be broken by the entry of institutional credit, unless the new institutions themselves find substitutes for the direct mechanisms used by moneylenders to overcome the problems of screening, incentives, and enforcement."

When microcredit entered the scene as an alternative institutional mechanism of delivering affordable credit to the poor, it did so by using certain methods that, knowingly or otherwise, did address precisely those problems of 'screening, incentives and enforcement'. And, according to the theories of microcredit, that is where the secret of its success lies. Within this common theme, there exists a multiplicity of theories partly because imperfect information can pose several different types of problems for the lender, and different theories are needed to explain how various features of microcredit deal with those different problems. These problems can be classified into three broad categories – moral hazard (related to incentives), adverse selection (related to screening) and enforcement. This categorization of the problems also provides a

10 The intellectual leadership of this research programme was given by the 'rural finance group' of the Ohio State University in the 1980s. The main findings of their research are presented in Adams *et al*. (1984) and von Pischke *et al*. (1983). Concise statements of the main arguments can be found in Adams and Graham (1981) and Schaefer-Kehert and von Pischke (1986).

11 Interest rates held below the market equilibrium level necessarily led to rationing of credit and the rationing process typically favoured the wealthy borrowers for a number of reasons. First, as the transaction costs of dealing with small loans demanded by poorer borrowers were found to be high relative to the interest rate the banks were allowed to charge, the banks preferred to deal with the larger loans demanded by wealthier borrowers. Second, since low interest rates implied that rents were transferred from the lender to the borrower, it led naturally to a competition for cornering those rents, and it is the wealthy borrowers who had the social and political clout to win this battle. As a result, interest rate restrictions almost everywhere led to the exclusion of poorer borrowers from the subsidized credit market; and it happened with such regularity that it came to be described as the 'iron law of interest rate restriction' (Gonzalez-Vega 1984).

convenient organizing framework for grouping the various theories of microcredit and that is how the rest of the paper is organized.[12]

3. Theories of Microcredit with *Ex Ante* Moral Hazard

In the general literature on the principal-agent problem as well as in the specific literature on credit market, including the literature on microcredit, the story of *ex ante* moral hazard is told in two slightly different ways. The difference lies in the decision variable that is supposed to be subject to moral hazard. One strand of the literature takes the level of effort expended by the agent as the relevant decision variable. The issue at stake in this case is the problem the principal faces in extracting the desired level of effort from the agent. Moral hazard consists in the fact that the agent is able to get away with putting in less effort than what is in the best interest of the principal. The other strand of the literature focuses on the choice of the project to be undertaken by the agent as the relevant decision variable. Moral hazard in this case consists in the propensity of the agent to adopt a riskier project than is ideal from the point of view of the principal. Both strands can be found in the moral hazard theories of microcredit. Fortunately, whether it is the level of effort or the choice of project that is taken as the object of moral hazard, it makes little difference to the main insights offered by these theories. There is, however, quite a difference in the narratives of the two ways of telling the story. In order to offer as unified an exposition as possible, we shall mainly adopt the narrative of effort, but occasionally we shall deviate from it when we find that the central message is much easier to get across through the alternative narrative of project choice.

The Problem of Moral Hazard in the Credit Market

We shall build on an approach developed by Ghosh *et al*. (2001), which the authors used to explain how moral hazard in effort can lead to credit rationing. Consider a project that requires a fixed investment L and has an uncertain return: y if it succeeds, 0 if it fails. The probability of success (p) is related to the level of effort (e) through the increasing and concave function p(e), such that $p'(e)>0$ and $p''(e)<0$; thus the probability of success increases with the level of effort but at a diminishing rate. Effort has a cost; for simplicity, the cost of effort is normalized at e, implying that cost rises proportionately to the level of effort. For the society as a whole, expected net return from the project is given by

$$p(e).Y - e - L \qquad (1)$$

Higher level of effort would tend to raise the value of net return by raising the probability of success p but it will also tend to reduce net return by entailing additional cost of effort. The optimal (or efficient) level of effort ($\hat{e}$) is the one that maximizes (1), considering both the gain through p(e) and the loss through e.[13] This is given by the first-order condition:

$$p'(e)= \frac{1}{Y} \qquad (2)$$

[12] There are of course theories that deal with multiple problems at the same time; we have grouped them according to what is taken to be the major problem in the models concerned.

[13] We are assuming risk-neutrality on the part of both borrowers and lenders. Introducing risk aversion will complicate the exposition but will not alter most of the conclusions. We shall, however, take up an important implication of risk aversion later in the analysis.

Now consider the case where an entrepreneur has no money of her own and borrows the amount L at an interest rate r. She would pay back R = (1+r)L if the project succeeds (we are assuming that Y > R), but nothing at all if the project fails because in that case the return from the project is zero and she has no transferable wealth to offer as collateral. The recognition that she does not and cannot pay back anything at all in the event of failure is an extreme case of 'limited liability constraint'. Given these conditions, the borrower's choice of effort level can be derived from the following optimization exercise:

$$max_e \quad p(e).(Y - R) - e \qquad (3)$$

$$s.t. \qquad p(e).(Y - R) - e \geq 0 \quad (4)$$

Equation (4) is known as the borrower's 'participation constraint'. It states that unless the borrower can earn a non-negative expected return she will not borrow at all. In other words, the maximization exercise is relevant only when the participation constraint is satisfied.

Assuming that the participation constraint is satisfied, the optimum level of effort (e) is given by the first-order condition:

$$p'(e)\ (Y - R) = 1 \qquad (5)$$

$$\text{Or,} \qquad p'(e) = \frac{1}{Y-R} \qquad (6)$$

Comparing (6) with (2), it may be noted that the value of p′(e) implied by (6) is greater than that implied by (2) i.e., $p'(\hat{e}) > p'(e^*)$. Since the assumption of diminishing return ($p''(e)<0$) implies that the value of p′(e) falls at higher levels of effort, we can infer that $\hat{e} < e^*$. Thus the borrower is likely to expend a socially sub-optimal level of effort.

A couple of factors combine to create this inefficiency. Partly, the problem lies in the existence of the limited liability constraint. To see why, suppose the borrower was required to pay back R regardless of whether the project succeeded or failed. In that case, she would have maximized the following expected return function:

$$p(e).(Y - R) + \{1 - p(e)\}\ (-R) - e \qquad (7)$$

On simplification, expression (7) becomes $p(e).Y - R - e$. It is evident that the first-order condition of maximisation in this case is exactly identical to (2) and hence the chosen level of effort would also be the same (e^*). In other words, in the absence of limited liability, the borrower would have expended the socially optimal level of effort.

One way of explaining why the borrower would put in less effort is to note an analogy with tax. In the presence of limited liability, the repayment burden acts like a tax on success - she has to repay only if the project succeeds, not if the project fails. Roughly speaking, the point is that she is not very keen to raise the level of effort because she knows that a part of the fruit of extra effort will be taken away by the lender. Of course, by expending less effort she also raises the probability of failure, but that does not worry her too much because she knows that she won't have to pay anything in the event of failure. If limited liability did not exist i.e., if she were required to pay back even in the case of failure, she would have been much more careful to prevent failure by expending more effort. If she knew that she would have to repay in any case she would try her best to ensure that the project didn't fail so that repayment could be made from the project's return rather than from her own purse. With limited liability, however, she is not equally keen to ensure success because she knows that the cost of failure would be borne by the lender - it's somebody else's problem. It is thus the protection on the downside afforded by limited liability that induces the borrower to expend socially inefficient level of effort.

But there is another side to the story. The problem of lax effort could have been overcome if the lender could observe and control the level of effort expended by the borrower. In that case, he could have made it a part of contractual requirement that the borrower expends the socially optimal level of effort, or else she would face unpleasant consequences like being hassled, or being cut off from future loans, or being shamed in public, and so on. It would be rational for the lender to take this course because if social surplus is maximized his own profit could be increased too. The lender, however, faces the problem that he cannot directly observe the level of effort. He might of course be able to observe the outcome of effort as revealed by the output of the project; and if effort and outcome were directly related to each other he could have deduced the level of effort indirectly by observing the outcome. But even this indirect route is denied to him by the fact that no one-to-one relationship between effort and outcome can be established because of inherent riskiness of the project. Higher level of effort can only increase the probability of success but cannot necessarily ensure a better outcome because there is always a chance that the project would fail despite the borrower's best efforts. So when the project actually fails, the lender can never be sure whether this was because the borrower was lax in her effort or because of sheer bad luck. The borrower would of course know the truth, but the lender won't that's the essence of asymmetric information.

Given the existence of asymmetric information, the lender would find it pointless to try to stipulate the level of effort in the loan contract. He has then no option but to leave it to the borrower to decide how much effort she would expend, and we have seen that with limited liability she would expend less than the socially optimal level of effort. It is thus the combination of asymmetric information and limited liability that together leads to inefficiency in the credit market.

This inefficiency has important implications for practical questions such as what would happen to the interest rate and whether people's demand for credit will be met fully or not, and so on. In order to answer these questions, it is necessary to examine the nature of market equilibrium that is likely to obtain under asymmetric information combined with limited liability. The precise nature of market equilibrium will depend on the market structure - in particular, on the degree of competition among the lenders and on whether the lenders are driven purely by the profit motive or mainly by the spirit of what is coming to be known as 'social business'. But it is possible to identify some general characteristics of the credit market that are likely to prevail regardless of the market structure, and these are the ones that are of interest in the present context.

Of the two sides of the market, borrowers and lenders, we have already identified the objective function of the borrowers. Given any repayment schedule R, they would maximize expression (3) and choose their effort level as dictated by the condition (6). The lenders on their part would try to maximize the following expected profit function:

$$\pi = p(e).\ R - L \qquad (8)$$

They will choose a level of interest r and hence a repayment schedule R that will maximize profit. They will be aware; however, that any choice about R will affect profit through two different routes - one direct and the other indirect, and the two routes will work in opposite directions. The direct route is through the presence of R in equation (8), whereby higher R will entail higher profits, other things remaining the same. The indirect route operates through p(e); if R is raised, the lender will have to bear in mind that borrowers will adjust their effort level in accordance with condition (6), which will have consequences for the probability of success p(e) and hence for their profit. To see the direction of this effect, note that according to condition (6) higher R will entail lower effort e, which in turn will induce lower p(e) and hence reduced profit.[14]

The existence of the indirect route implies that while choosing the level of repayment burden (R) the lender must take condition (6) into cognizance as a constraint. It's called the 'incentive compatibility constraint' (or, sometimes simply the incentive constraint), as it shows the values of e that the borrower will have the incentive to expend at given values of R. We have just noted that this constraint suggests a negative relationship between R and e, as shown by the IC curve in Figure 1. As R gets smaller, e gets bigger; and at the limit as R approaches zero, e approaches the socially optimal level of effort e* (as condition (5) tends to condition (2)). The IC curve will thus meet the e-axis at e*.

In order to find the market equilibrium, we now introduce the lender's iso-profit curve, which shows the combinations of R and e that will keep the lender's profit constant at any given level. It is easy to see from the profit function (8) that R and e will bear a negative relationship on the iso-profit curve; for example, if R goes up the positive effect on profit must be offset by an equal and opposite effect through lower p(e), and thus lower e, in order to keep profit constant. Accordingly, the iso-profit curve (IP) has been drawn with a negative slope in Figure 1. Also note that a higher iso-profit curve indicates a higher level of profit, because for any given level of e a higher value of R entails more profit.

The equilibrium levels of R and e will be established at the point where the lender's iso-profit curve meets the borrower's incentive compatibility curve because it is only at this point that the pair of R and e will be consistent with the borrower's incentive while keeping lender's profit at the target level. The target level of profit - i.e., the exact position of the iso-profit curve - will depend on the market structure. If the lender were a monopolist, he will try to maximize profit

14 Applying the implicit function theorem to (6), it is easy to show that $d\hat{e}/dR < 0$. Intuitively, condition (6) shows that higher R will lead to a higher value of $p'(e)$, and with diminishing returns, this can only happen at a lower value of e.

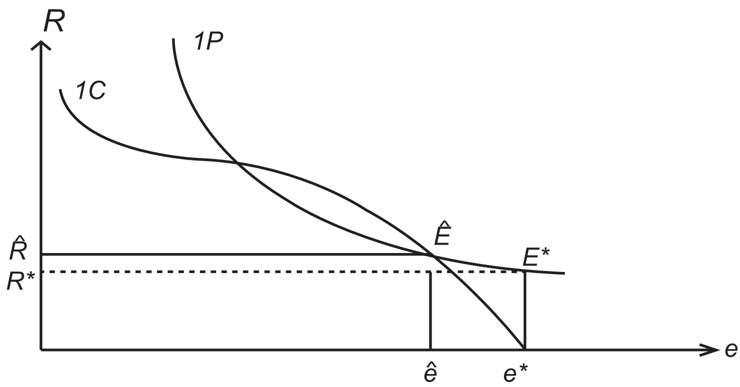
given the incentive constraint i.e., he will try to reach as high an iso-profit curve as possible that has some point in common with the incentive compatibility curve. If an interior solution exists, this will lead to a point of tangency between the two curves. If, however, perfect competition prevails, or the lender is a not-for-profit entity which simply wishes to break even, then the relevant iso-profit curve is the zero-profit curve:

$$\pi = p(e).\ R - L = 0 \qquad (9)$$

In this case, the more likely equilibrium is at a point of intersection between the two curves, as at point $\hat{E}$ in Figure 1.[15] For simplicity, we shall make the latter assumption regarding market structure, and thus work with the zero-profit curve, but it is important to point out that the main qualitative conclusions drawn from the ensuing analysis would remain valid under alternative assumptions as well.

Figure 1

Credit Market Equilibrium with Moral Hazard under Individual Liability



The equilibrium point $\hat{E}$ in Figure 1 can be characterised as 'constrained Pareto efficient', because given the existence of incentive compatibility constraint IC no other pair of R and e will improve the welfare of one party without reducing the other party's welfare. However, $\hat{E}$ does not represent the unconstrained Pareto efficient outcome or the social optimum. As we have seen before, the socially optimal level of effort (e*) lies above the level ($\hat{e}$) that would obtain under moral hazard. At e*, however, the (unconstrained) R cannot be the equilibrium repayment because the pair ($\hat{R}$, e*) takes the lender above the zero-profit curve. In order to maintain the zero-profit condition, the lender would have to reduce the repayment charge to R*; the point E* thus represents the unconstrained equilibrium.

Comparing the unconstrained equilibrium E* with the constrained equilibrium $\hat{E}$, we can see that

[15] Given the assumptions made, it can be shown that if the two curves intersect at more than one point the borrower would choose the lowest point and also that at the chosen point of intersection the IC curve would be steeper than the IP curve, as in Figure 1. For details, see Ghosh *et al*. (2001).

the equilibrium value of R, and therefore the equilibrium interest rate, is higher for the constrained equilibrium. This is one of the important consequences of moral hazard for the credit market - namely that the interest rate will be higher with moral hazard than without it. If repayment were to be lowered to R* in the presence of moral hazard, the IC constraint would dictate that the borrowers choose an effort level $\bar{e}$ that is above $\hat{e}$ but still below e*. But at this level of effort the lender would end up below the zero-profit curve, earning negative profit. That's why the lower interest rate R* associated with E* will not be offered under moral hazard.

An intuitive explanation of why interest rate happens to be higher under moral hazard - one that will prove helpful for subsequent analysis - can be found by comparing the implications of the borrower's incentive compatibility constraint and her participation constraint. At the equilibrium effort level $\hat{e}$, the expected pay-off for the borrower is $\rho(\hat{e})(Y-\hat{R})- \hat{e}$. According to the incentive compatibility constraint, this is the maximum possible pay-off consistent with $\hat{e}$. In other words, this is the pay-off the borrower must earn in order to have the incentive to offer the effort level $\hat{e}$. However, the participation constraint (3) suggests that if the incentive problem didn't stand in the way and the lender could somehow make $\hat{e}$ a necessary condition for borrowing, the borrower would be willing to expend $\hat{e}$ at a much lower pay-off so long as it did not become negative. In fact, the pay-off could have been reduced arbitrarily close to zero and the borrower would still expend $\hat{e}$. Thus, in a sense, the pay-off $\rho(\hat{e})(Y-\hat{R})- \hat{e}$ is an excess or a rent that the borrower is able to extract from the market by taking advantage of the scope for moral hazard created by the combination of asymmetric information and limited liability. In the general literature on moral hazard this is called the 'incentive rent'; and in the specific context of the credit market it is also called the 'limited liability rent' (Laffont and Martimort 2001).

The existence of the incentive rent entails a cost in terms of high interest rate. If the borrower didn't have to be paid this rent, the lender's profit would have been increased, but as this would violate the zero-profit condition the market would have brought down the rate of interest so as to restore zero profit. Thus the equilibrium interest rate would have been lower in the absence of incentive rent. This explains why interest rate is higher with moral hazard than without it.

This line of argument suggests that anything that lowers the incentive rent would lead to a lower equilibrium interest rate. This would be so, for example, if the borrower had some transferable wealth that could be used as collateral. The presence of collateral would mean that in the event of project failure the cost will no longer be borne entirely by the lender, a part of it will be borne by the borrower as well. This transfer of wealth from the borrower to the lender in the event of failure would reduce the expected pay-off for the borrower i.e., the incentive rent would fall and the lender's expected profit would rise at any given rate of interest. The necessity to restore the zero-profit condition would then set off market adjustments leading towards a lower equilibrium interest rate.

The analogy of carrot and stick is quite useful in this context. When the presence of collateral softens the bite of limited liability, the lender can use the threat of seizing the collateral as the stick with which to induce the borrower to expend a high level of effort. But if collateral doesn't exist and limited liability binds, the lender cannot use the stick any longer; instead, he has to offer a carrot to induce effort. The 'incentive rent' is that carrot. There is a trade-off between the carrot and the stick. To the extent the stick can be used the size of the carrot can be reduced - leading, as we have seen, to a lower equilibrium rate of interest.

Most theorists of microcredit have found it natural to assume that the stick of collateral does not exist in poor rural societies i.e., limited liability binds. In this setting, the formal credit market, if it tried to reach out to the rural poor at all, would have to offer the carrot of high incentive rent. But this would result in a high interest rate and a correspondingly low reach of credit. The genius of microcredit, from this perspective, is that its innovative lending mechanisms have created alternative sticks - in lieu of collateral - that can be used to reduce the incentive rent and thus bring down the interest rate within the reach of the poor and thereby extend the rural people's access to credit.

Group Lending with Joint Liability

One of the most widely noted features of the way microcredit is delivered in practice is group lending with joint liability. The nature of group lending has evolved significantly over the years, in many cases giving way to individual lending, and even where group lending persists the nature of joint liability has also evolved. Much of the theorizing has, however, been based on the early practice, what is now called the classical Grameen model. In this model, those who wish to take microcredit are required to form groups, and while loans are given to individuals and not to the group, each member of the group is partially responsible for the repayment of the others. The latter feature is called joint liability. We shall argue later that the way most of the theorists have modeled joint liability may have little resemblance to the way joint liability is applied in practice, but for the moment we shall go along with the traditional formulation.

We shall use the basic model of individual lending introduced in the previous section but modify it to introduce the new element of joint liability. For simplicity, we shall assume that there are only two-member groups, and that both members of a group are exactly identical in all relevant respects - that is, they have the same function p(e) relating probability of success to effort as well as the same cost of effort and that neither has any collateral to offer so that limited liability protects both of them equally. Joint liability demands that when one partner's project fails, and therefore she cannot repay her loan, the other partner must pay at least partially on behalf of the failed partner, provided she herself succeeds. If neither partner succeeds, then of course neither pays anything, and if both partners succeed they pay only for themselves. The joint liability payment is denoted here by c. Using the subscripts 1 and 2 to denote the two partners, their expected pay-off is given by:

$$p(e_i)(Y-R)+p(e_i)\,[1-p(e_j)]\,c-e_i\,;\quad i,j\in\{1,2\};\ i\neq j \qquad (10)$$

Comparing this pay-off function with the individual loan pay-off function (2), it can be seen that the presence of joint liability acts like an additional tax on success because the fruit of success will be reduced not only by one's own repayment burden R but also by an additional amount c in case the partner fails in her project. Unlike R, however, c is not an unavoidable tax on success. It can be avoided if the partner too succeeds. It is, therefore, in the interest of each partner that the other one succeeds. Both partners will then have the incentive to encourage, and if necessary pressurize, each other to raise the level of effort so that the probability of success increases. Joint liability will thus induce peer monitoring and peer pressure, which has the potential to mitigate the moral hazard stemming from asymmetric information and limited liability.

As we shall below, however, it is not guaranteed that this potential will always be realized. One case where it will definitely be realized is when the group members can costlessly observe each other's effort and decide to choose their effort levels in a co-operative manner. The objective of co-operation is to choose the effort levels in such a way that will maximize the pay-off for the group as a whole.[16] Since the partners have been assumed to be identical in all relevant respects (including the cost of effort) the level of effort that is optimal for one will also be optimal for the other. Thus they will solve the following common maximization problem:

$$max_e\, p(e)(Y - R) - p(e)[1 - p(e)]c - e \qquad (11)$$

The first-order condition gives the following incentive compatibility constraint:

$$p'(e)\, [(Y - R) - c + 2p\,(e)\, c] = 1 \qquad (12)$$

The lender's zero-profit condition is given by:

$$\pi = p(e)\, R + p(e)\, [1 - p(e)\,]\, c - L = 0 \qquad (13)$$

Substituting the equilibrium value of R (= L / p (e) – [1 – p(e)]c) from (13) into (12), and upon simplification, we get the co-operative level of effort under joint liability ($\hat{e}_{jc}$) from the equation

$$p'(\hat{e}_{jc}) = \frac{1}{Y - \frac{L}{p(\hat{e}_{jc})} + p(\hat{e}_{jc})c} \qquad (14)$$

In order to see the impact of joint liability on the level of effort, we would like to compare the value of $\hat{e}_{jc}$ given by (14) with the optimal level of effort under individual liability. We know that under individual liability the incentive compatibility condition is given by (6) and the zero-profit condition by (9). Combining the two, we can derive the optimal level of effort under individual liability ($\hat{e}_{il}$) from the following equation:

$$p'(\hat{e}_{il}) = \frac{1}{Y - \frac{L}{p(\hat{e}_{il})}} \qquad (15)$$

It can be now shown that $\hat{e}_{jc} > \hat{e}_{jl}$ (16)

[16] This is indeed the assumption made by Stiglitz in his classic paper that first systematically analysed the implications of joint liability for moral hazard in the credit market (Stiglitz 1990).

i.e., co-operative behavior under joint liability induces a greater level of effort than what would obtain under individual liability. We offer a simple diagrammatic proof of this proposition below, by adapting the IC-IP diagram introduced in Figure 1.[17]

The proof hinges on the fact that when joint liability is introduced both IC and IP curves fall compared to the individual liability case but the IC curve falls relatively less if the borrowers behave in a co-operative manner. Comparing the zero-profit conditions (9) and (13), it may be seen that the zero-profit condition under joint liability contains an additional term $p(e)\,[1-p(e)]c$, which stands for the joint liability payment the lender expects to receive from the borrowers. In order to maintain the zero-profit condition, the lender must reduce R to offset this gain. For any given level of $p(e)$, and hence for any given level of e, R must be reduced by $[1-p(e)]c$. Therefore, if joint liability is introduced the IP curve must fall by the amount $[1-p(e)]c$.

Now, comparing the IC conditions (5) and (12), we can see that the IC condition under joint liability (12) contains an additional term $-\,p'(e)[(1-2p(e)]c$, representing the burden of joint liability payment. In order to keep the left hand side of the equation equal to 1, the repayment burden R must fall. For any given level of $p'(e)$, hence for any given level of $p(e)$ i.e., for any given level of e, R must fall by the amount $[(1-2p(e)]c$. As a result, IC curve must fall by the amount$[(1-2p(e)]c$. This is smaller than $[1-p(e)\,]c$, the amount by which the IP curve falls.[18] As can be seen from Figure 2, the equilibrium $\hat{E}_{jc}$ for joint liability (with co-operative behaviour) will then be established at a point where, compared to the individual liability equilibrium $\hat{E}_{jl}$, the interest rate is lower and the effort level higher, as claimed in (16).

An intuitive explanation of this superiority of joint liability can be given in terms of what is called the 'diversification argument'.[19] Group lending with joint liability can be shown to enjoy what is called a 'diversification advantage' compared to individual liability, which enables the lender to bring down the rate of interest below what he will have to charge with individual liability. To see exactly where the advantage comes from, first consider the case of diversification with individual loan. Suppose a borrower utilizes her loan in a number of imperfectly correlated projects instead of using it all on a single project as we have assumed so far. With a single project, the borrower either repays the loan in full or she doesn't repay at all depending on whether the project succeeds or fails. With diversified projects, however, it is likely that some projects will succeed even as others fail, so that the borrower would be able to repay at least partially for the failed projects out of the returns from the successful ones. Diversification thus lessens the bite of limited liability, enabling the lender to recoup more of his loan.

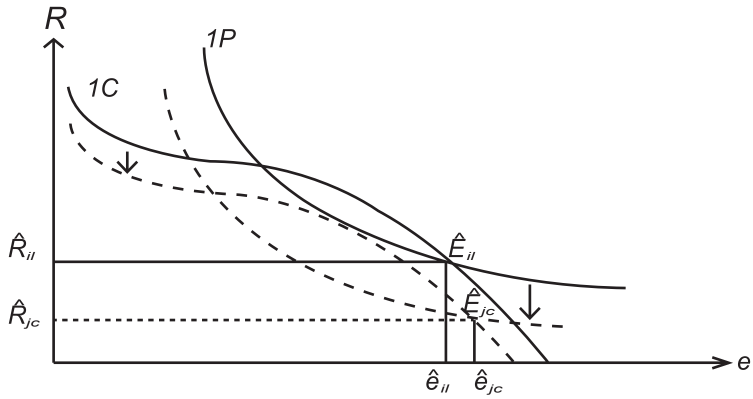
17 A more rigorous proof would involve solving the complicated differential equations (14) and (15), which, however, may not have closed form solutions. An alternative is to assume specific functional forms of the probability function and the cost of effort function, which makes it easier to arrive at closed-form solutions; see, for example, Ghatak and Guinnane (1999). Yet another approach is to simplify the whole problem by assuming that there are only two levels of effort, and thus only two probabilities of success, high and low, which again makes it easier to obtain closed-form solutions; see, for example, Laffont and Rey (2003). But these alternative approaches involve loss of generality; by contrast, our diagrammatic approach retains a high level of generality albeit at the cost of a little bit of rigour.

18 This is true for any value of $p \in [0,0.5)$. If $p > 0.5$, the IC curve will actually rise rather than fall but this will only reinforce the conclusion that follows.

19 This explanation is offered most clearly by Conning (1996, 2005) and is also referred to by Laffont and Rey (2003). The basic argument was first applied to the credit literature, though in a slightly different context, by Diamond (1984).

Figure 2

Credit Market Equilibrium with Moral Hazard under Joint Liability with Cooperative Behaviour



Something very similar happens in the case of lending with joint liability even when every member of a group invests in a single project. With co-operative behavior, the group as a whole acts a single entity, and the projects of all the members together can be viewed as diversified projects of that single entity. [20] Since the probability of the projects of all members failing simultaneously is less than the probability of failure of a single project, the group should be able to pay at least partially for the failed projects thanks to joint liability. Since the lender is now able to extract some penalty for failure, he can leave a smaller amount of 'incentive rent' to induce higher levels of effort.

To make the point with a more colorful analogy, we may restate the argument in terms of sticks and carrots. The lender contemplates the choice between a stick and a carrot to provide the right kind of incentive to the borrowers. Limited liability makes the stick difficult to administer; so he must offer some carrot – that's the incentive rent or the limited liability rent. When loan is given to a group with joint liability, and if the group acts co-operatively, the failure in one part of the group can be punished by extracting some penalty from other parts – that's the diversification advantage. In other words, joint liability provides a new stick to the lender. The emergence of this stick then allows the lender to reduce the carrot – i.e., lessen the amount of incentive rent.

As more rent is transferred to the lender, it's zero-profit condition implies a reduction in interest

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20 This way of reformulating the joint liability problem renders the analysis structurally similar to one particular strand in the general literature in moral hazard which studies a principal-agent problem with a single agent in a multi-task setting but facing limited liability (Holmstrom and Milgrom, 1991; Itoh, 1993), or where a single agent manages a multiple-outcome, single-task project under limited liability as in Innes (1990).

rate and better ability to offer additional loans, which enables the lender to extend the reach of credit. [21]

This result is central to the theoretical literature on microcredit. It can explain on the one hand how the microcredit institutions have been able to achieve exceptionally high rates of repayment despite the presence of limited liability. The explanation lies in the high level of effort induced by joint liability. With greater effort on the part of borrowers, the probability of success increases, thereby reducing the incidence of default and improving the repayment rate. At the same time, the result on lower interest rate explains how the microcredit sector is able to expand the access to credit for many poor borrowers. Finally, by bringing down the interest rate closer to the socially efficient level (e*), microcredit makes it possible to finance socially valuable projects that could not otherwise be financed. Thus, in one stroke, group lending with joint liability appears to achieve the multiple goals of efficiency, equity and greater sustainability of financial institutions.

The Pitfalls of Joint Liability

Yet, idea of joint liability, and its role in explaining the success of microcredit, has come to be increasingly questioned on a number of different fronts. One basic difficulty is that the entire analysis behind the presumed virtues of joint liability is predicated upon the assumption of co-operative behavior on the part of group members. If the members, however, decide to behave in a non-cooperative manner the result turns out to be strikingly different.

Under the non-cooperative scenario, each partner decides her effort level on her own but in doing so she must consider what level of effort the partner might choose because her best choice of effort would depend on her partner’s choice. For instance, if her partner chooses a low level of effort, thereby raising the likelihood that her project will fail, she too will choose a low level of effort so as to reduce the probability that she would be required to pay the joint liability fine for her partner’s failure. Conversely, if the partner chooses a high level of effort, thereby raising the likelihood of her project’s success, she too would be encouraged to put in more effort into her own project knowing that she is now less likely to have to pay the joint liability fine. The existence of joint liability thus engenders what game theorists call ‘strategic complementarity’ between the two partners.

[21] It should be pointed out that while we have identified reduction in interest rate as the vehicle through which the efficiency of a credit contract translates in the market place, this is not the only possible way of presenting the argument. Several other vehicles could be chosen - e.g., the size of loan, the size of collateral, and the size of project return. We have assumed a given loan size; but if loan size were allowed to vary efficiency would be expressed as the lender’s ability to offer larger loan. Similarly, we have assumed that the borrower has no collateral at all; but if instead we had assumed that different borrowers had different amounts of collateral (albeit less than the repayment burden so that limited liability still applied to some extent), the same efficiency would have found expression in smaller collateral requirement. Finally, we have assumed just one project with a given return, when it succeeds; but if different borrowers were assumed to have different returns, efficiency would be measured by the extent to which a lender was able to finance projects with lower returns (but still higher than the socially optimal return). Narratives involving all these vehicles are found in the literature - for example, the interest rate narrative is found in Ghatak and Guinanne (1999) and Laffont and Rey (2003), the loan size narrative in Stiglitz (1990) and Majadewicz (2004, 2011); the collateral narrative in Conning (1996, 2005) and the project return narrative in Aniket (2009). For the sake of uniformity of exposition, we have chosen by and large to tell the story in terms of interest rates (with some exceptions), but the diversity of channels through which the efficiency of a loan contract might be expressed in the market place must be recognised.

Each borrower decides her best action (i.e., choice of effort) keeping in view the possible actions by the partner and when their actions are consistent with each other we have the equilibrium, called Nash equilibrium. The options open to each borrower are represented by her 'best response function', which is derived by maximizing the pay-off function (8) with respect to her own effort level given any effort level of the partner. These response functions are obtained by solving the first-order conditions:

$$p'(e_i)(Y-R) - p'(e_i)[(1-p(e_j)]\,c = 1 \qquad i,j \in \{1,2\}\ ;\ i \neq j \tag{17}$$

Since the partners have been assumed to be identical in all relevant respects, their response functions will also be identical, leading to a symmetric Nash equilibrium in which each partner chooses the same level of effort. In that case, expression (17) can then be rewritten without the subscripts:

$$p'(e)(Y-R) - p'(e)[(1-p(e)]\,c = 1 \tag{18}$$

The lender's zero-profit function is the same as in the co-operative game, given by (13). Substituting (13) into (18), we get the following equation that would yield the optimum effort level ($\hat{e}_{jn}$) under non-cooperative conditions:

$$p'(\hat{e}_{jn}) = \frac{1}{Y - \frac{L}{p(\hat{e}_{jn})}} \tag{19}$$

This equation is exactly identical to (15), which is the corresponding equation we derived earlier for the individual liability case. Therefore, the equilibrium effort levels must also be the same.

$$\hat{e}_{jn} = \hat{e}_{il} \tag{20}$$

We thus arrive at the somewhat surprising conclusion that joint liability will not improve upon individual liability if the borrowers behave in a non-cooperative manner. Only co-operative behavior will ensure higher effort. One way of understanding this difference is in terms of externalities. When one partner chooses a higher level of effort she creates an externality for the other partner because it reduces the probability that the latter would have to bear the joint liability burden. Non-cooperative behavior, however, does not provide any mechanism for internalizing this externality; therefore, the mutual benefit of higher effort cannot be captured. It is only through co-operation that the externality can be internalized; thereby ensuring that higher level of effort will be expended by each partner.

It is instructive to go back to the IC-IP diagram to get a better insight into the failure of joint liability under non-cooperation. Comparison of IC condition (5) under individual liability with IC condition (18) under joint liability with non-cooperation shows that the latter has an additional term $-p'(e)[(1-p(e)]c$, which stems from the joint liability burden. In order to keep the left hand side of the equation equal to 1, the repayment burden must fall by exactly this amount. By repeating the argument we made earlier in connection with joint liability with cooperation, this implies that the IC curve must fall by the amount $[(1-p(e)]c$, which turns out to be exactly the amount by which the IP curve will also fall. The result, as shown in Figure 3, is that the effort level remains the same even as the equilibrium interest falls.

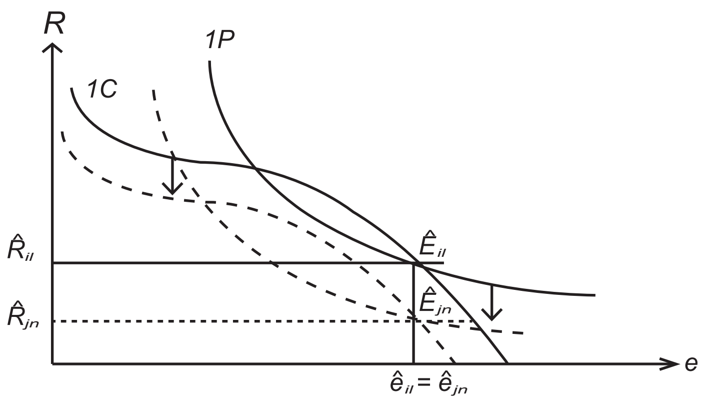
What is happening here is that while the receipt of joint liability payment enables the lender to bring down the rate of interest (so as to maintain the zero-profit condition), from the point of view of borrowers any gain in lower interest rate is exactly offset by the joint liability burden. As a result, they have no incentive to expend any more effort. Therefore, the probability of success will not change, and the repayment rate will not improve either compared to the individual liability case. Finally, since the combined cost of loan (including interest rate and joint liability cost) is exactly the same as the interest rate under individual liability, the reach of credit will not expand either. Thus, all the benefits claimed for joint liability are lost if the group members behave in a non-cooperative manner.

The superiority of joint liability thus hinges crucially on the assumption of co-operative behavior. But co-operative behaviour cannot simply be assumed to emerge, especially in view of the strategic complementarity noted earlier: if a borrower is assured that her partner will exert effort she will be encouraged to do so herself, but if she is afraid that the partner will not exert effort she won't either. But who is to give the assurance that the partner will exert high level of effort? We thus have a classic case of Prisoners' Dilemma, in which the absence of assurance about co-operation from the partner leads everyone to end up in the non-cooperative mode. Therefore, if joint liability is to improve upon individual liability, an incentive for co-operation must somehow be provided.

One possibility is to create the incentive internally, through the contract itself. Since the lender would prefer the borrowers to co-operate, he might try to devise the terms of the contract in such a way that the borrowers would find it in their interest to co-operate rather than not to. This means, however, that the lender must leave a larger amount of incentive rent to the borrowers than would otherwise be needed. And, as shown by Laffont and Rey (2003), the amount of incentive rent required to induce co-operation under joint liability (and costless monitoring) is exactly the same as in the case of individual liability. There is, therefore, no hope of improving upon individual liability through this route.

Figure 3

Credit Market Equilibrium with Moral Hazard under Joint Liability with Non-Cooperative Behaviour



An alternative is for the borrowers themselves to create the incentive externally, by devising a mechanism that would prevent deviant behavior. In the general literature on moral hazard involving a principal and multiple agents, this kind of cooperation-inducing mechanism is called a ‘side contract’, one through which the agents bind themselves to an agreement. It is assumed that the agents will, if necessary, take the help of a third party to enforce the contract. In his classic paper on joint liability in the credit market, Stiglitz (1990) had invoked precisely such a side contract.

A formal side contract enforced by a third party is, however, a rather fanciful idea in the context of rural societies in which people’s behavior is usually guided by informal codes of conduct, as encapsulated in the concept of a ‘moral economy’ (Scott 1976). In this setting, a side contract must be interpreted as an informal agreement enforced by social norms. The most natural interpretation of an enforcement mechanism in this context is the use of social sanctions, of the kind that is approved by the norms of a moral economy. If it can be assumed that borrowers are able and willing to impose social sanctions on each other in case anyone deviates from co-operative behavior (and additionally that monitoring is costless), joint liability can indeed be shown to achieve the cooperative equilibrium, thereby ensuring its superiority over individual liability (Conning 2005). The case for joint liability with costless monitoring, therefore, rests ultimately on the assumption that group members can threaten social sanctions to enforce contracts in ways that external lenders cannot.

The preceding discussion was based on the premise that monitoring is costless. Further complications arise, however, when it is recognized that monitoring is not actually costless. Some of the costs of monitoring are obvious - namely, the time and effort that are needed to find out what others are doing. A second, and less obvious, type of cost is related to the imposition of social sanctions discussed earlier. Peer monitoring would be useless without the backup of peer pressure and peer sanctions, but imposing pressure and sanctions on the peer is not a costless activity for the one who does the imposing. There is not only the psychological cost of doing unpleasant things to one’s friends and relatives, there is also a probable cost of weakening the fabric of social capital in a way that might be harmful for the imposer herself.[22] This too must be counted as the cost of monitoring. The first type of cost would be high in societies where social capital is weak, while the second type will be high where social capital is strong; either way, there is no escape from the costs of monitoring.

One immediate consequence of recognizing that monitoring can be costly is that it takes us back to the most basic question: what after all is the advantage of group lending over individual lending if costs of monitoring are to be incurred anyway? Of course, if one believes that peer monitoring would be less costly than lender monitoring, one can still claim the superiority of

[22] The edifice of a moral economy is based on the foundation of reciprocities – i.e., people belonging to the same social network helping each other out at times of crisis. If members of a network gang up on their peers to impose sanctions on each other, these reciprocities may not survive, which will eventually harm not only those on whom sanctions are imposed but also those who impose the sanctions. In this context, a particularly revealing story was narrated about the implementation of joint liability lending. Group members were found to be unwilling to impose sanctions on a delinquent peer because that particular peer happened to be a very popular midwife on whom the village depended heavily for childbirth and people were afraid of losing her services by antagonising her.

group lending (under co-operative behavior). But this belief needs empirical support. Of the two types of monitoring costs we have distinguished, the first type (time and effort) would most likely be higher for the lender, but the second type (the psychological and social costs of imposing sanctions) would probably be less. The net effect is an empirical matter.

In any case, theoretically the more interesting question is: if the lender and the peers had access to the same technology of monitoring, implying the same per unit costs of monitoring, would group lending still be superior? Madajewicz (2011) argues that it would be because even if the technology of monitoring were the same the two types of monitoring would have very different impacts on the lender's profit and the borrowers' incentive. When the lender monitors an individual loan, he must recoup the costs of monitoring from the borrower, by raising the interest rate. But, as we know, in an environment of moral hazard, higher interest rate will only serve to distort the incentive of the borrower by inducing her to reduce efforts, because in the presence of limited liability the repayment burden acts like a tax on success. By contrast, when the peers monitor each other, they do so by using their labor endowments, which is not subject to limited liability and therefore does not distort incentive. In consequence, effort levels will be higher and interest rates lower under peer-monitored group lending compared to lender-monitored individual lending.

In an extension of this theme, Conning (1996, 2005) compared peer monitoring with 'monitoring by delegates', whereby the lender engages a 'delegate' or a third party to do the monitoring on his behalf. The delegate may be either a bank official or a local person who knows the borrowers well. In addition to monitoring, the delegate may also be encouraged to either lend additional funds to the borrowers or underwrite their loans so as to increase his stake in the borrowers' success.[23] Drawing upon the recent theories of financial intermediation through delegates (e.g., Holmstrom and Tirole 1997), Conning shows that despite many advantages of delegated monitoring, peer monitoring will still generally outperform it because the lender will have to reimburse the delegate for their costs of monitoring, which will make a dent into their profits in a way that peer monitoring will not.

These findings would seem to suggest that the superiority of joint liability lending survives the recognition that monitoring can be costly. But this conclusion presumes that in group lending peers are going to monitor each other. If they do monitor, then indeed group lending would be superior to both individual and delegated monitoring even if everyone (including lenders and delegates) had access to the same technology of monitoring. But this begs the question: will the peers actually decide to monitor each other when doing so would involve costs?

The answer is no, if they are left to their own devices. The reason lies in the existence of a strategic complementarity in the decision to monitor, of the same kind as the one we saw in the case of the decision to exert effort: it is worthwhile for one borrower to monitor only if the partner also monitors, not otherwise. If my partner monitors me and ensures that I exert high level of effort and my project succeeds, I shall be keen to monitor her too so that her project doesn't fail saddling me with the joint liability burden. But if she doesn't monitor me and I exert low level of

[23] Banerjee *et al*. (1994) had earlier investigated the role of such delegates in the context of German cooperatives of the nineteenth century.

effort and my project fails, I shall be aware that I won't have to pay the joint liability fine on her behalf (owing to limited liability protection) if my partner also exerts low level of effort and her project fails; therefore, I shall have no incentive to incur the cost of monitoring. Given this strategic complementarity in costly monitoring, self-interested borrowers acting on their own will end up in a non-cooperative equilibrium with no monitoring and low level of effort.[24] Monitoring, like effort, becomes subject to moral hazard.

Clearly, costly monitoring, like costly effort, won't just happen; it must be induced in an environment of asymmetric information and limited liability. What can be done to induce it? As in the case of effort, we can think of two broad alternatives - one external to the credit contract and the other internal to it. The external inducement is, again, the use of social sanctions. As the fear of social sanction induces me to exert a high level of effort, it also at the same time induces me to monitor my partner lest the liability of her failure should be paid for by the fruits of my effort. If costs of monitoring are high, the severity of sanctions must be also be high to induce monitoring, but with appropriate level of sanctions monitoring will always happen whatever the cost.[25] Thus, as in the case of costless monitoring so in the case of costly monitoring social sanctions can come to the rescue of joint liability lending, ensuring that borrowers will exert a higher level of effort compared to individual lending.

There are, however, a couple of problems with this external solution. There is first a problem of conceptual inconsistency, which has largely been ignored in the literature so far. The inconsistency stems from the implicit assumption that the cost of monitoring and the cost of sanctions are independent of each other. But this assumption does not hold if, as we have argued, the psychological and social costs of imposing sanctions on a peer should be counted as part of the cost of monitoring. In that event, instead of overcoming the problem of costly monitoring social sanctions may indeed accentuate it. If sanctions are to be used to induce monitoring, it must now be allowed that the cost of monitoring will go up; in response sanctions will have to be made more severe to counter the heightened cost of monitoring; but the cost of monitoring will then rise even more and in response sanctions will have to be made even more severe, and so on, creating an upward spiral that may not have an equilibrium. In the limit, it may so happen that the very fabric of social capital, which gives legitimacy to social sanctions, will suffer such an irreparable damage that sanctions may lose their effectiveness altogether.

The second problem is of an empirical nature. Social sanctions may not work well where social capital happens to be weak. This is true of many environments, especially urban environments, in which microcredit institutions happen to work. Some alternative inducement mechanism must exist in those environments.

Mechanisms internal to the contract may offer the necessary alternative. Conscious of the existence of moral hazard in monitoring, the lender may want to provide an incentive to the borrowers so that they actually monitor each other. This incentive will have to be provided on top of the usual incentive for exerting effort. The question then arises: would joint liability lending still retain its superiority over individual lending? In the case of costless monitoring, we noted earlier

[24] See Chowdhury (2005) for a formal demonstration of this proposition.
[25] A formal proof can be found in Ghatak and Guinanne (1999).

that while the lender can indeed provide the necessary inducement to monitor, the amount of incentive rent required is just as high as in the case of individual lending, so that joint liability lending can claim no superiority over individual lending. In the case of costly monitoring, however, the picture is more complicated - it depends crucially on the sequence in which decisions are taken on monitoring and effort levels.

In the presence of costly monitoring, the strategic interactions among borrowers induced by joint liability can be seen as a game involving two kinds of decisions. The first decision involves whether to monitor or not, and the second decision involves whether to exert a high level of effort (or to choose the safe project) or not. These decisions may be taken either simultaneously or sequentially, but their implications for the success in inducing monitoring are radically different.

Consider first the case of simultaneous decision-making.[26] We can think of a simple game in which there are only two group members, each of whom makes a binary choice regarding both monitoring and effort. If they decide to monitor, they incur a cost c and if they do not monitor the cost is zero. If they choose a high level of effort they achieve a high probability of success denoted by $\bar{\pi}$ and if a low level of effort is chosen they achieve a low probability of success denoted by $\underline{\pi}$. The co-operative outcome will be achieved when each borrower chooses the strategy pair ($\bar{\pi}$, c). If these strategies are chosen simultaneously, it can be easily demonstrated that ($\bar{\pi}$, c) cannot be a Nash equilibrium.

If ($\bar{\pi}$, c) is to be a Nash equilibrium, it must be a symmetric best response for both players. But this cannot be so because if borrower 1 chooses ($\bar{\pi}$, c) borrower 2 will reason that her best response is in fact ($\bar{\pi}$, 0): given that borrower 1 will choose high level of effort, borrower 2 has no incentive to incur the cost of monitoring c but she will choose a high level of effort spurred by the knowledge that she was going to be monitored. Borrower 1 will then reason that her best response to borrower 2's ($\bar{\pi}$, 0) is ($\underline{\pi}$, 0), because if her partner is not going to monitor she can get away by lowering the level of effort. Borrower 2 will then change her response to ($\underline{\pi}$, 0), because if her partner is going to choose a low level of effort she doesn't want to increase the likelihood of being liable to pay for her partner's failure by raising her own probability of success. Thus the only symmetric equilibrium of the game is ($\underline{\pi}$, 0), the non-cooperative strategy. In essence, the problem stems from the strategic complementarity that is inherent in monitoring and in effort, as discussed earlier.

The whole idea of inducing peer monitoring through joint liability thus collapses if monitoring and effort choices are made simultaneously. In recognition of this problem, Conning (2005) and Laffont and Rey (2003) assumed a sequential structure of the decision-making process, in which the borrowers first decide on their monitoring level and then decide the effort level in light of the decision on monitoring made earlier. Once this sequence is allowed, it gives the lender the opportunity to commit the borrowers to monitoring by giving them an appropriate amount of incentive rent. This is what prevents peer monitoring from collapsing in this framework.

26 The argument in this paragraph and the next draws upon Conning (2005).

This formulation enables the authors to ensure that joint liability will lead to a co-operative outcome albeit at the cost of a higher incentive rent (compared to costless monitoring); and then they go on to ask whether joint liability is still superior to individual liability. Their answer is that it depends on the extent to which monitoring is costly. The higher the costs of monitoring the higher is the amount of incentive rent that must be left to the borrower to ensure that they do monitor each other. If the costs are very high, the incentive rent may turn out be even higher than in the case of individual lending. Therefore, the conclusion is that joint liability lending will be superior to individual lending even without the help of social sanctions provided the costs of monitoring are low.

One problem with this formulation is that the sequential structure that is assumed here is rather artificial. In the case of a one-period loan where all the borrowers receive loans simultaneously, there is no reason to suppose that borrowers will choose their monitoring level before choosing the level of effort. There is nothing to prevent them from making the two decisions simultaneously.

By contrast, a sequential structure emerges much more naturally if one considers the idea of conditional loan that was a common feature of the classic Grameen Bank model. In this model, only one member of a group was first given a loan; the second member received loan only after some time once the bank was reasonably confident that the first borrower would be able to repay her loan; if the first member was found to be delinquent the second member would be denied the loan when her time came. Loans for the remaining members were similarly staggered and made conditional on good repayment history of those who had borrowed first. When loan is offered in this conditionally sequential manner, the choice of monitoring and the choice of effort get naturally separated in time.

Chowdhury (2005) and Aniket (2009), among others, explore the implications of this temporal separation of the two choices. They both compare simultaneous lending with sequential lending but under different assumptions about the decision-making process in simultaneous lending. Chowdhury assumes that borrowers not only take loan at the same time, but they also decide on monitoring and effort decisions at the same time i.e., simultaneous lending is combined with simultaneous decision-making. Aniket, on the other hand, assumes a sequential decision-making structure (*á la* Conning and Laffont-Rey), in which the borrowers first decide on monitoring and then on effort.

As we have seen before, if decisions on monitoring and effort are taken at the same time, joint liability fails to induce a positive level of monitoring. Therefore, under the decision-making framework assumed by Chowdhury, simultaneous group lending can claim no superiority over individual lending. His concern was to investigate whether group lending can reclaim its superiority with a sequential financing scheme given that such a scheme provides a natural mechanism for separating monitoring choice from the choice of effort.[27] Not surprisingly, he finds that sequential financing does give an edge to group lending because it is able to generate a positive level of monitoring.

27 Chowdhury (2005) analysed the problem in the context of moral hazard in project choice arising from asymmetric information on the verifiability of project outcome - known as the problem of audit - rather than moral hazard in the choice of effort. However, the basic argument can be easily recast in terms of choice of effort.

The intuition behind this result is quite simple. Suppose, in period 1, borrower 1 receives the loan. For her, there is only decision to make: whether to exert a high level of effort or not. Borrower 2 also has only one decision to make: whether to monitor borrower 1 or not. In making this decision, borrower 2 will be aware that if she does not do the monitoring in the current period borrower 1 would exert low level of effort, which will raise the probability of her failure and this in turn will jeopardize borrower 2's prospect of receiving the loan in the second period. By monitoring, she may be able ensure that borrower 1 chooses a high level of effort, so that the loan gets repaid and she herself receives a loan in the second period. Therefore, regardless of whether borrower 1 monitors borrower 2 in the second period or not, it is in the interest of borrower 2 to monitor borrower 1 in the first period. The temporal separation of monitoring and effort thus dissolves the strategic complementarity that induces non-monitoring in a simultaneous loan contract.

It may be noted that the preceding argument did not invoke any joint liability payment at all. What induces monitoring here is not the desire to avoid repayment burden on behalf of a failed partner but rather the desire to receive one's own loan in the future. The stick of joint liability fine is replaced by the stick of denial of loan to the peers as the means of achieving the desired level of monitoring and effort. This change of stick makes a big difference to the relative strengths of alternative credit contracts. With sequential financing group lending is able to induce positive level of monitoring and can thus claim superiority over individual lending even without the help of joint liability fine[28], while it cannot do so with simultaneous financing relying on joint liability alone.

For Aniket (2009) the issue was slightly different. The question was not whether simultaneous or sequential financing can give group lending an advantage over individual lending by inducing positive level of monitoring because under his assumed decision-making framework simultaneous lending too can induce positive monitoring as demonstrated by Conning and others. For him, therefore, group lending is superior to individual lending in any case (provided costs of monitoring are not very high), no matter whether financing is simultaneous or sequential. His question was: given that both modes of financing can induce positive monitoring, which one is more efficient, in the sense of being able to finance more of socially desirable projects? The answer would depend on the amount of incentive rents that must be left to the borrowers under alternative schemes, because the lower the rent the lower would be the rate of interest (consistent with lender's zero-profit condition) and the greater would be the lender's ability to finance socially profitable projects. Aniket demonstrates that sequential lending is more efficient because it enables the lender to reduce the amount of incentive rent.

The reason lies in the nature of the borrowers' incentive compatibility constraints that must be satisfied under the alternative schemes. Under simultaneous lending, two different incentive compatibility constraints must be satisfied. First, there is a collective incentive constraint that is meant to ensure that all group members decide to monitor at the desired level and exert high level of effort rather than opt for the softer option of no monitoring and low effort. And then there is an individual constraint that is meant to ensure that given the commitment on monitoring

[28] Chowdhury shows, however, that the efficiency of loan and the group's repayment performance can be improved further by adding joint liability fine to conditional sequential loan.

already made by the group each individual has the incentive to expend the desired amount of effort. Since the first constraint incentivizes two tasks - namely, monitoring and effort - simultaneously, the rent associated with the first constraint is larger compared to the individual constraint where only one task (namely, effort) is incentivized. In the case of sequential lending, however, the group's collective incentive compatibility condition does not need to be satisfied as the two tasks do not need to be incentivized simultaneously. By separating the monitoring and effort decisions temporally, sequential financing enables the lender to offer only a single-task incentive in each period – namely, the incentive to monitor to one borrower and the incentive for effort to her partner. It is this replacement of two-task incentive by one-task incentive that enables the lender to reducethe incentive rent under sequential lending, which in turn makes sequential lending more efficient than simultaneous lending.

Yet another problem with costly monitoring has been analyzed by Madajewicz (2004, 2011). This problem becomes relevant when borrowers are risk-averse. Most of the theoretical literature on microcredit has assumed borrowers to be risk-neutral, mainly as an expositional simplification, although for poor borrowers risk-aversion would be a more natural assumption. Madajewicz finds that the introduction of this plausible assumption makes a striking difference to the analysis of joint liability.[29] Essentially, the problem is that for risk-averse borrowers joint liability induces two different kinds of incentives which pull in opposite directions. The standard, positive, incentive is that it induces the borrowers to monitor each other so that they don't have to pay the joint liability penalty for the partner's failure. This positive incentive has been widely recognized in the literature albeit under the assumption of risk-neutrality. But there is also a negative incentive, which has largely been ignored in the literature as it was swept aside by the ubiquitous assumption of risk-neutrality.

In order to understand the nature of this negative incentive, it will be convenient to change our narrative slightly – from one of moral hazard in the choice of effort to that of moral hazard in the choice of projects. Each borrower is assumed to have a choice between two projects – one safe and the other risky, which have the same expected return but the risky project has a higher return when it succeeds. The problem of moral hazard arises because in the presence of asymmetric information and limited liability the borrower may be inclined to adopt the risky project (because success would give her a higher return while failure doesn't worry her owing to limited liability) even though the lender wants her to adopt the safe project. Joint liability is expected to mitigate this moral hazard by giving incentive to the borrowers to monitor each other so that they adopt the safe project – this is the positive incentive referred to earlier.

But now compare the situations facing an individual liability borrower and a joint liability borrower when they choose the safe project. For the individual liability borrower, adoption of the safe project will yield a certain return. For the joint liability borrower, however, the return is no longer certain because even though her own project will give a certain return her overall return becomes uncertain as she may have to pay joint liability fine in case the partner chooses the risky project and it fails. In other words, joint liability replaces a certain outcome with a lottery,

29 The classic paper by Stiglitz (1990) did assume risk-aversion on the part of borrowers but most of the subsequent contributions were based on the assumption of risk-neutrality.

whose outcome depends on her partner's choice and her luck. If the expected return from the lottery is the same as the certain return, this particular consequence of joint liability does not make any difference to the risk-neutral borrower, but it does to a risk-averse one - she does not like risk associated with the lottery. In order to mitigate that risk, she may become inclined to adopt the risky project herself, in the hope that if the project succeeds its higher return would enable her to bear the risk better. Joint liability may thus induce a borrower to choose a risky project even though as an individual liability borrower she may have chosen the safe project – that's the negative effect of joint liability under risk-aversion.

In his pioneering paper, Stiglitz (1990) did recognize this possibility but he argued that it could be ignored because its effect would be of second-order importance compared to the positive effect if the joint liability fine is made arbitrarily small. Madajewicz correctly argues, however, that the idea of an arbitrarily small joint liability is plausible only if monitoring is costless (which Stiglitz assumed). If monitoring is appreciably costly the joint liability fine will have to be large in order to give the borrowers the right amount of incentive to monitor. In that case, the negative effect will no longer be insignificant and the net effect of joint liability would depend on the relative strengths of positive and negative incentive effects. Thus, with costly monitoring and risk-averse borrowers, the superiority of joint liability cannot be taken for granted.

4. Theories of Microcredit involving Adverse Selection

Ever since the classic work of Arrow (1963) and Akerlof (1970), it has become well-known that when informational asymmetries exist market can behave in strange ways. In particular, bad products and bad clients may drive good products and good clients out of the market – a kind of market failure that has come to be known as adverse selection.[30] In a couple of pioneering papers, Jaffe and Russell (1976) and Stiglitz and Weiss (1981) applied this idea to the credit market and showed that when lenders cannot distinguish between 'good' and 'bad' borrowers the market clearing interest rate might allow too many 'bad' borrowers and too few 'good' borrowers to demand loans than is desirable from the lender's point of view. In consequence, the lender might resort to credit rationing, leaving a part of the demand for credit unsatisfied.[31] This would be socially inefficient although it would be a rational response for the lender– a classic case of market failure.[32]

30 Akerlof (1970) analysed the second hand car market, where sellers have private information about the condition of the car that buyers can hardly know about. He showed that given such information asymmetry, the price mechanism would work in such a way that bad cars ('lemon' in American parlance) would tend to drive good cars out of the market. Ever since, the phrase 'the lemons problem' has become synonymous with the problem of adverse selection in general.

31 There is a difference, however, in the nature of credit rationing in the two models. In Jaffe and Russell, credit rationing takes the form of offering a smaller amount of loan than what is demanded by the borrower at the market rate of interest. By contrast, in the main model developed by Stiglitz and Weiss, it takes the form of the lender randomly denying loans to some borrowers even if they were prepared to pay a slightly higher interest rate than what was prevailing in the market. For a comprehensive review of credit rationing, see Jaffe and Stiglitz (1990). An early application of the idea of credit rationing in the context of rural economies of the developing world can be found in Carter (1988).

32 The possibility or the necessity of the Stiglitz-Weiss type credit rationing has been questioned, however. Two main conclusions emerge from this literature. First, the existence of credit rationing requires additional assumptions that may or may not hold in specific circumstances. Second, even if there is no credit rationing, the fact remains that adverse selection will render the market outcome inefficient. Thus inefficiency rather than credit rationing *per se* remains the most robust conclusion of this literature. See, for example, Hubbard (1998), de Meza and Webb (2006), Arnold and Riley (2009) and Agur (2012).

A strand of microcredit theories has claimed that the practice of microcredit institutions contains a number of features (especially the joint liability mechanism) that can help avoid the adverse selection problem and thereby improve the performance of the credit market. This section provides an analytical review of these theories. Before proceeding to this review, however, we first set the stage by explaining how asymmetric information tends to create adverse selection in the standard credit market with individual lending.

Adverse Selection in the Credit Market with Individual Lending

Following Stiglitz and Weiss (1981), we take as the starting point that there are borrowers with different degrees of riskiness; the borrowers themselves know how risky they are but the lender does not. While in real life one would expect to find a continuum of borrowers with different levels of 'risk', for simplicity we shall assume here that there are just two types of borrowers, called 'risky' and 'safe'. The probability of success of their respective project is denoted by p_s for safe borrowers and p_r for risky borrowers, where $0<p_r<p_s<1$. The lender is unable to distinguish between safe and risky borrowers; however, he is assumed to know that safe and risky types exist in the population in the proportions θ and $(1-\theta)$respectively.

Both types of borrowers are assumed to have an outside option of value v, which they can earn with certainty if they do not invest; v thus constitutes the opportunity cost of the project from the point of view of the borrowers. Neither type of borrower has any collateral to offer, nor do they have any liquid assets of their own, which means that they must borrow if they are to invest at all. Each project has two possible outcomes: success or failure. When the project succeeds, it yields the return R_s per dollar of investment to the safe borrowers and R_r to the risky ones, and if it fails it yields zero to both types. The outcomes of the projects are assumed to be independently distributed.

As in the preceding two sections, the lender is assumed to operate on a zero-profit basis. His cost of fund is denoted by ρ, which also stands for the social cost of funds, so that the overall social cost of investment in a project is given by $(\rho+v)$. The lender's task is to choose a rate of repayment r (principal plus interest) per dollar of loan, which will maximise borrower's utility while satisfying his own zero-profit condition.

If the lender knew the borrower's risk attribute, he could have charged two different rates of interest to the two types of borrowers, commensurate with their levels of risk, and consistent with his own zero-profit condition

$$r_i p_i - \rho = 0; \quad i = s,r \tag{21}$$

In equilibrium, we shall have

$$r_i{*} = \frac{\rho}{p_i}; \quad i = s,r \tag{22}$$

Since $p_r<p_s$, equation (22) would entail $r^*_r > r^*_s$. This would be an efficient outcome as more risky borrowers would be required to pay a higher interest rate. However, this solution does not work in a situation of asymmetric information where the lender cannot distinguish between the two types of borrowers because the risky borrowers would pretend to be safe so as to pay the lower interest rate meant for safe borrowers; the lender's zero-profit condition would not be satisfied in that event – he will go bankrupt. In technical jargon, we say that a 'separating contract' (or a 'separating equilibrium') does not exist in this situation.

The question then arises whether there exists a 'pooling contract' or a 'pooling equilibrium' where the same contract is offered to both types of borrowers without violating the zero-profit condition. If such equilibrium does exist, what are its characteristics – in particular, will it attract both types of borrowers or only one, and will it be efficient? It turns out that a pooling equilibrium does indeed exist but its characteristics depend critically on the nature of risks and returns faced by the borrowers.

In their classic paper on asymmetric information in the credit market, Stiglitz and Weiss (1981) assumed that both safe and risky borrowers had the same expected return but the risky borrowers had a greater spread around the mean − known as the assumption of mean-preserving spread. In the present context, this assumption implies the following relationships:

$$p_s R_s = p_r R_r;\ R_r > R_s;\ p_r < p_s \qquad (23)$$

In this formulation, when a project succeeds the risky borrower gets a higher return than a safe borrower, but her project succeeds less often, yielding the same expected return. An alternative formulation was proposed by de Meza and Webb (1987), in which the two types of borrowers get the same return when the project succeeds but the risky borrower has a lower expected return because of her lower probability of success.

$$p_s R_s > p_r R_r;\ R_r = R_s;\ p_r < p_s \qquad (24)$$

Theories of microcredit have been developed under both sets of assumptions. Since the implications of these assumptions for the nature of equilibrium in the credit market are very different, we need to understand their implications for individual contracts first before embarking on an elucidation of the theories of microcredit. To this end, we shall analyze the consequences of offering a pooling contract to individual borrowers first under the Stiglitz-Weiss (S-W) scenario and then under the de Meza-Webb (M-W) scenario.[33]

Pooling equilibrium with individual contracts under the Stiglitz-Weiss (S-W) scenario

Let the common expected return to the two types of borrowers be denoted by $\overline{R}$ and the common interest charged by the lender by r. Let us also assume that the project is socially productive whichever type of borrower undertakes it. We then have the following relationships.

$$\overline{R} = p_s R_s = p_r R_r \qquad (25)$$

$$\overline{R} - p_s r < \overline{R} - p_r r \qquad (26)$$

$$\overline{R} > \rho + v \qquad (27)$$

[33] Technically speaking, both sets of assumptions imply that the probability distribution of returns to the safe borrower stochastically dominates that of the risky borrower but in two quite different ways: the M-W case represents first-order stochastic dominance whereas the S-W case represents second-order stochastic dominance. On the difference between the two kinds of stochastic dominance, see Rothschild and Stiglitz (1970).

The participation constraints of the two groups of borrowers are

$$\overline{R} - p_s r \geq v, \quad and \quad \overline{R} - p_r r \geq v, \tag{28}$$

The critical rates of interest at which the two groups will participate are then given by

$$\hat{r}_s = \frac{\overline{R} - v}{p_s} \quad and \quad \hat{r}_r = \frac{\overline{R} - v}{p_r} \tag{29}$$

Since $p_s > p_r$, we must have $\hat{r}_s < \hat{r}_r$. The equilibrium interest must be less than these critical values for the respective borrower group to participate in the credit market. Defining the average probability of success as $\overline{p} = \theta\, p_s + (1\text{-}\theta)\, p_r$, the equilibrium interest rate under a pooling contract can be derived from the lender's zero-profit condition as follows:

$$r^* \overline{p} = p, \text{ or, } r^* = \frac{p}{\overline{p}} \tag{30}$$

Whether a particular type of borrower will participate in the credit market or not will depend on where r^* happens to lie in relation to the critical values $(\hat{r}_s, \hat{r}_r)$. Comparing the equations for $\hat{r}_r$ and r^*, it may be noted that r^* must always be less than $\hat{r}_r$.[34] This leaves us with two possibilities: either $(r^* < \hat{r}_s < \hat{r}_r)$ or $(\hat{r}_s < r^* < \hat{r}_r)$. In the first case, both groups will participate, but in the second case only the risky group will participate and the safe group will stay away.[35]

The second possibility gives rise to adverse selection in the credit market under asymmetric information. The absence of safe borrowers also means that the credit market is inefficient because by assumption all borrowers have socially productive projects. If safe borrowers cannot participate in the credit market, some of the socially productive projects do not get undertaken. Thus, under the S-W scenario, the credit market may suffer from underinvestment.[36]

Pooling equilibrium with individual contracts under the de Meza-Webb (M-W) scenario

The M-W scenario differs from the S-W scenario in that we now have a common return for both types of borrowers when the project succeeds rather than a common expected return. Let this common return be denoted by R . The expected net returns will now be different for the two types of borrowers even though the pooling contract offers the same interest to both.

$$p_s (\tilde{R} - r) > p_r (\tilde{R} - r) \tag{31}$$

[34] This is so because $(\overline{R} - v) > p$ (from (7)) and $\overline{p} > p_r$ by definition.

[35] It may seem odd that we are using the term 'pooling equilibrium' to describe a situation where all the safe borrowers are left out, but this is merely a consequence of our simplifying assumption of a discrete probability distribution with only two values of project return. If instead we had assumed a continuous probability distribution with many different returns and their corresponding probabilities, we would have had a truly pooling equilibrium with a mix of risk profiles but some borrowers at the upper end of the probability distribution being left out by adverse selection.

[36] For further analysis of the underinvestment problem under asymmetric information in the credit market, see Gale (1990), Jaffee and Stiglitz (1990) and Hubbard (1998).

The fact that expected returns now differ between the two types of borrowers allows us to examine an interesting case where the safe borrowers are socially productive while the risky borrower are not, i.e.,

$$p_s \tilde{R} > p + v; \qquad p_r \tilde{R} < p + v; \tag{32}$$

The participation constraints of the two groups of borrowers are

$$p_i (\tilde{R} - r) > v; \;\; i = r, s \tag{33}$$

The critical rates of interest at which both groups participate are then given by

$$\hat{r}_s = \tilde{R} - \frac{v}{p_s} \;\; and \;\; \hat{r}_s = \tilde{R} - \frac{v}{p_r} \tag{34}$$

Since $p_s > p_r$, we must have $\hat{r}_s > \hat{r}_r$. Note that this is opposite to what we found for the S-W case. The reason is that as the risky borrowers have a lower expected return in the M-W case, the critical interest rate above which they will not participate must be lower compared to the safe borrowers. As before, whether a particular group participates in the credit market or not will depend upon the relationship of these critical values with the equilibrium interest r^* (as given in (20). From (22),

$$\tilde{R} - \frac{v}{p_s} > \frac{p}{p_s} \text{ and } \tilde{R} - \frac{v}{p_r} < \frac{p}{p_r} \tag{35}$$

Using (24) and (30), and noting that $p_s > \overline{p} > p_r$, the inequalities in (35) imply that r^* can be either greater than $\hat{r}_s$ or smaller than $\hat{r}_r$ or somewhere in between. Let us first consider the in-between case where $\hat{r}_s > r^* > \hat{r}_r$. In this situation, only the safe borrowers will participate in the credit market and the risky borrowers will stay away – the complete opposite of the result found for the S-W scenario. This will be a socially efficient outcome though, because by assumption the risky borrowers are socially unproductive. Now consider an alternative case where $\hat{r}_s > \hat{r}_r > r^*$. Now both groups will participate, but this will be an inefficient outcome as socially unproductive risky borrowers have also come to the fold. This is also a case of adverse selection but of a different kind. Here the selection is adverse not because some good borrowers are put off by the pooling contract (as in the S-W scenario) but because some bad borrowers are attracted by it. And inefficiency in the credit market arises not from underinvestment but from overinvestment.[37]

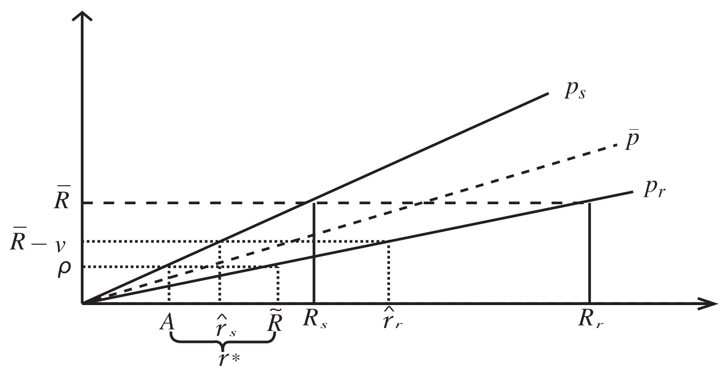
In both S-W and M-W scenario, the possibility of adverse selection arises from the equilibrium r^* taking a value within a particular range. Since, with given ρ, the value of r^* depends on the average probability of success $\overline{p}$ (see equation (30)), which in turn depends on the proportions of risky and safe borrowers in the population (as measured by the parameter θ), the likelihood of adverse selection itself depends on these proportions. The following diagrammatic analysis helps to see these relationships more intuitively.

[37] The problem of overinvestment under asymmetric information is further analysed by Bernanke and Gertler (1990).

Figure 4 represents the S-W scenario and Figure 5 the M-W scenario. In both cases, the rays p_s and p_r going through the origin stand for the probabilities of success: the slopes of these two rays are equal respectively to the probability of success of the safe borrower (p_s) and that of the risky borrower (p_r). Since $p_s > p_r$, the p_s ray is steeper than the p_s ray. The average probability of success ($\bar{p}$) is represented by a line lying in between these two rays. The exact location of this line will depend on the proportions of safe and risky borrowers in the population. The higher the proportion of safe borrowers (θ), the closer it will be to the p_s ray.

Figure 4

Adverse Selection in the Credit Market :
The Stiglitz-Weiss (S-W) Scenario



In Figure 4 (the S-W case), the returns to the project, R_s and R_r , for the safe and risky types respectively, are shown on the x-axis, and the social cost of capital ρ is shown on the y-axis. We now proceed in three steps. In the first step, we locate on the y-axis the point of expected return, $\bar{R}$. Given that $\bar{R} = p_s\ R_s = p_r\ R_r$, the location of $\bar{R}$ on the y-axis can be found by drawing a horizontal line that cuts the p_s and p_r rays just vertically above the points R_s and R_r respectively. In the second step, we locate the critical interest rates $\hat{r}_s$ and $\hat{r}_r$ on the x-axis. Noting from (29) that $p_s\hat{r}_s = p_r\hat{r}_r = \bar{R} - v$, we first locate the point ($\bar{R} - v$) on the y-axis and then draw a horizontal line from that point. From the points at which this line intersects the p_s and p_r rays, we then draw vertical lines on the x-axis, which will give us the critical values $\hat{r}_s$ and $\hat{r}_r$.

Finally, we locate the equilibrium interest rate $r*$ on the x-axis. Noting from (30) that $\bar{p}r* = \rho$, this can be done by first locating the point ρ on the y-axis and then following a procedure similar to the one used in the second step: draw a horizontal line from ρ, locate the point of intersection with the $\bar{p}$ ray, and then locate the point vertically below on the x-axis – this will represent $r*$. As θ varies from 0 to 1, the $\bar{p}$ ray will span between the rays p_r (when θ= 0) and p_s (when θ= 1). Accordingly, the equilibrium $r*$ will lie within the range represented by the line segment AB on the x-axis.

Clearly, depending on the value of θ, which determines the location of $\bar{p}$ ray, $r*$ can lie either to the right or the left of $\hat{r}_s$. There is a critical value of θ, which underlies the $\bar{p}$ ray as drawn in Figure 1, at which $r*$ will be equal to $\hat{r}_s$. For any lower value of θ, the $\bar{p}$ ray will be flatter than what has been shown in the diagram, and the corresponding $r*$ will lie to the right of $\hat{r}_s$. In that case, safe borrowers will not participate in the credit market. This is where adverse selection comes in.

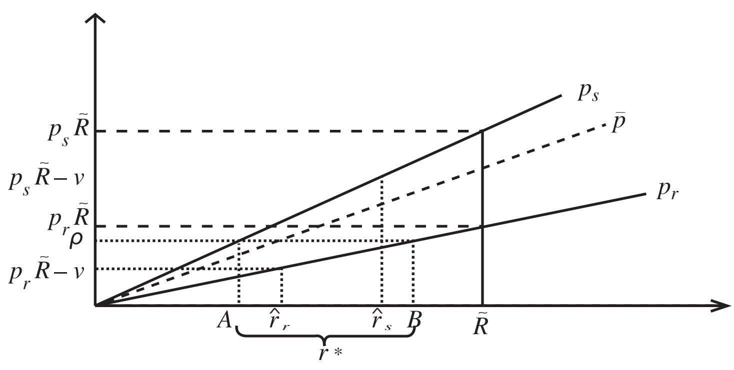
Intuitively, the problem arises from the fact that the lower the value θ, i.e. the higher the proportion of risky borrowers in the population the higher the pooling interest rate will have to be in order to allow for increased risk of default. But as the interest rate goes up, the contract becomes less and less attractive to safe borrowers who have a lower return (when the project succeeds), while the risky borrowers may still be interested as they enjoy a higher return when the project succeeds.[38] That is why, when the value of θ falls below a critical level, adverse selection sets in.

For a diagrammatic treatment of the M-W scenario (in Figure 5), we follow the same three steps as in Figure 4. The main difference is that in the first step we now have only one return $\tilde{R}$ on the x-axis but two different points of expected returns on the y-axis. Accordingly, in the second step, we locate two points on the y-axis, instead of one, representing $(p_s\tilde{R} - v)$ and $(p_r\tilde{R} - v)$ respectively. In the third step, we again draw a horizontal line from ρ on the y-axis, but we deliberately place ρ above the point representing $(p_r\tilde{R} - v)$ to reflect the assumption that risky borrowers are socially unproductive. Then, following the same logic as in Figure 4, we locate the critical interest rates $\hat{r}_s$ and $\hat{r}_r$ on the x-axis and the range AB within which the equilibrium interest rate $r*$ will lie.

As θ varies from 0 to 1, making the $\bar{p}$ ray span between the rays p_r (when θ= 0) and p_s (when θ= 1), there will be a critical value of θ, and hence a particular location of $\bar{p}$ (as drawn in the diagram), at which $r*$ will be equal to $\hat{r}_r$. For any lower value of θ, the $\bar{p}$ ray will be flatter, so that $r*$ will lie to the right of $\hat{r}_r$. In this situation, the risky borrowers will stay away from the credit market and only the safe borrowers will participate; this will be an efficient outcome since only the safe borrowers are socially productive. However, for any higher value of θ, the $\bar{p}$ ray will be steeper and $r*$ will lie to the left of $\hat{r}_r$. In this situation, the socially unproductive risky borrowers will also join the credit market, leading to adverse selection.

Figure 5

**Adverse Selection in the Credit Market :
The de Meza-Webb (M-W) Scenario**



[38] Even though their projects are also more likely to fail, it does not worry them so much because the limited liability constraint protects them from repayment in case of failure. Of course, failure may still be a concern as a very high probability of failure might make the expected return fall below the opportunity cost v, but until that point is reached, i.e., the so long as the participation constraint does not bind, failure does not matter.

To see the intuition behind this adverse selection, note that when the proportion of risky borrower is high the average risk of default is also high, so that the lender is obliged to offer a pooling contract with a high interest rate. Up to a point, safe borrowers will not be put off by high interest rate because their expected return may be high enough to satisfy their participation constraint i.e., to enable them to recoup the opportunity cost v after repaying loan. However, risky borrowers may want to stay away because their expected return is too low to recoup the opportunity cost. But as the proportion of safe borrower rises, the overall risk of default declines, which allows the lender to offer a pooling contract with a lower interest rate. And if this proportion rises high enough, the interest rate may fall enough to attract the risky borrowers. To make the point differently, the existence of safe borrowers creates a pecuniary externality for risky borrowers by helping to keep the interest rate low. The more numerous the safe borrowers are, the bigger is the externality. And if they are sufficiently numerous to bring the equilibrium interest rate below the critical level consistent with the participation constraint of risky borrowers, adverse selection will occur.

Joint Liability as a Solution to Adverse Selection

Before discussing how the practice of group-lending in microfinance can deal with the problem of adverse selection, it might be useful to first note how the literature has sought to find a solution in the context of individual-based lending itself. In the general literature on adverse selection (in any market), the standard approach is to look for a menu of contracts with two characteristics: first, each contract in the menu should be compatible with the participation constraint of the principal (which in the present context means that each credit contract must satisfy the lender's zero-profit condition), and second, different types of agents will choose different items from the menu depending on what suits them best, thus leading to a separating equilibrium. Since each type of agent will maximise its own utility through its choice of contract, while keeping the principal on his reservation utility, the outcome will be Pareto efficient. In the context of adverse selection in the credit market, a solution along this was suggested by Bester (1985).

The menu of contracts he suggested consists of two instruments: the rate of interest (r) and the amount of collateral (c). The lender can offer a range of contracts (r,c) by varying the levels of the two instruments. In order to satisfy the zero-profit condition, contracts with higher interest rates must be coupled with lower values of collateral and vice versa. Faced with this choice of contracts, borrowers of different risk types will choose differently. The low risk-types will choose contracts with low-interest rate and high collateral, because they are confident about not being obliged to part with the collateral very frequently. By contrast, the high risk-types will choose contracts with high interest rate and low collateral as they are more likely to fail and hence more likely to lose their collateral. This is of course exactly what the lender wants: he wants to charge higher interest rates for the more risky borrowers. The problem is that he cannot achieve this goal when his menu of contracts consists of only one instrument – namely, the interest rate – because the high-risk types will pretend to be low-risk, choose the low interest rate contract, and thereby break the zero-profit condition of the lender. This outcome is neatly averted, however, by coupling the additional instrument of collateral with the interest rate. If now the high-risk types try to pretend to be low-risk and choose low interest rates, they will be obliged to offer high collateral, which they do not want to do. Out of their own interest, they will then choose the 'high-interest low-collateral' option. Adverse selection is thereby avoided and efficiency achieved.

While theoretically elegant, the problem with this solution is that there might be a limit to what the borrowers can put up as collateral owing to the wealth constraint. In particular, if the 'low-interest high-collateral' contracts require levels of collateral that are higher than what the low-risk borrowers can afford to offer, then many low-risk types will be forced to stay out of the market, thus allowing adverse selection to creep back in. A possible way out was suggested by Besanko and Thakor (1987), who showed that low-risk borrowers may be able to offer supplementary collateral by way of guarantee from co-signees. This mechanism is expected to work because the co-signees, who are assumed to belong to the same community as the borrowers and are therefore likely to be able to distinguish between different risk-types, should be willing to co-sign the loan applications of low-risk borrowers.

It is this idea that local knowledge can be harnessed as substitute for hard collateral that was exploited by the theorists of microcredit working with models of adverse selection. With group-based lending, the instrument of collateral is replaced by joint liability payment. If the lender now offers a menu of contracts (r,c) in which low rates of interest (r) are coupled with high joint liability payment (c) and vice versa, it can be argued, following Bester's logic, that safer borrowers would opt for the 'low-interest high-joint-liability' option while risky borrowers will choose the opposite combination. Once again a separating equilibrium should emerge and adverse selection be avoided.

It turns out, however, that when collateral is replaced by joint liability payment, the application of Bester's logic is not straightforward. Since the choice of contracts is now made by groups rather than individuals, the most we can argue, based on Bester's logic, is that groups of safe borrowers would opt for the 'low-interest high-joint-liability' option while groups of risky borrowers will choose the opposite combination. In other words, for Bester's logic to apply to group lending, the groups must be homogeneous in nature consisting of members of the same risk-types. But this begs the question: who is going to ensure that groups will be homogenous? What is to prevent formation of heterogeneous groups containing members of different risk types? This is where the importance of local information comes in. The lender may not know who are low-risk and who are high-risk borrowers but in a closely knit society the borrowers themselves are likely to know each other's type. What is needed, therefore, is an incentive mechanism that will induce the borrowers to form only homogeneous groups.

One possibility is to follow a strategy suggested by Varian (1990). He proposed a screening mechanism in which borrowers themselves from groups amongst themselves but the lender ensures that only safe borrowers will form groups leaving out the risky borrowers. The lender does so by interviewing at random any one member of a group and trying to assess whether that particular member is a good type or a bad type. If the interviewee is assessed to be a bad type, the whole group will be rejected. This will give incentive to the safe borrowers to form groups only with other safe borrowers.

A practical problem with this procedure is that the lender' assessment process may not be very reliable, in which case the whole practice of group-based lending will be rendered inefficient. More fundamentally, direct intervention by the lender is not really necessary to ensure formation of homogeneous groups. In a couple of influential papers, Ghatak (1999, 2000) has shown that if lender offers joint liability contracts, homogeneous groups will be formed in an endogenous manner. The very logic of joint liability will lead to 'assortative matching', whereby safe borrowers form groups only with safe borrowers and risky borrowers form groups only with risky borrowers.

Consider the logic that drives the process of group formation. Every borrower, regardless of her risk type, would want to form group with a safe partner because this will minimize the prospect of joint liability payment, and thereby maximize her own expected pay-off. But not every borrower will attach the same value to having a safe partner. A safe borrower will value a safe partner more. This is because being a safe borrower, she is more likely to succeed and therefore more likely to have to pay the joint liability penalty if she joins with a risky partner.[39] In other words, the expected joint liability cost of being associated with a risky partner is higher for a safe borrower than for a risky borrower. Correspondingly, the benefit of being associated with a safe partner is higher for a safe borrower than for a risky borrower. Therefore a safe borrower values a safe partner more than does a risky borrower. Given this difference in valuation, safe borrowers will be driven towards other safe borrowers, leaving risky borrowers to form groups amongst themselves.

A little bit of formal logic may help clarify the point better. Consider the simplest case of two-person groups, in which the first person is designated by i and her partner by j, where both i and j can be either of the safe type (s) or the risky type (r). The probabilities of success are denoted by p_s and p_r for the safe and risky types respectively. In keeping with the Stiglitz-Weiss assumptions, $p_s > p_r$ but the safe type has a lower return ($R_s < R_r$) when the project succeeds (and both have zero return when the project fails) so that both types have the same expected return: $p_s R_s = p_r R_r$. Take any joint liability contract, denoted by (r,c), where, as before, r stands for the rate of interest and c for the joint liability penalty. The expected payoff (U) of borrower i with a partner j is given by

$$EU_{ij}(r,c) = p_i\, p_j\,(R_i - r) + p_i\,(1 - p_j)\,(R_i - r - c) \qquad (36)$$

The first part of the right hand side of (36) stands for the pay-off when both i and j succeed and the second part for the pay-off when i succeeds but j fails.[40] The pay-off function can be rewritten as:

$$EU_{ij}(r,c) = p_i\,(R_i - r - c) + p_i\, p_j\, c \qquad (37)$$

It can now be easily worked out that $EU_{ss} - EU_{sr} = p_s\,(p_s - p_r)$. This is the gain, from the point of

39 Recall that joint liability penalty is paid only when a borrower herself succeeds in her project while her partner fails.

40 There are actually four possibilities: (i) both *i* and *j* succeed, (ii) *i* succeeds, *j* fails, (iii) *i* fails, *j* succeeds, and (iv) both *i* and *j* fail. Since *i* does not receive anything nor pays anything if she fails, only the first two cases enter in her pay-off function.

view of a safe borrower, of having a safe partner compared to having a risky partner. From the point of view of a risky borrower, the corresponding gain is given by $EU_{rs} - EU_{rr} = p_r\,(p_s - p_r)$. Since $p_s > p_r$, the gain from having a safe partner is clearly greater for a safe borrower than for a risky borrower. A safe borrower will, therefore, value a safe partner more than will a risky borrower.

It is this difference in valuation that guides the nature of group formation. If the process of group formation is completely voluntary, the groups will form in such a way that satisfies a principle known as the 'optimal sorting property'.[41] This principle says that groups are formed optimally when members not in the same group could not form another group without making at least one of them worse off. Given the difference in valuation noted above, it is easy to see that only assortative matching, leading to homogenous groups, satisfies this property. Clearly, if a safe borrower were to find herself in a heterogeneous group, she would be worse off compared to being in a homogenous group of safe borrowers because a risky partner is less valuable to her than a safe partner.

One further issue needs to be addressed, however, before the optimality of assortative matching can be firmly established. If side payments were allowed among the borrowers, one would have to ask: can the risky borrowers entice the safe borrowers to form heterogeneous groups with them by offering a bribe? The answer is 'no', and the reason again lies in the difference in valuation noted above. The risky borrower may well try to bribe the safe borrower, because after all she too prefers a safe partner to a risky one, but would fail to do so because the maximum value she attaches to having a safe partner is less than the maximum value the safe borrower herself attaches to having a safe partner. In other words, the maximum amount a risky borrower would be willing to offer as bribe is less than what the safe borrower would demand as compensation for giving up a safe partner. Side payments can thus never be large enough to induce safe borrowers to form groups with risky borrowers. Therefore, only assortative matching can occur.

Once it is established that only homogenous groups are formed comprising of borrowers of similar risk types, it is easy to demonstrate how lenders can induce a separating equilibrium by offering a menu of contracts with varying combinations of (r, c). The crucial point here is that borrowers of different risk types will have different trade-offs between r and c. To see how, first note that under assortative matching equation (36) transforms into:

$$EU_{ii}\,(c,r) = p_i\,R_i - \{\,p_i r + p_i\,(1 - p_i)\,c\,\} \qquad (38)$$

Noting that the expected return $p_i R_i$ is a given constant for a particular situation, we can view (38) as generating a set of indifference curves between r and c. The marginal rate of substitution between them is given by $\frac{dc}{dr} = \frac{1}{1 - p_i}$. Since $p_s > p_i$, it follows that the indifference curve is steeper for the safe borrowers.[42]

[41] For more on this property, see the pioneering work of Becker (1993) on assortative matching in the context of the marriage market.

[42] As such, the preferences of the two types of borrowers satisfy what is known as the 'single-crossing property', which is essential for the existence of a separating equilibrium under asymmetric information. See Fudenberg and Tirole (1991), chapter 7.

This implies that to receive a small reduction in the interest rate, safe borrowers would be willing to pay a higher amount of joint liability penalty than risky borrowers. Safe borrowers are confident that since they have safe partners they won't have to pay the joint liability penalty very often; they are therefore happy enough to accept a higher value of penalty for the benefit of enjoying a lower interest rate. By contrast, a risky borrower is more concerned about joint liability payments since she has a risky partner who is very likely to fail more often than the partner of a safe borrower. That's why she is keen to keep the joint liability penalty low even at the cost of a higher interest rate. Taking advantage of this difference in trade-off, the lender can offer a menu of contracts with varying combinations of (r,c). Faced with this menu, safe groups will choose a contract with low interest rate and high joint liability penalty while risky groups will choose the opposite combination. Group lending mechanism thus gets rid of the adverse selection problem as safe borrowers are no longer driven away from the credit market.[43]

Though theoretically elegant, this result has to contend with a rather serious practical problem: namely, that hardly any microcredit institution offers contracts with varying degrees of joint liability penalty. The most common practice is to offer a single contract. The question, therefore, arises whether group lending can overcome the adverse selection problem by offering just a single contract. The answer, somewhat surprisingly, turns out to be 'yes'. The argument is slightly more subtle than in the case of a menu of contracts, but the essential point is that even with a single contract (r,c) safe borrowers may be induced to stay in the credit market because they would effectively pay less than risky borrowers.

Note that under joint liability the cost of credit has two components – r and c. Both components are of course conditional. A borrower pays nothing if her project fails. But if it succeeds, she will pay r if the partner also succeeds, which has probability p_j, and $(r + c)$ if the partner fails, which has probability$(1 - p_j)$. Thus conditional on her own success, the expected cost of credit for borrower *i* is $[\ p_j r + (1 - p_j)(r + c)\ ]$, which reduces to $r + (1 - p_j)\ c$. Since under assortative matching a safe borrower will have a safe partner, her expected cost of credit is $r + (1 - p_s)\ c$; by the same token, the expected cost of credit for a risky borrower is $r + (1 - p_r)\ c$. Since $p_s > p_r$, the expected cost of credit must be lower for the safe borrower.

The underlying idea is simply that since assortative matching ensures that the partner of a safe borrower is less likely to fail than the partner of a risky borrower, a safe borrower will have to pay the joint liability penalty less often. Therefore, conditional on her own success, a safe borrower will face a lower effective cost of credit than a risky borrower. In consequence, even a single contract may succeed in generating a separating equilibrium in which both types of borrowers co-exist, thereby eliminating the problem of adverse selection.[44]

43 The preceding discussion has assumed the Stiglitz-Weiss scenario. Ghatak (2000) demonstrates that if we assume instead the de Meza-Webb scenario, a similar logic will entail that group lending mechanism can be used to drive the socially unproductive risky borrowers away from the credit market, thus avoiding adverse selection of the other type. See also Tassel (1999) for an analysis very similar to Ghatak's, and Laffont and N'Guessan (2000) and Laffont (2003) for more on the implications of group lending under the de Meza-Webb scenario.

44 This statement is valid for the S-W scenario. For the M-W scenario, the corresponding result is that even a single contract can eliminate adverse selection by driving socially unproductive risky borrowers away. See Ghatak (1999, 2000) for formal proof of both propositions.

The avoidance of adverse selection not only helps the safe borrowers by enabling them to get access to the credit market; it also helps the risky borrowers as the presence of safe borrowers helps to bring the interest rate down. Group lending with joint liability thus marks a Pareto improvement over individual lending under asymmetric information. In fact, Ghatak (2000) reaches the even stronger conclusion that group lending leads to the socially efficient outcome i.e., the first best outcome that the market would have reached with individual lending if informational asymmetries did not exist.[45] Finally, the presence of safe borrowers also helps to reduce the overall rate of default, which may explain how microcredit programs have achieved remarkably high repayment rates around the world.

Deviations from Assortative Matching

The preceding discussion of the benefits of group lending is entirely contingent on the assumption that potential borrowers know each other well enough to be able to tell who is a safe borrower and who is not. It is this assumption that makes assortative matching possible, which in turn drives the rest of the results. But local knowledge cannot always be assumed to be so complete – for example, in urban areas. Can joint liability contracts still do the trick of avoiding adverse selection in such environments? Will assortative matching still occur? More fundamentally, is assortative matching actually necessary for group-based lending to work? Attempts to answer these questions lead to some interesting insights into the strengths and weaknesses of joint liability lending.

If potential borrowers do not know each other's type, there is no reason to expect assortative matching to occur. It may still happen as a matter of coincidence, but heterogeneous grouping is the more likely outcome. Armendáriz and Gollier (2000) show, however, that even with heterogeneous grouping joint liability contracts may lead to Pareto improvement over individual liability contracts under certain conditions.[46] The secret lies in the fact that the very act of group formation, no matter what type it is, creates a 'collateral effect' through cross-subsidization amongst borrowers as successful members pay up for the unsuccessful ones. This collateral effect renders group formation into an effective risk-pooling mechanism, which enhances efficiency. The 'collateral effect' allows the bank to reduce the interest rate, which in turn allows some safe borrowers to participate, who may have been forced out of the credit market by high interest rate under individual lending.

45 The latter conclusion has been contested, however. Gangopdhyay *et al*. (2005) point out that the efficiency result is contingent on a curious feature of the optimal contract derived in Ghatak (2000) which entails that the amount of joint liability in the groups exceeds the sum of individual liabilities. The problem with this feature is that when one member of the group fails and the other succeeds, the latter may prefer to announce that both succeeded and pay the interest rate for both rather than paying back her own loan plus joint liability for her partner. If this anomaly is removed by adding the constraint that the amount of joint liability cannot exceed the amount of individual liability, the result that joint liability contracts mark a Pareto improvement over individual liability contracts still goes through, but the efficiency result does not. In a recent paper, Katzur and Lensink (2012) have shown, however, that the efficiency result can be restored, even with the new constraint, if the project outcomes of members within a group are assumed to be correlated, rather than statistically independent as assumed by Ghatak.

46 Like Ghatak (1999), Armendáriz and Gollier (2000) also maintain the Stiglitz-Weiss assumptions about risk distribution. As Laffont and N'Guessan (2000) demonstrate, however, while most of Ghatak's major findings remain valid under the alternative scenario of de Meza-Webb assumptions; the same is not true about the findings of Armendáriz and Gollier. In particular, with heterogeneous groups, in which borrowers do not know each other's type, joint liability can no longer be shown to generate the 'collateral effect' that is necessary to bring the interest rate down below the level that would obtain under individual lending.

Joint liability in fact induces two opposing effects in this case. The reduction in interest rate through the collateral effect is the positive effect. But there is also a negative effect which stems from the obligation to pay the joint liability penalty for a failed partner. Since mixed matching is possible, any borrower would have to reckon with the prospect that she might land with a risky partner, which would render this obligation even more onerous. This is the 'joint responsibility effect', which acts as a disincentive to join group lending. The safe borrower will participate only if the incentive of lower interest rate is strong enough to outweigh the disincentive of the joint responsibility effect.

The balance of these two opposing forces depends critically on the relative returns of the safe and risky borrowers when their projects succeed. If the return for the safe borrower is not high enough to pay fully for the default of risky partner but the return for the risky borrower is, then the collateral effect will outweigh the joint responsibility effect for the safe borrower. The reason is that in this case the safe borrowers bear the joint liability burden only partially while the risky borrower bears the burden fully (in case she succeeds). The risky borrowers thus contribute relatively more to the overall collateral effect and thus contribute more towards the reduction of interest rate. In other words, the superior ability to risky borrowers to pay the collateral enables the safe borrowers to enjoy some reduction in interest rate as an externality. The higher the return of risky borrower compared to that of the safe borrower, i.e., the greater the degree of externality, the more likely it is that the collateral effect will outweigh the joint responsibility effect for the safe borrowers. The stronger, therefore, is the likelihood that joint liability will be able to avoid adverse selection even without assortative matching.

The idea that group lending will not always lead to positive assortative matching but may still mark an improvement over individual lending has been carried forward in several directions. This new brand of theories makes an even more radical departure than Armendáriz and Gollierby by demonstrating that group lending may not induce positive assortative matching of risk even when borrowers are aware of each other's risk types, and yet adverse selection may be avoided. What matters for the lender's success in avoiding adverse selection is that he is able to induce an equilibrium in which risky borrowers find it worthwhile to enter the credit market.[47] Whether the safe borrowers choose to team up with other safe borrowers or with risky borrowers or some with risky and some with safe borrowers does not really matter so long as they do enter the credit market. In this spirit, this new brand of theories seeks to identify conditions in which the equilibrium without adverse selection may not be characterized by positive assortative matching of risks. Two strands of such theories may be distinguished. One strand, in line with the earlier literature, takes joint liability as the crucial feature of group lending that acts as the safeguard against adverse selection, while the second strand emphasizes other features of group lending.

The first strand of theories introduces the idea that when potential borrowers ponder over whom to choose as partners, risk attributes of the persons or their projects is not the only characteristics they look for. There may be other considerations involved as well. And when multiple considerations guide the process of group formation, joint liability may not always induce positive assortative matching of risk, even if borrowers know each other's risk types.

[47] We are assuming here the context of the Stiglitz-Weiss information scenario.

One such consideration is the desire to minimize the chances of strategic default by the partner. Chatterjee and Sarangi (2005) argue, for example, that strategic default is best avoided by forming groups with people one knows and trusts, even if such people are of different risk types. Of course, a borrower will have to consider the trade-off between the riskiness and trustworthiness of potential partners. But the point is that the trade-off may not always dictate formation of groups that are homogeneous in risks; in many situations it may suggest formation of groups that may be heterogeneous in risks but homogeneous in terms of social and family ties.

Sadoulet (2000) also introduces strategic default as an additional consideration but unlike Chatterjee and Sarangi he finds the solution to default not so much in choosing a trustworthy partner as in giving the partner an incentive not to default. This incentive takes the form of providing insurance against project failure in the context of lender's threat of non-renewal of future loans in case of group default. When the borrowers ponder about how to choose a partner so that the incentive of insurance will have the best chance of preventing strategic default, they may end up in relationships that do not match in risks. Indeed, for many, the ideal partnership will be with borrowers of opposite risk types, leading to negative assortative matching!

The crucial point here is that faced with the non-renewal threat borrowers' incentive to default and their incentive to provide mutual insurance in order to prevent default will both vary depending on their risk types. Once the current project succeeds, a riskier borrower will have a higher incentive to default compared to a safer borrower because the former might reckon that her next project is more likely to fail and hence future loans are not likely to be of much use to her anyway. By contrast, a safer borrower will have a higher incentive to provide insurance to the partner because she has a bigger incentive to ensure the receipt of future loans (as her project is more likely to succeed in the future). Thus the incentive to default and the incentive to provide insurance will both vary with risk types but in opposite directions. It is this opposite nature of variation in the two incentives that leads to the possibility of negative assortative matching by creating a complementarity between opposite risk types.

Consider the choice of a partner from the perspective of a riskier borrower first. Since a safer borrower would be more eager to provide insurance, the riskier borrower would be better off teaming up with a safer partner because other risky borrowers like her would not be willing to offer the same degree of insurance. But wouldn't a safer borrower want to team up with a safer partner rather than with a riskier one in order to minimize the need for providing insurance? Yes, she would, but the problem is that she won't succeed in doing so. Both safer and riskier borrowers will want to have a safer partner but the riskier one would end winning the contest. Since riskier borrowers need a higher degree of insurance compared to safer borrowers they would outbid the latter in the attempt to join up with safe borrowers. A safe borrower would therefore always team up with someone riskier than herself. The process of group formation will thus culminate in negative assortative matching.[48]

The only qualification is that the riskier borrower must not be so risky that the cost of insuring her outweighs the expected benefit of ensuring the continuity of future loans. Since those 'too

48 Guttman (2008) provides an independent analysis of how the threat of non-renewal of loans can lead to negative assortative matching.

risky' borrowers will not be accepted as partners by safer borrowers, they must form homogeneous groups amongst themselves. The upshot is that one should expect to find heterogeneous matching at the lower end of the risk distribution and homogeneous matching at the upper end.

Despite this variety of matching, the fact remains that joint liability brings about an improvement over individual lending. It not only removes adverse selection by opening a pathway for the safer borrowers to enter the credit market, it also improves repayment by inducing a kind a group formation that best counters the propensity for strategic default.[49]

A second strand of theories that jettisons the idea of positive assortative matching abandons the premise of joint liability itself. A common contention of these theories is that there are features of group lending other than joint liability that can also get rid of adverse selection but the logic of group formation induced by these features is such that it almost always leads to negative assortative matching.

In a couple of related papers, Gangopadhyay and Lensink (2005) and Katzur and Lensink (2011) examine the implications of co-signing as an alternative to joint liability as a means of avoiding adverse selection. This is still a case of group lending but with a difference. The co-signed loan contract specifies that two individuals simultaneously apply for a loan, but only one of the borrowers is liable for the loan of the other; she is the co-signer. As such, this may be described as a case of one-sided or asymmetric joint liability as distinct from the two-sided or symmetric joint liability assumed in the standard literature.[50] As in the symmetric case, however, the co-signer will pay joint liability only if she herself succeeds while her partner fails.

The authors assume that the borrowers operate in the Stiglitz-Weiss scenario in which the expected returns are the same for everyone. For simplicity, all safe borrowers are assumed to have the same probability of success, and likewise all risky borrowers also have the same probability of success albeit less than that of safe borrowers. Finally, side payments are allowed i.e., borrowers are allowed to pay each other with the objective of forming groups with the peers they prefer.

Assuming for simplicity only two-person groups, there are four possible ordered pairs {s, s}, {s, r}, {r, s} and {r, r}, where the first person of the pair is designated as the co-signer and the second person as the principal applicant. The authors prove that under the assumptions made the heterogeneous group {r, s} – the one with risky borrower as the co-signer and safe borrower as the principal applicant – will emerge in equilibrium. A simple intuitive proof is offered below.

49 The role of joint liability in reducing strategic default has been discussed extensively in section 5 below, but the models reviewed there take groups as exogenously given, whereas here the process of group formation is itself viewed as an endogenous mechanism of countering strategic default taking advantage of risk diversity among potential borrowers.

50 This model builds upon the work on co-signing by Besanko and Thakor (1987) discussed earlier in this section. A major difference, however, is that in the Besanko-Thakor model the co-signer does not invest and therefore does not borrow, whereas in the present model both co-signee and the principal applicant borrow. An important implication is that the risk profile of the co-signer does not play a role in the Besanko-Thakor model but it does so in the present model.

Let us first compare the two heterogeneous pairs {r, s} and {s, r}. The two pairs will have exactly the same expected aggregate gross return since by assumption every borrower has the same expected return. They will also have the same expected aggregate repayment burden excluding joint liability (i.e., the repayment a borrower must make on her own account when she succeeds), since both groups consist of the same pair of borrowers with only their positions reversed and the position has no bearing on own-account repayment. However, they will differ in terms of the amount they are expected to pay by way of joint liability, which in turn will make a difference to the expected aggregate pay-off. In this regard, the {r, s} pair can be seen to have two advantages over {s, r}. First, since the principal applicant in the first pair is less likely to fail, the need for paying joint liability will also be less. Second, since the co-signer in the first pair is more likely to fail, she will have fewer occasions to pay joint liability for any given failure of the partner. On both counts the {r, s} pair will have to pay less by way of joint liability. Accordingly, it will have a higher expected aggregate pay-off than {s, r}. It will also be the one preferred by both borrowers because with side payments they can both be better off in an outcome that offers higher expected aggregate pay-off. Therefore, if a heterogeneous group is formed at all in equilibrium, it can only be of the type {r, s}.

Now compare {r, s} with {s, s}. Once again, the aggregate expected return will be the same in the two cases, but there will be differences on two counts. First, unlike in the previous case, there will be a difference in the amount of own-account repayment as the composition of the two groups is not the same. Since the co-signer of the heterogeneous group is a risky borrower, who fails more often, the aggregate own-account repayment will be lower for {r, s}. Second, since joint liability doesn't have to be paid when a co-signer herself fails, the joint liability burden will also be lower for {r, s}. For both reasons, the expected aggregate pay-off will be higher for {r, s} compared to {s, s}. This implies that a safe borrower will have the incentive to look for a risky borrower rather than a safe borrower as her co-signer.

But would a risky borrower agree to be the co-signer of a safe borrower? That depends on what other options are open to her. One option is to seek to reverse the role, i.e., to go for {s, r} instead of {r, s}. But this will not work since, as we have already seen, {r, s} dominates {s, r} in equilibrium. The other option is to co-sign another risky borrower i.e., the form the group {r, r}, but this would not be a preferred option either because the co-signer will have to pay joint liability more often with a risky partner than with a safe partner. Thus, when asked by a safe borrower to be her co-signer, the risky borrower can do no better than to agree. Therefore, the pairing {r, s} will dominate all other pairings; hence the emergence of negative assortative matching.

Co-signing will thus achieve the objective of avoiding adverse selection albeit by matching risky borrowers with opposite risk types rather than with similar types as in the standard symmetric joint liability case. Moreover, as a means of avoiding adverse selection, co-signing can be shown to have a couple of advantages over symmetric joint liability.[51] First, co-signing can achieve the socially efficient outcome associated with full information in a wider set of circumstances compared to symmetric joint liability. The second advantage relates to the

[51] For proof of these propositions, see Gangopadhyay and Lensink (2005) and Katzur and Lensink (2011).

outreach of microcredit. Under the standard joint liability contract, the client's project payoff necessary to induce her to enter the credit market may be prohibitively high for small entrepreneurs. By contrast, in certain settings, the co-signed contracts can significantly reduce the threshold value of project return, thereby ensuring a wider outreach of microfinance schemes.

5. Theories of Microcredit Dealing with the Enforcement Problem

We now turn to the case where the borrower may have earned enough return to be able to repay the lender but doesn't want to and there is nothing the lender can do to enforce repayment. The lender's inability to enforce repayment may stem from various sources, including the limited liability constraint associated with the absence of collateral. If the borrower does not have a tangible collateral that can be lawfully seized by the lender without incurring too high a transaction cost, the only conceivable option left to the lender is either to do something unlawful (such as threatening violence or seizing household assets that were not pledged as collateral) or to apply some kind of social pressure. The problem, however, is that while these options may be available to some extent to local moneylenders, neither option is really open to a formal lender who has his reputation to protect and the long arm of law to contend with. Aware of this limitation, dishonest borrowers may choose to default even when they are able to repay. This is the problem of *ex post* moral hazard, also known as the problem of strategic default.[52]

This poses a rather more serious problem to the lender than that of *ex ante* moral hazard discussed in section II. There the lenders were at least dealing with honest borrowers, who would voluntarily repay if only the project return were high enough; the task facing the lender was to induce the borrower to behave in a way that would increase project return (either by exerting more effort or by choosing a less risky project). Here, by contrast, they are dealing with dishonest borrowers who wouldn't repay even when project return permits them to do so. How do you induce such borrowers to behave in a way that will not put the lenders out of business?

If all borrowers were prone to strategic default and lenders had no way to prevent it, potential borrowers without collateral would never receive a loan if the credit contract were seen as a one-time transaction. Since the lender knows that the borrower would not repay he would not offer the loan in the first place. A possibility opens up, however, if we allow repeated transactions, in which the same pair of borrower and lender enters a credit contract over and over again. The lender can then threaten not to offer loan in the future in case the borrower defaults. If this threat is credible and the borrower values the availability of future loan sufficiently it may be possible to devise a credit contract that induces the borrower not to default.

One potential problem is that the threat may not work because the borrower might have access to other lenders to fall back upon if the first lender cuts her off. While this possibility cannot be denied, access to other lenders will not necessarily render the threat from the first lender

52 There is of course another kind of default which we might call genuine default; it occurs when borrowers are not able to repay the loan even if they want to. When strategic default coexists with genuine default and the lender is unable to distinguish between the two, it creates a rather special problem for the credit market. We take up this case at the end of this section.

completely toothless. After all, if a borrower defaults to one lender, her reputation would be sullied, which may make her access to other lenders more difficult – in particular, she may have to accept more onerous terms and conditions compared to what she would have received from the first lender. Default may thus have a real cost for the borrower, even if she has access to other lenders.

It is this cost of default that could make denial of future loan a credible threat.[53] With this threat, it can be shown that the lender may be able to offer a mutually beneficial contract that allows the credit market to function even in the absence of any collateral. We shall presently demonstrate, however, that the outcome in this case will be socially sub-optimal – this is the inefficiency of a credit market characterized by *ex post* moral hazard. We shall also see that, as in the case of *ex ante* moral hazard, the source of this inefficiency lies in the incentive rent that the lender must leave with the borrower. The point is that the mere threat of cutting off future loans is not enough to prevent strategic default. Sure, the loss of future loan would inflict a cost on the borrower, but this loss will be weighed up by the borrower against what she will gain by defaulting, and only if the loss outweighs the gain would she decide not to default. The lender must, therefore, find a way of making the gain from repaying greater than the gain from defaulting. It is this imperative to provide necessary incentive to the borrower that creates the possibility of a socially sub-optimal outcome.

Features of a Credit Market in the Presence of Strategic Default

Let us consider an individual who has the production function $Y = F(L)$, where Y is output and L is the amount of capital invested, and the technology exhibits diminishing marginal returns: $F'(L) > 0$, $F''(L) < 0$. Let the per unit cost of capital be denoted by ρ. If the individual relies entirely on her own capital, and is risk-neutral, she would decide her optimal level of investment L^* by maximizing

$$F(L) - (1+\rho)L \tag{39}$$

The solution L* given by the following first-order condition is the socially optimal level of investment in the absence of externalities:

$$F'(L^*) = 1+\rho \tag{40}$$

[53] There remains a deeper problem, however, which may render the threat useless even if the borrower's access to other lenders either does not exist or is compromised if it does. This has to do with a point first made by Bulow and Rogoff (1989) writing in the context of sovereign lending, but it has serious implications for all models involving denial of future credit. They show that if the borrower can save at the same rate as the lender then credit denial is useless as a means of ensuring loan repayment. The reason is simple: rather than repay one dollar today to obtain a future loan, the borrower would rather just save the dollar and effectively self-finance the promised future loan (Bond and Krishnamurthy 2004). This argument implies that if the threat of denial of future credit has to have any deterrent power, some other conditions must be satisfied. Two such conditions may be mentioned. First, the borrower's credit needs may increase over time, in which case recycling the defaulted loan won't suffice. Second, the borrower could face impediments in trying to save; in other words, borrowing may be easier than saving, which can happen if people have time-inconsistent preferences. Our discussion throughout this paper assumes that some such condition is satisfied.

Now consider the case where the investor has no money of her own so that investment has to be made entirely from loan. Also assume the ideal case where there is no *ex post* (or for that matter *ex ante*) moral hazard; the lender knows that the borrower will duly repay her loan i.e., enforcement problem does not exist. The lender then offers loan at the interest rate r that satisfies his zero-profit condition, and the borrower maximizes her net return (which also stands for her utility function if the borrower is risk-neutral):

$$F(L) - (1+r)\,L \qquad (41)$$

The borrower is assumed to have an outside option of value v, which she can earn if she were not taking the loan. She will take the loan only if the net return from it is no less than v; this defines her participation constraint:

$$F(L) - (1+r)\,L \geq v \qquad (42)$$

The borrower then chooses L so as to maximize the utility function (41) subject to the participation constraint (42). The first order condition is

$$F'(L) = 1 + r \qquad (43)$$

And the lender's zero-profit condition is

$$(1+r)\,L = (1+\rho)\,L \qquad (44)$$

The last equation implies that $r = \rho$; using it in (43), we can see that the amount of capital the borrower would invest in this case is exactly the same as in the first case where the borrower's own funds were invested. If the optimal amount of loan L^* given by (40) satisfies the participation constraint (42), that will be the equilibrium loan. This shows that in the absence of strategic default the credit market will achieve the social optimum.

Let us now introduce the possibility of strategic default. In the absence of the lender's ability to enforce repayment, the only way credit market can operate in this situation is by providing the incentive to repay. And since the incentive to repay is introduced through the non-renewal threat, the behavior of credit market in this case is best analyzed in the framework of a repeated game in which the lender and the borrower can interact with each other over and over again. For simplicity, we shall assume an infinitely repeated game in which the lender will continue to offer loan in every period so long as the borrower repays in the previous period; if the borrower defaults at any stage of the game the lender employs the trigger strategy of not lending to her ever again. The task facing the lender is to figure out how to set the interest rate and the loan size so that the borrower will have the incentive to repay (so as not to forgo the benefits of future loans) thus obviating the need for employing any external enforcement mechanism. [54]

Recall that the borrower has an outside option of value v i.e., if she decides to default at any stage, she is assured of earning v forever. She also has a positive time preference i.e., she

[54] The exposition below builds upon the analysis of strategic default in Ghosh *et al*.(2001).

prefers current income to future income, and the degree of time preference is expressed by the discount factor δ (< 1). We use *R* to denote the repayment burden *(1+r) L*. The incentive compatibility (IC) constraint which will induce the borrower to repay can now be stated as follows:

$$F(L) + \frac{\delta}{1-\delta}\, v \leq \frac{F(L)-R}{1-\delta} \qquad (45)$$

The left hand side of the inequality shows the payoff to the borrower if she decides to default after taking loan. It has two parts. The first part *F(L)* stands for what she gets in the first period if she defaults; obviously she gets to retain the whole output of the project without repaying anything. The second part shows what she would get in the subsequent periods once she has defaulted – it's the discounted present value of her outside option v, which she will receive forever. The right hand side of the inequality shows the payoff if the borrower decides never to default: it's the discounted present value of the net return *[F(L) − R]* that she will receive after repaying her loan in every period forever.

Thus inequality (45) says that the payoff from default must be less than the payoff from repaying. If the pair *(R, L)* satisfies this inequality for given values of v and δ, the borrower will decide to repay of her own accord even though she could have gotten away by not repaying if she wanted to. With a little bit of algebra the incentive constraint (45) can be rewritten as:

$$\delta\, [F(L) - v] \geq R \qquad (46)$$

Recalling that *R = (1+r)L*, the participation constraint (42) and the zero-profit condition (44) can be also rewritten respectively as

$$F\,(L) - v \;\geq\; R \qquad (47)$$

$$R = (1+\rho)\, L \qquad (48)$$

If the credit market is to operate in a Pareto efficient manner while avoiding strategic default, the equilibrium pair $(\hat{R}, \hat{L})$ must maximise the net returns *[F(L) − R]* given by (41), and satisfy the participation constraint given by (46), the incentive constraint given by (47) and the zero profit condition given by (48).

A diagrammatical approach to the derivation of $(\hat{R}, \hat{L})$ is offered in Figure 6.[55] The production function is represented by the concave function *F(L)*. The lender's zero-profit line (48) is given by the upward-sloping straight line IP (standing for iso-profit line) which starts from the origin and has the slope (1+ρ). For the interest rates that satisfy the zero-profit condition, net return to the borrower *[F(L) − R]* is shown by the gap between the production function *F(L)* and the*IP* line.

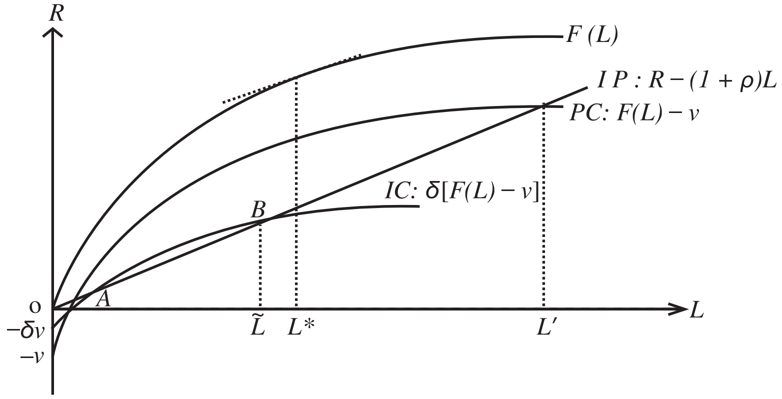
The curve *PC* (standing for participation constraint) represents the difference *F(L)*- v. All points on or below this curve satisfies the participation constraint (47). However, if the zero-profit condition is also to be satisfied, only those values of L are relevant for which the PC curve remains above the IP line. This sets an upper limit to the size of the loan *(L')*, beyond which the

55 This is an adaptation of Figure 4 in Ghosh *et al*. (2001).

borrower would not be interested because the net return falls below her outside option (thanks to diminishing returns) i.e., her participation constraint is not satisfied.

Figure 6

Credit Market Equilibrium with *Ex Post* Moral Hazard



The curve IC (standing for incentive compatibility) represents the discounted difference *δ[F(L)-v]*. All points on or below IC satisfy the incentive constraint (47). It is clear that, since $\delta < 1$, this curve will lie below the PC curve (for all positive values); this means that any point that satisfies IC constraint (47) will also satisfy the PC constraint (46) (but the converse is not true). If the zero-profit condition is also to be satisfied, only those values of *L* are relevant for which the *IC* curve remains above the *IP* line. This sets the upper limit to the loan size ($\tilde{L}$), corresponding to the upper intersection point A of *IC* and *IP*, beyond which the *IC* condition is not satisfied. There is also a lower limit (L^0) corresponding to the lower intersection point B. Clearly, only the points (*R, L*) lying on the line segment AB, or equivalently, only the loan amounts falling within the range ($L^0,\tilde{L}$) can satisfy all three constraints (46), (47) and (48).

If the socially optimal value L^* (one that maximises the borrower's pay-off function (41) subject only to the lender's zero-profit condition) falls within the range ($L^0,\tilde{L}$), it will satisfy all three constraints. That is, in spite of the threat of *ex post* moral hazard the market will reach the social optimum; there will be no inefficiency.

The more interesting case, however, occurs when L^* lies beyond the upper limit $\tilde{L}$ (this is the case depicted in Figure 6). Two features of this case are worth noting. First, the constrained optimal loan size is then given by $\tilde{L} < L^*$, i.e., the equilibrium loan size will be less than the socially optimum level – the credit market will be inefficient.[56] Second, if $L^* \leq \tilde{L}$, the borrower's participation constraint is satisfied at L^*; she will, therefore, be willing to borrow L^* at the given interest rate but the lender will not offer more than $\tilde{L}$ in order to avoid strategic default – the

[56] Since *F'(L*) = (1+r) = (1+p)*, at L^* the tangent to the curve *F(L)* must equal the slope of the IP line, where the gap between *F(L)* and IP line, representing the pay-off of the borrower, will be maximised. It follows from the concavity of *F(L)* that, for all $L < L^*$, the gap, and hence the pay-off to the borrower, will be rising function of *L*. Therefore, even though any loan size within the range ($L^0,\tilde{L}$) is feasible, the constrained optimum will occur at the highest feasible value of *L* i.e., $\tilde{L}$.

borrower will be credit-constrained.Thus, the credit market will be characterized by both inefficiency and rationing.To get an insight into the reason for this inefficiency, note that the incentive constraint (46) can be rewritten as follows:

$$F(L) - R \geq \delta v + (1 - \delta)\, F(L)$$

$$\text{Or,} \quad F(L) - R \geq v + (1 - \delta)\, [F(L) - v] \qquad (49)$$

Now compare this with the participation constraint (47), which says that for the borrower to take loan it's enough that the net return *F(L) – R* is equal to v. But the incentive constraint (11) says that for the borrower not to default it's not enough that the net return equals v; it must exceed v by at least the amount *(1-δ)[F(L)-v]*. This additional amount is the measure of the 'incentive rent' that the lender must leave with the borrower in order to give her the incentive not to default.[57] In Figure 6, this rent is given by the vertical difference between the *PC* curve and the *IC* curve.

It is this compulsion to provide an incentive rent that creates the possibility that the socially optimum amount of loan may not be offered by the lender. In Figure 6, *L** is such that the net return *[F(L*) – R]* exceeds v but falls short of *v+(1-δ)[F(L)-v]*. In other words, while the participation constraint is satisfied, the incentive rent is not enough to deter default. Knowing this, the lender will not offer the loan *L**, even though the borrower is willing to take it.

If the lender offers any loan at all, it will be different from *L**; but different in what way - more or less? Our diagrammatic analysis showed earlier that the amount of loan offered by the lender would be less than *L**. To understand the intuition behind this result, consider the implication of the incentive constraint being violated by *L**. From (46), the violation implies that

$$R > \delta\, [F(L^*) - v]$$

$$\text{Or,} \quad (1 + r)\, L^* > \delta\, [F(L^*) - v] \qquad (50)$$

This inequality can be interpreted as follows. At any point in time, the borrower thinks that she can save the repayment burden $(1+r)\, L^*$ by defaulting; this is her gain from the act of default. If she does decide to default, then of course in the next period she will have to forgo the surplus $[F(L^*) - v]$ and the right hand side of (50) gives the present value of that loss. The inequality (12) thus shows that at every point in time the gain from defaulting today is greater than the loss tomorrow, which is why the lender is unwilling to lend the amount *L**.

Faced with this situation, the lender will want to adjust the volume of loan so that the temptation to default falls. For this to happen, the marginal gain from defaulting must fall relative to the marginal loss as the loan size changes. From (50), the marginal gain from defaulting is $(1+r)$ and the marginal loss is *δF′ (L)*. Therefore, the temptation to default will fall only if *δF′ (L)* becomes progressively smaller relative to $(1+r)$. But since *r* is fixed at *ρ* by the lender's zero-profit condition, the marginal gain from default $(1+r)$ remains constant in the present framework.

57 Since *δ<1* and *F(L) > v* (so long as the participation constraint is satisfied), this additional amount must be a positive quantity. Also note that lower δ implies higher incentive rent i.e., the more impatient the borrower is the greater is the incentive rent needed to deter default.

As a result, the marginal loss from defaulting ($\delta F'(L)$) must be allowed to rise in absolute terms, and given δ (and given diminishing returns) this is only possible if L is lowered.[58] That's why when the incentive constraint binds the lender will offer a loan that is below the socially optimal level.

To summarize, the imperative to provide the borrower with an 'incentive rent' so as to deter strategic default creates the possibility that the socially optimal level of loan will not be offered by the lender even if the borrower were willing to take it. In this situation the socially optimal level of loan will induce default as the gain from defaulting would exceed the loss. The lender must then adjust the size of loan so that the marginal gain from defaulting gets smaller relative to the marginal loss. In the present framework, this can only be achieved by offering a smaller amount of loan than is socially optimal or is desired by the borrowers. Strategic default thus leads to inefficiency as well as rationing in the credit market.

It follows that any mechanism that reduces the incentive rent will enable the credit market to get closer to efficiency and reduce rationing. Several features of the microcredit market have been interpreted in this light. It has been argued that these features enable the lenders to reduce the incentive rent and thereby improve the functioning of the credit market in the face of the threat of strategic default. Some the major theoretical analyses along these lines are reviewed below.

Microcredit as a Mechanism to Deal with Strategic Default

In a classic paper, Besley and Coate (1995) examined the role of the joint liability system in microcredit operations in mitigating the problem of strategic default. The underlying premise of their approach is that, regardless of the liability system – joint or individual – the bank tries to enforce repayment by imposing a penalty on the borrower. The penalty could take the form of denial of future credit as discussed above; but it could also include other elements such as hassle, naming and shaming, mental torture, and so on. We have seen above that when the bank lends to an individual the penalty of denying future loan could work in preventing strategic default, but at a cost – namely, that the amount of loan would be socially inefficient and the borrowers would be credit-rationed. The question that Besley and Coate pose is: will the system of penalty work better if the bank were to lend with joint liability rather than individual liability?

Strictly speaking, Besley and Coate do not explicitly address the issue of social inefficiency. Instead they focus on repayment rates i.e., on the success in mitigating strategic default as reflected in repayment rates; and the question they ask is whether joint liability is better than individual liability in improving repayment rates. One could argue, however, that any mechanism that improves repayment rates by reducing the incentive to default would enable the bank to offer a smaller amount of incentive rent needed to resist the temptation to default; and as we have seen, anything that reduces the incentive rent helps the credit market move closer to efficiency. In that sense, the Besley-Coate analysis could be taken to be speaking to

58 In a different framework, where the zero-profit condition does not apply, there would be scope for adjustment through variation in the interest rate as well.

the broader concerns of the credit market, even though the immediate focus is on repayment rates.[59]

Their paper starts with the presumption that joint liability should help reduce strategic default. After all, since accepting joint liability means being liable to be punished for the partner's default as well as one's own, borrowers who consider repaying to be worthwhile on their own account will try to ensure that they are not penalized on the partners' account. To that end, they will try to apply peer pressure on the partners, and if it doesn't work may even pay up on their behalf.

Closer examination reveals, however, that this presumption is not necessarily valid. The main insight of Besley and Coate is that in the context of strategic default the logic of joint liability generates two countervailing forces – one positive and the other negative; and if the negative force dominates joint liability may actually turn out to be worse than individual liability. The positive effect is that group members whose projects have earned high returns may have an incentive to repay the loans of members whose projects have yielded insufficient return to make repayment worthwhile. The negative effect arises when the whole group defaults, even when some members would have repaid under individual lending. The main task of the paper is to identify the conditions under which one or the other force will dominate. It also shows how group lending may harness social collateral, which serves to mitigate the negative effect.

The effect of joint liability on the incentive to repay is shaped by the strategic interdependence that joint liability generates. In order to capture this interdependence, the formal analysis of the Besley-Coate model takes the form of a two-person two-stage game. In the first stage, the borrowers simultaneously choose between the strategies of whether or not to contribute to the pool of repayment. If both players take the same decision in the first stage, the game stops there - either both repay or neither does. If they decide differently, the game goes to the second stage, where the player who had decided to contribute must now decide whether to repay for the partner or to default.

The decision to repay will of course depend on how severe the penalty of default is relative to the repayment burden (r). The group as a whole is taken to be in default even if only one member defaults; in that event both members will face the penalty - that's the essence of joint liability. However, the severity of penalty may not be the same for them; it would depend on the returns they respectively earn form the loan-financed projects. The model stipulates that the penalty imposed by the bank is an increasing function of project return, which is *ex ante* probabilistic, but the *ex post* outcome is assumed to be observable. Thus borrowers who are fortunate enough to earn higher project returns are liable to pay a heavier penalty.

This link between penalty and project return implies that the incentive to repay (or to default) is a function of project return. At low levels of return, the penalty of default may be too low compared to the repayment burden to make repayment worthwhile; so the borrower will be inclined to default. However, since the penalty rises with return, there must be a 'critical' level of

[59] Other authors have taken up the issue of efficiency more explicitly. For instance, Arnold *et al*. (2009) show that even if group lending improves the repayment rate, the equilibrium will still be characterised by the kind of allocational distortions that are found in credit markets with enforcement problem. Social sanctions may ameliorate the problem, but will not remove it entirely.

project return for any given repayment burden – denoted by $\varphi(r)$ – above which the penalty is higher than repayment; so the borrower will be willing to repay. By extending the logic of this argument, there is another critical level of return $\varphi(2r)$ beyond which the penalty is higher than $2r$, the combined repayment burden of the group (composed of two borrowers). Clearly, if a borrower receives a return above $\varphi(2r)$, she would be willing to repay $2r$ from her own purse, i.e., to repay on behalf of both herself and her partner, even if the partner decides to default, rather than incur the heavy penalty of group default. These two critical levels – $\varphi(r)$ and $\varphi(2r)$ – define three regions of project return (θ): viz., $\theta > \varphi(2r)$, $\varphi(2r) > \theta > \varphi(r)$ and $\theta < \varphi(r)$. Accordingly, we can identify six possible cases of the pairs of project returns accruing to the two borrowers.

(a) For both borrowers $\theta \geq \varphi(2r)$

(b) For one borrower $\theta \geq \varphi(2r)$; and for the other $\varphi(2r) \geq \theta \geq \varphi(r)$

(c) For one borrower $\theta \geq \varphi(2r)$; and for the other $\theta < \varphi(r)$.

(d) For both borrowers $\varphi(2r) \geq \theta \geq \varphi(r)$.

(e) For one borrower $\varphi(2r) \geq \theta \geq \varphi(r)$; and for the other $\theta < \varphi(r)$.

(f) For both borrowers $\theta < \varphi(r)$.

Now compare repayment under joint and individual liability in each of these cases. There will be full repayment in cases (a) and (b) regardless of the liability system, because, as noted above, any return above $\varphi(r)$ induces repayment under individual liability, while a return above $\varphi(2r)$ for at least one borrower induces full repayment under joint liability. At the other extreme is case (f), in which there will be default under both systems, because project return, and hence the penalty, is simply too low to induce either partner to repay. Thus, in these three cases there will be no difference in repayment under the two systems.

The difference begins to emerge when we consider the other three cases. In case (c), under individual liability one borrower will repay (the one with $\theta \geq \varphi(2r)$) but the other will not (the one with $\theta < \varphi(r)$). Under joint liability, however, full repayment will be made because the borrower with high return will find it worthwhile to repay on behalf of both borrowers even though her partner is going to default. This is a clear case where joint liability succeeds in mitigating the problem of strategic default.

Case (d) is slightly tricky. Under individual liability, both borrowers will repay. However, under joint liability an ambiguity arises because there are now two possible equilibria. Both players are aware that each has earned enough to make repayment worthwhile on one's own account, but that does not necessarily ensure that both will repay – it all depends on what each borrower believes about what the partner is going to do. If one borrower believes that the other will contribute, there is no problem – each will repay the amount r. But if one borrower is pessimistic about the other's intentions, then she won't repay either. The problem here is that although the first borrower is happy enough to repay ***r*** on her own account, she knows that a total repayment of r will not satisfy the bank. In order to avoid penalty, a total amount of $2r$ must be repaid, but since she does not earn a high enough return to make repayment of $2r$ worthwhile she will decide to default. Thus each will end up defaulting and paying a penalty that is greater than the repayment burden. This is clearly a Pareto inferior outcome compared to the first equilibrium, but the players may easily end up there because of a co-ordination failure. If the borrowers can somehow reach the Pareto superior equilibrium, the repayment outcome under joint liability will be the same as in individual liability – full repayment will be made in both cases, but if co-ordination failure leads to the Pareto inferior equilibrium joint liability will turn out to be inferior to individual liability.

Case (e) tilts the case further against joint liability. Under individual liability, the first borrower will repay and the second borrower will default. By contrast, under joint liability both will default. The problem is similar to the case of pessimistic equilibrium discussed above, except that default by one partner is a certainty in this case, and not just a conjecture. Knowing that the partner is going to default, the other borrower will reckon that in order to avoid penalty she will have to repay *2r*, which she will not find worthwhile paying given her project return. Thus she will default under joint liability even though she would have repaid under individual liability.

In summary, the relative performance of joint and individual liability in terms of repayment depends critically on the distribution of project returns. There are a number of cases where there is no difference in performance (namely, cases (a), (b), (f) and the Pareto superior outcome of case *(d))*. There is one case where joint liability clearly outperforms individual liability – that is the case of one borrower earning a very high return ($\theta \geq \varphi(2r)$) and the other borrower earning a very low return ($\theta < \varphi(r)$). On the other hand, joint liability turns out to be inferior to individual liability when either one borrower earns a moderate return ($\varphi(2r) \geq \theta \geq \varphi(r)$) and the other earns a low return ($\theta < \varphi(r)$) or both earn moderate return but end up in a Pareto inferior outcome due to coordination failure. In the latter two cases, joint liability will aggravate the problem of strategic default instead of mitigating it.

Clearly, one way of making joint liability a more effective weapon against strategic default is to raise the level of penalty. There are, however, limits to how far a microcredit institution can go towards raising the penalty given the social mission it professes to have of serving the poor. Besley and Coate argue that this limitation can be overcome to some extent by harnessing one aspect of group lending that is absent from individual lending – namely, the potential of imposing social sanctions on deviant behavior. Borrowers who are in a position to repay on their own account will try to ensure that the partner also repays so that they don’t have to bear the full repayment burden on behalf of the group. To that end, they will be willing to threaten the potential defaulters with social sanctions, and this threat is likely to be more credible as well as socially more acceptable than anything the bank itself might try. If the power of sanctions is sufficiently strong, the potential negative effect of joint liability may be mitigated in full, rendering it superior to individual liability as a mechanism for preventing strategic default.

The Besley-Coate analysis was based on the assumptions of a given interest rate and a given penalty function. This raises the question: if the bank had the freedom to design a contract by choosing the right kind of penalty function and the right level of repayment burden, what kind of contracting system would it choose - individual or joint liability? Laffont and N’Guessan (2001) addressed this question by taking a mechanism design approach and by allowing for collusion among borrowers instead of assuming a non-cooperative sequential game. Despite these differences in approach, they reinforce the Besley-Coate result by demonstrating that if the bank's enforcement mechanism is weak group contracting may be worse than individual contracting because the negative effect of joint liability overwhelms the good effect. Social sanctions then remains the only instrument left to make group lending better than individual lending.

But social sanctions cannot always be relied upon to come to the rescue. Some societies may not have enough social capital to make such sanctions effective, and even where sanctions can be applied there are limits to how far they can be pushed without doing lasting damage to the social fabric.[60] This raises the question of whether alternative mechanisms can be devised to make group lending an effective strategy against strategic default. Several authors have taken up this question.

Armendáriz (1999) identifies a couple of such design issues: viz., group size and the structure of monitoring within groups.Besley and Coate assumed two-person groups for simplicity of analysis but in the real world groups are usually larger and Armendáriz argues that banks can improve the efficacy of joint liability by carefully choosing the group size. Large size has the advantage that it makes the joint liability burden lighter for each successful borrower as the burden is likely to be shared among several members. On the other hand, it also raises the possibility of free riding by unsuccessful borrowers. A group size that optimally balances these two opposing effects would make for greater efficacy of joint liability.

Armendáriz also compares between the mutual monitoring structures, in which all borrowers simultaneously monitor each other, with the rotating monitoring structure, in which members take turn in monitoring each other. She finds that their relative performance in improving repayment depends on the relative strengths of fixed versus variable costs of monitoring. If the variable cost is low and fixed cost is high, the rotating structure (of the kind observed in the classic GrameenBank lending model) turns out to be better than mutual monitoring.

Continuing the search for better contract designs, Bond and Rai (2008) re-examine the role of social sanctions in improving the repayment rate and argue that symmetric group loans as practised by most micro-lenders is not the best way to harness the power of social sanctions in the presence of unequal social power. The main insight of their paper is that when people differ in their ability to impose sanctions on each other, or equivalently, in their susceptibility to sanctions from each other, the bank should be able to enhance the effectiveness of sanctions by refining their loan contracts in such a way that makes good use of unequal power relations among the borrowers. They consider several possible ways of doing so and come up in favor of co-signed loans.

The ideal solution would be for the bank to offer asymmetric loans, tailoring them to the borrowers' respective susceptibility to sanction. In particular, the bank should provide bigger loans to weaker or less powerful borrowers who face larger sanctions in the event of default, the reason simply being that since weaker borrowers are threatened with tougher sanctions they would have a higher willingness to repay. But a sense of fairness as well as the bank's inability

[60] On this, see the discussion in the section 3 on the role and limits of social sanctions in mitigating ex ante moral hazard.

to observe borrowers' power relations accurately prevents it from making such asymmetric loans in practice. In theory, both the problem of fairness and the inability to observe power relations could be overcome through a revelation mechanism i.e., by offering a menu of contracts to choose from. The menu would be designed in such a way that the borrowers would reveal the internal power relations through their choice of contracts. In particular, less powerful borrowers will voluntarily choose larger loans and the more powerful ones will choose smaller loans. Bond and Rai show, however, that this will work only if all the borrowers are highly productive, which would rarely be the case in reality. Thus, in practice, group loans are constrained to be symmetric even though asymmetric loans would be more efficient.

But Bond and Rai argue that an alternative mechanism is available – viz., co-signed loans, which would yield better results than symmetric group loans when power relations are very unequal. Under both mechanisms, the prospective borrowers must form groups in order to receive loan, but the difference is that while in symmetric loans both members of a group receive a loan and are jointly liable for each other, under the co-signing system only one person receives the loan and the other merely co-signs or guarantees the borrower.

To see how co-signing may outperform symmetric joint liability loans, assume that the bank offers loan of a standard size α (to be interpreted as the amount to be repaid including principal and interest) and also imposes a standard penalty c for default. Social sanction s represents an additional penalty for default. The cost of this penalty would depend on the relative power of the members of a group, as measured by their relative susceptibility to sanction, which is denoted by μ and takes the value in the range $(0, 1/2)$. When μ equals $1/2$, there is equal power relation and both members of a group are equally susceptible to sanction, whose cost to the borrower is given by $(1/2)$s. In case of unequal power relation, we shall use μ to denote the susceptibility of the stronger party and $(1 - \mu)$ for the weaker party. Clearly, the lower the value of μ the stronger is the first party.

Consider first the case where power is equal ($\mu = 1/2$) and the loan size is such that $\alpha < c+(1/2)s$. A standard joint liability symmetric loan will work very well in this case because the cost of default is higher than the repayment burden for each member, which will ensure that both members will repay. But now suppose the relation becomes unequal i.e., μ gets smaller than $1/2$. As μ gets smaller, the cost of default to the stronger party $c+\mu s$ also gets smaller while the cost of default to the weaker party $c+(1-\mu)$s gets bigger. For sufficiently small μ, we may end up with the following relationship: $c+\mu s< \alpha < c+(1-\mu)s$. In this case, with symmetric loan the bank will receive payment only from the weaker party, while the stronger party will default. One way of avoiding default is to give loan only to the weaker party and to make the stronger party the co-signee so that by threatening the heavy sanction $(1-\mu)$s she can induce the weaker party to repay. Thus, under unequal power relations, co-signing is likely to ensure better repayment performance than symmetric joint liability loans.[61]

61 One might think that this system will not work well in practice because an outside bank is unlikely to know which member of the group is stronger and should therefore be made the co-signee. But this is not really a problem because the bank doesn't need to decide who should be the co-signee. That decision can be left to the group and the stronger party will emerge as the co-signee. This is because the weaker party will never agree to be the co-signee since she knows that she simply does not have the power to impose a high enough sanction on the stronger party to prevent her from defaulting. Only the stronger party will agree to be the co-signee because she has the power to ensure that the weaker party will repay.

Sinn (2009) identifies an alternative way of strengthening the enforcement power of social sanctions: it is to offer loans to group members sequentially instead of simultaneously as in the Besley-Coate model. The argument focuses on the problem identified by Besley and Coate that when project returns fall in an intermediate range for both borrowers, each may opt for strategic default under the joint liability system, even though both would have repaid under individual liability.

Besley and Coate showed that one possible way of avoiding such strategic default is to harness the social collateral of group members: with sufficiently strong social sanctions it may be possible to induce the borrowers to reach the Pareto superior equilibrium in which both of them repay. Sinn argues that for any given strength of social sanctions, its effectiveness can be improved by switching from simultaneous to sequential loan, provided the bank's own enforcement mechanism is not strong enough to prevent default. The advantage of sequential loan is that as one borrower waits her turn to be allocated her loan, she will threaten her borrowing partner with social sanctions should she strategically default, so as to ensure that she will receive her own loan when her turn arrives. Similarly, once a borrower has repaid her loan, she will pressurize her peer into repaying hers, so that she doesn't become liable for repaying a second loan as well. Thus in sequential lending both borrowers will have the incentive to apply social sanctions on each other and thereby avoid strategic default.[62]

Enforcement Problem under Asymmetric Information

So far we have discussed the enforcement problem under the assumption that the lender knows which borrowers are able to repay but would still try default – the case we have described as strategic default. The lender's problem in this case is to induce the able borrower to repay by making default an unattractive option. But the situation becomes much more complicated if the lender is unable to distinguish between strategic default and what might be termed as genuine default i.e., the case where a borrower is genuinely unable to repay because she has been subject to some negative shock, e.g., the project return may have been unexpectedly low or the loan (or the proceeds from the loan-financed project) had to be diverted to meet some unforeseen but essential family needs. The borrower will know whether her default is strategic or genuine but a bank may not. Devising an incentive compatible contract that is also compatible with financial sustainability of the bank becomes even more challenging under such asymmetric information.

The group lending system assumes an added importance in this situation. Not only would it be able to minimise strategic default through the mechanisms (and under the conditions) discussed above, it might also be able to deal with the case of genuine default better. In an environment where possibilities of strategic and genuine defaults arise at the same time, group lending can be seen as a mechanism for strengthening the bonds of mutual insurance among the borrowers. Members of the group, who had a lucky break, may be able and willing to repay no only on their own account but also on behalf of those who are genuinely unable to repay because they had an unlucky break.

[62] This argument is similar to the temporal separation argument made by Aniket (2009) in the context of *ex ante* moral hazard. See the discussion in the section 3.

Informal mutual insurance mechanisms of one kind or another have existed in traditional societies for centuries. Recently, these mechanisms have come under intense theoretical and empirical scrutiny.[63] There is by now quite strong empirical evidence that like the informal credit market the informal insurance mechanisms too do not work very well, and for much the same reasons: viz., informational asymmetries and enforcement problems.[64] In the face of systemic shocks, which afflict a large swathe of the population at the same time, mutual insurance is not expected to work in any case. But the evidence suggests that even in the case of idiosyncratic shocks, where the need and scope for mutual insurance are evidently high, the optimal amount of insurance is not generally provided. At the heart of this failure lies the scope for free riding that is created by asymmetry of information and limitations of enforcement mechanisms that exist even within traditional societies.

Group lending systems based on joint liability can improve upon this situation by giving people an added incentive to offer insurance to those who need it. If the group as a whole is going to default because some members cannot help defaulting for genuine reasons (i.e., bad luck), those who are able to help the unlucky members by paying up on their behalf might do so in order to avoid the penalty of group default. This would simultaneously constitute an improvement in the insurance market and in the credit market. Indeed improvement on the insurance front would be the reason for improvement on the credit front.[65] The greater assurance of mutual insurance, engendered by the joint liability system, would help bring into the credit network many of those who would otherwise shun borrowing for fear of facing the unpleasant prospect of 'genuine' default.

The joint liability system can thus improve upon the functioning of the credit market by reducing the prospects of both strategic and genuine default. Harnessing of social capital plays a crucial role in all this, but in different ways for the two kinds of default. For strategic default it works by activating social sanctions, and for genuine default it works by encouraging social support. But, one way or the other, joint liability helps to mitigate the problem of default.

The only problem is that joint liability can go too far – it may overkill in its attempt to prevent default. To see how, note that like individual default group default too can be either strategic or genuine. The default is strategic when the lucky members are capable of paying on behalf of the group as a whole but won't (because the penalty of default is smaller than the gain from defaulting). But the default is genuine when group can't help but default simply because the projects of group members, taken together, have yielded insufficient return to pay off the liabilities of all the members. Under asymmetric information, the bank is unable to distinguish between the two cases; so the joint liability system penalizes the group in both cases.

That's where the problem of overkill comes in. It is one thing to try and prevent default when the borrowers are able to repay either singly or as a group, but quite another to try and enforce repayment when group default will occur for genuine reasons. In the latter case, while the

63 See, *inter alia*, the collection of papers in Dercon (2005) and the works cited therein, and the excellent survey article by Fafchamps (2011).

64 See, for example, the evidence cited in Besley (1995), Townsend (1994) and Udry (1994).

65 A pioneering analysis of the mutual insurance aspect of group lending is offered by Rashid and Townsend (1992).

borrowers are made to suffer, the bank does not gain anything in return because the repayment will never be made despite the penalty, and the penalty itself can only be non-pecuniary in nature(e.g., hassle, withholding or denying future loans, etc.).The consequence is a deadweight loss for the society as a whole.

It follows that anything that will minimize the possibility of penalty in the event of genuine difficulty, while at the same time preventing strategic default when the group as a whole is capable of repaying, will constitute an improvement. Since the bank cannot distinguish between genuine and strategic default through direct observation, such an improvement can only be brought about, if at all, by some kind of revelation mechanism, i.e., a mechanism through which the borrowers themselves are made to reveal the nature of default. Rai and Sjöström(2004) suggest that adding a kind of cross-reporting game to joint liability will achieve this goal.[66]

The cross-reporting game works as follows. If a group member defaults, then instead of penalizing the group as a whole the bank will penalize a particular borrower, who may or may not be the defaulter. The rule is that borrower *j* receives a harsh punishment only if another borrower *i* reports that borrower *j* is withholding some output from the bank. This allows an unsuccessful borrower *i* to threaten her successful partnerjby saying: "You had better help me repay, or *i* will tell the bank that you refused to help even though you had the means to do so and they will impose a harsh punishment on you." This threat – indeed the sheer possibility of this threat – will induce the successful borrower *j* to help repay i's loan if she can. On the other hand, if *j* is genuinely unable to help *i*, then *i* cannot gain anything by threatening *j* in this way.[67] Therefore, no threats are made and no harsh punishments are imposed when both borrowers fail, which eliminates the possibility of deadweight loss.

An alternative approach to reducing the deadweight loss inherent in the joint liability system has been suggested by Tedeschi (2006). He focuses specifically on the case in which the joint liability penalty takes the form of denial of future loans. The deadweight loss in this case arises from the fact that denying a person loan at all dates in the future is an unnecessarily harsh measure because it entails loss of potential surplus which the society could have enjoyed from the utilization of future loans. While it may be necessary to accept some loss of surplus in order to deter strategic default, the aim should be to minimize this loss. Tedeschi suggests that the best strategy would be to delay rather than deny future loans and to let the length of delay vary depending on the likelihood of default.[68]

He envisages a process in which the lender and the borrower may alternate between lending and punishment phases. At the beginning of the process, the borrower and the lender engage

[66] The cross-reporting strategy they recommend is similar in spirit to the one proposed by Brusco (1997), who studied moral hazard in team production and showed that workers can stop co-workers from shirking by threatening to send negative reports about effort levels. The logic underlying these reporting games is close to that of the implementation model proposed by Hurwicz, Maskin and Postlewaite (1995) in the general literature on mechanism design.

[67] Rai and Sjöström (2004) demonstrate that this cross-reporting strategy is robust to collusion i.e., when the group as a whole is able to repay the loans the threat of cross-reporting cannot be used by the borrowers as a means of sharing the returns amongst themselves by depriving the bank of its due share.

[68] The strategy proposed by Tedeschi is an adaptation of Green and Porter's (1984) dynamic collusion game to the specific context of the credit market.

in a lending phase, where when one loan is successfully repaid, another loan is given. If, in any period, the borrower defaults, it triggers the onset of a punishment phase, where no new loans are extended to the borrower in default. The punishment phase lasts for a certain period, which is sufficiently long to prevent a borrower from strategic default, but not so long as to unduly punish a borrower that defaults for genuine reasons (faced with anegative shock).After the punishment has been served, the borrower may return to the lending phase, with prior unpaid debts forgiven. The task facing the bank is to determine the optimal length of the punishment phase, given the information at its disposal.[69]

While the strategy of cross-reporting *á la* Rai and Sjöström and the idea of delaying rather than denying loan *á la* Tedeschi aim to mitigate the deadweight loss induced by joint liability, one may actually ask a more fundamental question: is it possible to improve the prospects of mutual insurance through a lending mechanism that does not rely upon the powers of joint liability? If such a mechanism can be found, the benefits of joint liability could be enjoyed without incurring the deadweight loss that comes with it. In a recent contribution, Rai and Sjöström(2010) argue that such a mechanism actually already exists, in the form of public meetings that many MFIs routinely hold for disbursing loans and collecting repayments from the borrower groups.

The argument turns on the inter-linkage between insurance and the credit market noted earlier. In the absence of full insurance, lending may also be inefficient because, in the face of uninsured risk, projects with high expected returns but also high risk would not be undertaken. By contrast, if the borrowers could side contract with each other informally to fully insure themselves against all kinds of risks, lending would be efficient. The problem, however, is that individuals taking part in informal insurance arrangements face similar (albeit lesser) problems of enforcement and asymmetric information as outside insurers and lenders, being unable to always distinguish strategic default from the genuine ones. It follows that any mechanism that improves information sharing among the borrowers would improve the performance of the credit market by making possible greater degree of mutual insurance. Public meetings can be seen precisely as such a mechanism – they enhance the borrowers' ability to side contract by allowing sharing of information about each other.

One implication of this argument is that so long as regular public meetings are conducted by the MFIs, it does not matter whether joint or individual liability is practiced; all that matters is that a group of borrowers come together regularly and discuss their situation openly so that information is shared amongst them. The hypothesis is that to the extent that this process helps reduce the asymmetries of information amongst borrowers, the scope for mutual insurance will improve and therefore loan repayment will also improve (insofar as potentially genuine defaulters are prevented from defaulting with the help of informal insurance).[70]

69 The extent to which this strategy will reduce the deadweight loss depends on the richness of information on the basis of which lender determines the length of the punishment phase. It can be shown that, given the information set assumed by Tedeschi, the length of the punishment phase is not the first best; a better outcome could be reached by using borrower histories, which do not belong to the information set assumed in Tedeschi's model. See, however, Sadoulet (2005), for a model that incorporates borrower histories.

70 Rai and Sjöström cite data from the Green Bank experiment in the Philippines (Gine and Karlan 2011) to support the point about the irrelevance of the liability system for loan repayment when public meetings take place regularly.

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