University of Kent

School of Economics Discussion Papers

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December 2014

KDPE 1415

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Abstract

In recent years, microfinance institutions have expanded into group lending with individual liability, leaving out the joint liability clause which was an important feature in earlier lending contracts. Recent experimental evidence indicates that group lending may yield benefits, specifically lowering default rates, even in the absence of joint liability. In this paper, we develop a theoretical model where the public nature of group meetings means that borrowers have incentives to repay a group loan to safeguard their reputation. We show that the introduction of group loans with individual liability will cause sorting between joint liability and individual liability group loans. Specifically, borrowers who attach more importance to their reputation will select into individual liability loans, causing default rates and interest rates to rise for joint liability loans. The introduction of group loans with individual liability can even make joint liability loans infeasible in equilibrium.

Keywords: Microfinance, Group Lending, Joint Liability, Social Sanctions, Reputation
JEL Classification: G21, O12, O16, D8

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1 Introduction

During the last thirty years, the practice of group lending has been adopted widely by financial institutions in different parts of the world to provide access to credit to the very poor, who have limited or no means to put up a collateral for a loan.

The popularity of group lending has produced a rich theoretical literature which attempts to explain these practices as equilibrium outcomes in alternative institutional settings. Joint liability has been central to these studies and has been shown to potentially mitigate some of the serious informational and enforcement problems that prevent households without collateral from receiving loans and making productive investments.

The credit market imperfections that result from contractual incompleteness have been broadly classified into three categories. First, *adverse selection* in borrower types can occur if some borrowers are intrinsically more likely to pay back than others and banks cannot observe the different borrower types. Alternatively, it may be that individuals choose investments that are too risky from the bank's perspective or put in too little effort into influencing project success because they do not fully compensate the bank when project returns are low. This could be termed *ex-ante moral hazard* because it concerns borrower decisions before returns from investments are realized. Finally, there may be *ex-post moral hazard* faced by successful borrowers who are tempted to avoid payment once project returns are in hand.

In each of these cases, under alternative sets of assumptions, credit contracts which hold a group of borrowers jointly liable for repayment could improve welfare by allowing banks to offer larger loan sizes or lower interest rates compared what is profitable with individual contracts (see, for example, Ghatak 1999; Banerjee, Besley and Guinnane 1994; Besley and Coate 1995).

In recent years, microfinance institutions have begun to offer 'group loans' without the joint liability clause that featured in earlier loans. A simple characterisation of this new type of group loan is that the loan officer continues to meet with borrowers in a group, which enables the microfinance institution to lower transaction costs, but one individual in the group is no longer held liable for the loan taken out by another member. Since the early 2000's, two well-known microfinance institutions in Bangladesh, Grameen Bank and ASA have shifted away from joint liability contracts towards group loans with individual liability (see Rutherford 2006 for changes introduced at Grameen Bank and Gine and Karlan 2014 for broader trends in the sector).

Recent experimental evidence suggests that group lending may yield benefits even in the absence fo joint liability. Feigenberg et al. (2013) conduct an experiment in India in which loan groups were randomly assigned to contracts that required either weekly or monthly meetings. Although all loans involved individual liability, borrowers in groups with the higher meeting frequency were less likely to default on subsequent loans. Gine and Karlan

(2014) report on an experiment in which half the group lending centres of a Fillipino bank were randomly converted from joint liability to individual liability while maintaining all other features of the group lending. The switch did not affect default rates in the three years following the experiment.

A number of recent theoretical papers have also highlighted the merits of individual lending or group lending with individual liability, relative to group lending with joint liability. De Quidt et al. (2012) point out that even when a group loan contract does not explicitly stipulate joint liability, borrowers can pool risk and thus mimic the behaviour prescribed by joint liability contracts. Indeed, if the level of social capital is high, borrowers in group loans would achieve higher welfare with individual liability as compared to joint liability. Baland et al. (2013) show, in a model of ex-post moral hazard, that the largest incentive-compatible individual loan would not be feasible in a group contract with joint liability. Rai and Sjostrom (2004) has shown that a cross-reporting mechanism among borrowers in a group loan can induce an efficient outcome while joint liability in the absence of such cross-reporting would not.

An important aspect of group loans that has received relatively little attention in the recent literature is the role of reputation. When a loan officer deals with borrowers in a group, the failure of an individual to comply with the terms of a contract immediately becomes known within the group and can spread, thereafter, through the community. An individual with many social and economic ties within a community would wish to safeguard his or her reputation and this provides an added incentive to fulfill the terms of the loan, whether or not there is joint liability. Arguably, this added incentive is missing in individual loan contracts because matters related to the loan can be discussed with the loan officer in private.

In this paper, we investigate behaviour of borrowers in group loans where such reputational effects are present, comparing outcomes between contracts with and without joint liability. Specifically, we introduce a framework in which defaulting on a loan can reveal information about an individual's productivity in a communal activity, and thus lead to social exclusion when low productivity is revealed. In this setting, the ranking of the two types of group loans – in terms of the default rate and welfare of borrowers – is ambiguous. As expected, joint liability can reduce the default rate by inducing a borrower to repay for a group member whose own investment has been unsuccessful. However, depending on the distribution of borrower types in the population, defaulting on an individual liablity loan may have more informational content – and thus more likely to trigger social sanctions – than defaulting on a joint liability loan. In this case, group loans without joint liability do better.

Secondly, we show that when banks can offer both types of contracts in the credit market, the presence of group loans without joint liability will cause the interest rates in joint liability contracts to rise, and may even make joint liability contracts infeasible. The reason is as follows. In joint liability contracts, potential borrowers who are more concerned about their reputation will be induced to make payments more often. These individuals will find group loans without joint liability relatively more attractive when both types of loans are made available. As they opt for group loans without joint liability, this will leave joint liability contracts with borrowers who are less concerned about their reputation, which in turn will push up the rate of default for these contracts.

The sorting effect that we identify when both type are on offer means that the welfare achieved under each type of loan cannot be considered in isolation in the design of loan contracts. While there may be a rationale for offering group loans with individual liability – as highlighted by both the recent empirical and theoretical literature – financial service providers must also bear in mind that offering group loans with individual liability will adversely affect the performance of group loans with joint liability already on offer because of the type of selection into different types of loan contracts described above.

Besley and Coate's (1995) seminal paper on ex-post moral hazard in group loan contracts also explored the incentives induced by the threat of social sanctions. However, in their model, the social sanctions are triggered by the loss that a defaulting borrower inflicts on another who is held jointly liable. Therefore, it ignores the possibility that the threat of social sanctions may be present even when joint liability is absent from the contract. In our model, we assume that a loan default (potentially) reveals information about an individual that is relevant for his or her productivity in a group activity. Thus, defaulting on a loan can lead to exclusion from a group activity and its proceeds. This mechanism allows us to make a theoretical distinction between individual loans, group loans without joint liability and group loans with joint liability.

A recent paper which shares some similiarities with our theoretical framework is Guttman (2010), where agents take part, in parallel, in a 'trust game' and a 'microcredit game' involving joint liability and ex-ante moral hazard. Exerting low effect in the "microcredit game" can signal an agent's quality and unravel a good equlibrium in the trust game. Therefore, as in our model, reputational concerns and endogenous social capital can induce borrowers to comply with the terms of the loan contract. However, Guttman does not make comparisons between group loans with and without joint liability in the presence of such reputational effects. This comparison is the main component of the analysis conducted in our paper.

The remainder of the paper proceeds as follows. Section 2 describes the theoretical setup. Three different types of loan contracts – individual loans, group loans with individual liability and group loans with joint liability – are analysed in sections 3, 4 and 5. In Section 6, we make welfare comparisions across the three types of loan contracts. We consider a market where the technology for group loans both with and without joint liability are available in Section 7. Our findings are summarised in Section 8.

2 Theoretical Setup

2.1 Production

We begin by describing the production technology. An individual can invest any available assets in a riskless project with a rate of return r. There is also a risky project which requires an investment of exactly s, which returns ρ with probability π and 0 otherwise. An individual may undertake no more than one risky project but can invest any amount of money in the riskless project.

If $\pi\rho > r$, then the maximum expected return for differing levels of wealth, in the absence of any borrowing, is as follows:

$$f(w) = \begin{array}{l} rw \text{ if } w < s \\ \pi\rho s + (w-s)\,r \text{ if } w \geq s \end{array} \tag{1}$$

2.2 Borrowing

Suppose it were possible to borrow funds from a bank at an interest rate r_b. It should be evident that if $r_b \geq r$, then it never pays to borrow to invest in the riskless project.

But if an individual has total available wealth $w < s$, and is risk-neutral, he would borrow to invest in the risky project if

$$\pi\left[\rho s - r_b\,(s-w)\right] + (1-\pi)\,0 \geq rw \tag{2}$$

i.e. if the expected return from the risky project minus the expected cost of borrowing exceeds the return from investing in the riskless project. Rearranging the condition in (2), we obtain

$$\pi\rho s \geq \pi r_b s + (r - \pi r_b)\,w \tag{3}$$

2.3 Description of the Game

The game consists of the following players: a 'bank', a number of potential borrowers, and the 'community'. The timing of events in the game and the choice of action at each stage are described below.

1. The bank offers a menu of loan contracts, which specify loan size, interest rate, whether the loans entail individual or joint liability and the penalty for the individual or the group for defaulting on the loan;

2. The potential borrowers choose which loan contract to take, if any;

3. If a loan is taken, the borrower decides how to invest it;

4. Once project returns are realised, borrowers decide whether or not to repay the bank;

5. Finally, from observing their repayment behaviour, the community decides whether or not to include borrowers in a communal activity.

For ease of analysis, we restrict the membership size for group loans to two. The implications of larger sizes, which can be subtle and complex, are considered in detail in a related paper, Baland et al. (2013). The bank has the possibility of imposing a maximum penalty of K_b on any client (or group of clients) that defaults. The bank can also commit, ex ante, to imposing such a punishment.

The objective of the bank is to maximise profits, that of potential borrowers is to maximise the expected net return on any investments plus their utility from participation in the communal activity. Meanwhile, the 'community' selects group members to maximise the joint output from the communal activity, per person, net of any costs.

2.4 The Communal Activity and Agent Types

We assume that individuals who may be called on to participate in the communal activity can have two productivity types, denoted by θ_h and θ_l. We denote by λ_0 the fraction of high θ-types in the population. The agent's productivity type is known only to the agent himself, while the community has priors corresponding to the population distribution: $\Pr\left(\theta^i = \theta_h\right) = \lambda_0$ for each i.

The output from the communal activity is given by the following production funcion:

$$\hat{g}\left(n_h, n_l\right)$$

where n_h and n_l are, respectively, the number of individuals of the high and low θ-types. We assume that the funciton $\hat{g}\left(.,.\right)$ is homogeneous of degree 1; i.e. $\hat{g}\left(tn_h, tn_l\right) = t\hat{g}\left(n_h, n_l\right)$. If so, then the output per individual would be equal to

$$\begin{aligned} & \frac{1}{n}\hat{g}\left(n_h, n_l\right) \\ = \; & \hat{g}\left(\frac{n_h}{n}, \frac{n_l}{n}\right) \end{aligned}$$

where $n = n_h + n_l$. This last expression can be written as $g\left(\lambda\right) = \hat{g}\left(\lambda, 1-\lambda\right)$ where $\lambda = \frac{n_h}{n}$. We assume that $g'\left(\lambda\right) > 0$; i.e. output per person is increasing in the proportion of high-types involved in the community activity.

Individuals also vary according to how much they value participation in the group activity. We represent person i's utility from participation by $\gamma^i g\left(\lambda\right)$ where γ^i has a population distribution given by $F\left(\gamma\right)$ which we assume to be continous with compact support $\left[\gamma_{\min}, \gamma_{\max}\right]$.

We assume that θ and γ values are correlated in the population. In particular,

$$\Pr\left(\theta^i = \theta_h | \gamma^i = \gamma\right) = h(\gamma) \tag{4}$$

Furthermore, $h'(\gamma) > 0$, and $h(\gamma_{\min}), h(\gamma_{\max}) \in (0,1)$. We define the function $H : [\gamma_{\min}, \gamma_{\max}] \longrightarrow [0,1]$ as follows:

$$H(\gamma) = \int_{\gamma_{\min}}^{\gamma} h(x) f(x|x < \gamma) \, dx$$

where $f'(x) = F(x)$.

In words, $H(\gamma)$ is the conditional probability that an individual is of type θ_h when his γ-type is known to be below γ. Given the joint distribution of θ and γ in the population, and the community's prior beliefs about θ, we must have

$$H(\gamma_{\max}) = \lambda_0$$

Moreover, since $h'(\gamma) > 0$, we can show that $H'(\gamma) > 0$ (see the Appendix).

2.5 Exclusion from the Communal Activity

Imagine a community of size n in which the proportion of θ_h-types is λ; i.e. there are $n\lambda$ individuals of type θ_h in the population.

Suppose some new information is revealed about individual i such that the probability of i being a θ_h-type is updated to λ_i. For what values of λ_i would individual i be excluded from the communal activity?

If i is of type θ_h, then excluding i from the communal activity reduces the proportion of θ_h-types participating in the communal activity to $\frac{n\lambda-1}{n-1}$.

If i is of type θ_l, then excluding i from the communal activity increases the proportion of θ_h-types participating in the communal activity to $\frac{n\lambda}{n-1}$.

Therefore, the smallest value of λ_i for which individual i would actually be retained for the communal activity is given by

$$\lambda_i g\left(\frac{n\lambda - 1}{n-1}\right) + (1-\lambda_i) g\left(\frac{n\lambda}{n-1}\right) = g(\lambda) \tag{5}$$

Let us denote by $t(n,\lambda)$ the value of λ_i which solves (5). If $\lambda_i < t(n,\lambda)$, then the left-hand side of (5) is smaller than the right-hand side and so the expected value of the communal activity will be higher if i is excluded. If $\lambda_i > t(n,\lambda)$, then the opposite is true.

3 Individual Loans in the Absence of Social Sanctions

First, we consider the benchmark case where an individual's decision whether to default on or repay an individual loan does not affect the community's beliefs about his θ and γ values. If so, the only punishment that such a borrower faces is the penalty imposed by the bank, K_b. Therefore, the bank should reason that a borrower with a successful project will repay an individual loan if and only if

$$Lr_b \leq K_b \tag{6}$$

where L is the size of the loan. Therefore, it would offer individual loans upto size $L \leq K_b/r_b$. In equilibrium, such a loan would be repaid with probability π (when the borrower's risky project has been successful). And therefore, in a competitive market – where the bank makes zero expected profits on individual loan contracts – we obtain (assuming the bank's cost of capital equals r)

$$\pi r_b = r \tag{7}$$

Using (6) and (7), we obtain the maximum size of an individual loan that the bank would be willing to offer:

$$L_0 = \pi K_b / r \tag{8}$$

We previously established that individuals with wealth greater than s would choose not to borrow if the interest rate exceeds the return from the riskless project (and they are obliged to repay). Therefore, when community beliefs are unaffected by a borrower's behaviour towards the bank, the individual loan contract can only benefit individuals with wealth $w \in [s - L_0, s)$.

4 Individual Loans in the Presence of Social Sanctions

Let us now consider how the scope of individual loan contract changes if the community's beliefs about an individual's type is influenced by one's behaviour after taking a bank loan. We argue that the community is most likely to have information about the individual's behaviour in the case of a group loan because the loan officer deals with all members of the group in the group meeting. Therefore, in the following we refer to these loans as 'group meeting' loans to distinguish them from the group loans with joint liability which we analyse subsequently.

Consider, for instance, what would happen if the community believed that a person with a succesful project who refused to pay his debt to the bank was considered to be a low θ-type. Formally, we would represent such beliefs as follows:

$$\Pr\left(\theta^i = \theta_h | P^i < Lr_b \text{ in state } G\right) < t\left(n, \lambda_0\right) \tag{9}$$

where 'G' denotes the outcome that person i's project has been successful, and n is the size of the community. With these beliefs, the community would indeed find it in its interest to exclude such a person from the community activity and, therefore, the threat of social sanctions would be credible.

Therefore, a borrower would choose to default under these conditions if and only if

$$Lr_b > K_b + \gamma^i g(\lambda_0)$$

where γ^i denotes his γ-type. Therefore, the best response of a borrower would be to repay the bank if $\gamma^i \geq \frac{Lr_b - K_b}{g(\lambda_0)}$ and pay nothing otherwise. For these strategies, the community beliefs regarding a borrower's θ-type are given by

$$\Pr\left(\theta^i = \theta_h | \gamma^i < \frac{Lr_b - K_b}{g(\lambda_0)}\right) = H\left(\frac{Lr_b - K_b}{g(\lambda_0)}\right) \tag{10}$$

Therefore, the beliefs in (10) are consistent with the strategy of excluding defaulters if and only if

$$H\left(\frac{Lr_b - K_b}{g(\lambda_0)}\right) < t(n, \lambda_0) \tag{11}$$

In summary, we have established the following:

Lemma 1 *If the condition in (11) holds, then there exists an equilibrium in the subgame following the issuance of an individual loan (L, r_b) in which the community chooses to exclude from the communal activity any borrower who fails to make a payment of Lr_b when her project has been successful. The threshold value of γ below which a borrower would actually default is given by $\frac{Lr_b - K_b}{g(\lambda_0)}$.*

Using Lemma 1, we can determine the probability with which the bank will receive repayment for the individual loan. We can reason that the bank will be repaid if and only if the project succeeds <u>and</u> the γ-type exceeds the threshold $\frac{Lr_b - K_b}{g(\lambda_0)}$.

Let $D(r_b, L, K_b, \lambda_0)$ be the probability of repayment of an individual loan when the interest rate is r_b, the loan size is L, the bank sanctions are described by the parameter K_b and the proportion of high-types in the community is λ_0 (we may supress the sanction parameters hereafter for ease of notation). Then, we have

$$\begin{aligned} D(r_b, L, K_b, \lambda_0) &= \pi \Pr\left(\gamma^i \geq \frac{Lr_b - K_b}{g(\lambda_0)}\right) \\ &= \pi\left[1 - F\left(\frac{Lr_b - K_b}{g(\lambda_0)}\right)\right] \end{aligned} \tag{12}$$

By definition, $F'(.) \geq 0$, and therefore $\frac{\partial D}{\partial L}, \frac{\partial D}{\partial r_b} < 0$; i.e. the probability of repayment falls with the loan size and the interest rate. Larger loans are higher risk from the point of view of the bank, and it would need to charge a higher interest rate to break even. On the other hand, raising the interest rate also raises the risk of default and the probability of default will eventually rise to 1. Therefore, there are potential loan sizes which the bank cannot offer at any interest rate without incurring a loss.

Does the presence of social sanctions improve the scope of individual loan contracts in any sense? Suppose that an individual loan of size $L < L_0$ is offered at the interest rate $r_b = r/\pi$. By construction, we have $Lr/\pi \leq K_b + \gamma g(\lambda_0)$ for each $\gamma \in [\gamma_{\min}, \gamma_{\max}]$. Therefore, $F\left(\frac{Lr/\pi - K_b}{g(\lambda_0)}\right) = 0$ and $D(r_b, L, K_b) = \pi$. Therefore, the interest rate $r_b = r/\pi$ is, indeed, the competitive interest rate. Any attempt to lower the interest rate below r/π would cause banks to lose money because the probability of repayment cannot exceed π. And competition will prevent any interest rate above π from emerging. Consequently, we obtain the same contract $(L, r/\pi)$ as in the case where community sanctions are not present.

Suppose we choose L such that $Lr/\pi = K_b + \gamma_{\min} g(\lambda_0)$. If $\gamma_{\min}, g(\lambda_0) > 0$, then this must imply that $L > L_0$. Moreover, $F\left(\frac{Lr/\pi - K_b}{g(\lambda_0)}\right) = F(\gamma_{\min}) = 0$. Therefore, $D(r_b, L, K_b, \lambda_0) = \pi$. Once again, the equilibrium interest rate will be r/π. Therefore, the community sanctions allow loan sizes up to

$$L_{pool} = \frac{\pi}{r}\left(K_b + \gamma_{\min} g(\lambda_0)\right) \tag{13}$$

to be offered at interest rate r/π. Note that this contract involves a 'pooling equilibrium' in the subgame following the issuance of the loan: all γ-types choose to repay the loan when they have succeeded.

Therefore, the presence of social sanctions allow larger loans to be offered. In particular, individuals with wealth $w \in [s - L_{pool}, s)$, where $L_{pool} > L_0$, can benefit from a group loan.

4.1 Separating Equilibria in the Social Sanctions Subgame

Are loans of size above L_{pool} feasible? First note that, for larger loan sizes, the probability of repayment must fall below π (since $r_b \geq r/\pi$ and $\frac{\partial D}{\partial r_b}, \frac{\partial D}{\partial L} < 0$). Therefore, if larger loan sizes are at all feasible, the bank must raise the interest rate above r/π. It is not evident that the bank can break even by doing so because as the interest rate increases, so does the probability of default. However, we can provide a sufficient condition under which some loan sizes larger than L_{pool} will be feasible in a separating equilibrium.

It is important to note that if a separating equilibrium prevails, then some borrowers who are successful in their projects will default on their loans. Consequently, they will be excluded from the community activity and the proportion of θ_h-types among those who participate in the activity will increase. This, in turn, will affect the per capita output from the community activity. In the following analysis, we assume that the proportion of θ_h-types in the population is λ_0. Although this proportion will increase over time when a separating equilibrium is in effect, it serves as a useful benchmark for the purpose of comparisons.[1]

Definition 1 *An individual loan contract* (L, r_b) *is feasible in equilibrium in a* λ_0 *population (i.e. a population with a* λ_0 *proportion of* θ_h*-types) if there exists a* $\gamma_s \in [\gamma_{\min}, \gamma_{\max}]$ *such that successful individuals repay the loan when their* γ*-type is above* γ_s *and the loan provider breaks even.*

To determine the conditions in which a separating equilibrium is feasible, we first establish the following lemma.

Lemma 2 *Suppose the individual loan contract* (L, r_b) *emerges in equilibrium in a* λ_0 *population and all* γ*-types above* $\gamma_s \in [\gamma_{\min}, \gamma_{\max}]$ *are willing to repay the loan if successful. Then some loan size* $L' > L$ *is also feasible if*

$$\frac{d}{dr_b}\left[r_b D\left(r_b, L, K_b, \lambda_0\right)\right] > 0 \tag{14}$$

Proof. From the zero-profit condition, we obtain $r_b D\left(r_b, L, K_b, \lambda_0\right) = r$. If the condition in (14) holds, there exists some $\delta > 0$ such that

$$\left(r_b + \delta\right) D\left(r_b + \delta, L, K_b, \lambda_0\right) > r$$

Since the function $D(.)$ is continuous in L, it follows that there exists some $\varepsilon > 0$ such that

$$\left(r_b + \delta\right) D\left(r_b + \delta, L + \varepsilon, K_b, \lambda_0\right) = r$$

i.e. the bank can offer a loan of size $L + \varepsilon$ at interest rate $r_b + \delta$ and still break even. Therefore, the loan contract $(L + \varepsilon, r_b + \delta)$ will also be offered in equilibrium. ■

Using Lemma 2, we can argue that a loan of size greater than L_{pool} is feasible if

$$\frac{d}{dr_b}\left[r_b D\left(r_b, L_{pool}, K_b, \lambda_0\right)\right]|_{r_b = \frac{r}{\pi}} > 0$$

$$\implies \pi\left[D\left(\frac{r}{\pi}, L_{pool}\right) - \frac{r}{\pi} f\left(\frac{L_{pool}\frac{r}{\pi} - K_b}{g\left(\lambda_0\right)}\right)\frac{L_{pool}}{g\left(\lambda_0\right)}\right] > 0$$

Since $D\left(\frac{r}{\pi}, L_{pool}\right) = \pi$ and $\frac{L_{pool}\frac{r}{\pi} - K_b}{g(\lambda_0)} = \gamma_{\min}$, we obtain

$$\pi^2 > r f\left(\gamma_{\min}\right)\frac{L_{pool}}{g\left(\lambda_0\right)}$$

[1] An alternative assumption would be that all individuals who would default in a separating equilibrium have already been excluded from the collective activity. Then, the proportion of θ_h-types engaged in the collective activity would be $\int_{\gamma_s}^{\gamma_{\max}} h(x) f(x | x > \gamma_s)\, dx$. But note that, in this case, there would be no further defaults, and the resulting equilibrium would be a pooling equilibrium.

$$\implies f(\gamma_{\min}) < \frac{\pi}{(K_b + \gamma_{\min} g(\lambda_0))} \tag{15}$$

This is a condition on the distribution of γ-types in the population. In words, we require that only a small fraction of potential borrowers would be willing to default and face community sanctions if the interest rate were raised marginally. It is significant that the upper tail of the γ-distribution does not matter for the effectiveness of community sanctions in enforcing the loan contract. This means, in particular, that a redistribution of the gains from the community activity can affect the scope of using social sanctions for enforcing bank contracts.

5 Joint-Liability Loans

Next, we consider joint-liability loan contracts. As in Besley and Coate (1995), the borrowing group will have a membership of two. However, we introduce the possibility of endogenous social sanctions, of the kind discussed in Section 4.

In the case of joint-liability loans, there are four relevant outcomes relating to project success: both borrowers may succeed, both borrowers may fail, the first borrower succeeds while the second fails, the first borrower fails while the second succeeds. We use the terms GG, BB, GB and BG, respectively to denote these states.

As in Section 4, we assume that the community believes that a person with a successful project who refused to repay the bank is 'unworthy' to take part in the communal activity. In addition, we assume that the community believes that a person with a successful project who refuses to repay for a group member whose own project has failed is also 'unworthy' to take part in the communal activity. The second assumption means that social pressures tend to promote 'cross-subsidisation'. Formally, we represent these beliefs as follows:

$$\Pr\left(\theta^i = \theta_h | P^i < Lr_b \text{ in state } GG\right) \quad < \quad t(n, \lambda_0) \tag{16}$$

$$\Pr\left(\theta^i = \theta_h | P^i < 2Lr_b \text{ in state } GB\right) \quad < \quad t(n, \lambda_0) \tag{17}$$

With these beliefs, the community would indeed find it in its interest to exclude a person who refuses to pay his own debt in state GG or both loans in state GB, and, therefore, the threat of social sanctions would be credible. Therefore, a borrower in a joint liability contract would choose to default, respectively, in states GG and GB if and only if the following conditions hold:

$$Lr_b \quad > \quad K_b + \gamma^i g(\lambda_0)$$

$$2Lr_b \quad > \quad K_b + \gamma^i g(\lambda_0)$$

Therefore, the best response of a borrower would be as follows: to repay own loan in state GG if $\gamma^i \geq \frac{Lr_b - K_b}{g(\lambda_0)}$ and pay nothing otherwise; to repay both loans in state GB if $\gamma^i \geq \frac{2Lr_b - K_b}{g(\lambda_0)}$ and pay nothing otherwise.

The community beliefs regarding a borrower's type, as indicated in (16) and (17) are consistent with Bayes' Rule if the following conditions hold:

$$H\left(\frac{2Lr_b - K_b}{g(\lambda_0)}\right) < t(n, \lambda_0) \tag{18}$$

$$H\left(\frac{Lr_b - K_b}{g(\lambda_0)}\right) < t(n, \lambda_0) \tag{19}$$

Since $H(.)$ is an increasing function, the condition in (18) implies the one in (19).

Is it possible that, in state GG, if $\gamma^i < \frac{Lr_b - K_b}{g(\lambda_0)}$, person j can be induced to pay for both loans? We have assumed that the community beliefs in state GG depends only on one's willingness to pay one's *own* loan (as shown in condition **??**). In other words, the community would be satisfied with person j's trustworthiness as long as he is willing to repay his own debt. So, he can only be induced to repay both loans if the bank sanctions are severe enough. This requires that $K_b \geq 2Lr_b$. But if this last condition holds, it cannot be that $\gamma^i < \frac{Lr_b - K_b}{g(\lambda_0)}$ as the range of γ's is positive. Therefore, full repayment of the bank loan occurs in state GG if and only if $\gamma^i, \gamma^j > \frac{Lr_b - K_b}{g(\lambda_0)}$. Thus, we have established the following:

Lemma 3 *If the condition in (18) holds, then there exists an equilibrium in the subgame following the issuance of a joint-liability loan (L, r_b) in which the community chooses to exclude from the communal activity any borrower who fails to make a payment of Lr_b when both projects in the group have been successful, or a payment of $2Lr_b$ when only her own project has been successful. The threshold value of γ below which a borrower would actually default in these two scenarios are given by $\frac{Lr_b - K_b}{g(\lambda_0)}$ and $\frac{2Lr_b - K_b}{g(\lambda_0)}$ respectively.*

Using Lemma 3, we can determine the probability with which the bank will receive repayment for the joint liability loan. We can reason that the bank will be repaid if both projects succeed and the γ-type exceeds the threshold $\frac{Lr_b - K_b}{g(\lambda_0)}$ for both borrowers or only one of the projects succeeds and the γ-type of the successful borrower exceeds the threshold $\frac{2Lr_b - K_b}{g(\lambda_0)}$.

Let $\hat{D}(r_b, L, K_b, \lambda_0)$ be the probability of repayment of a joint-liability loan when the interest rate is r_b, the loan size is L, and the bank and community sanctions are described by the parameter K_b (we supress the sanction parameters hereafter for ease of notation). Then, we have

$$\begin{aligned} \hat{D}(r_b, L, K_b, \lambda_0) &= \Pr(\text{state } GG) \Pr\left(\gamma^i, \gamma^j > \frac{Lr_b - K_b}{g(\lambda_0)}\right) + \Pr(\text{state } GB) \Pr\left(\gamma^i > \frac{2Lr_b - K_b}{g(\lambda_0)}\right) \\ &\quad + \Pr(\text{state } BG) \Pr\left(\gamma^j > \frac{2Lr_b - K_b}{g(\lambda_0)}\right) \\ &= \pi^2 \left[1 - F\left(\frac{Lr_b - K_b}{g(\lambda_0)}\right)\right]^2 + 2\pi(1-\pi)\left[1 - F\left(\frac{2Lr_b - K_b}{g(\lambda_0)}\right)\right] \end{aligned} \tag{20}$$

By definition, $F'(.) \geq 0$, and therefore $\frac{\partial \hat{D}}{\partial L}, \frac{\partial \hat{D}}{\partial r_b} < 0$; i.e. the probability of repayment falls with the loan size and the interest rate. Larger loans are higher risk from the point of view of the bank, and it would need to charge a higher interest rate to break even. On the other hand, raising the interest rate also raises the risk of default and the probability of default will eventually rise to 1. Therefore, there are potential loan sizes which the bank cannot offer at any interest rate without incurring a loss.

6 Comparison of Loan Contracts

In principle, the three types of loan contracts discussed thus far – individual loans, individual loans disbursed in group meetings, and joint liability loans – may be offered simultaneously in the credit market. In this section, we consider which contracts emerge in equilibrium and whether different types of contracts would cater to borrowers with differing characteristics.

To compare the different loan contracts, we first consider, for each type of contract, the interest rate at which a bank would break even for different loan sizes (if that loan size is feasible) with the assumption that there is no sorting among borrowers. In the case of individual loans, we established in Section 3 that for $L \leq L_0$, the bank breaks even at an interest rate $\frac{r}{\pi}$ and that loan sizes above L_0 are not feasible.

In the case of individual loans disbursed in group meetings, we established in Section 4, that for $L \leq L_{pool}$, the bank breaks even at an interest rate $\frac{r}{\pi}$. Moreover, loan sizes amove L_{pool} are feasible if the condition in (15) holds. In this case, the interest rate will be higher than $\frac{r}{\pi}$ (because not all γ-types will repay the loan even if their projects succeed).

In the case of joint liability loans, the break-even interest rate varies continuously with the size of the loan. To facilitate comparison, we first identify the loan size for which the break-even interest rate is $\frac{r}{\pi}$. For L sufficiently small, we obtain $\hat{D}\left(\frac{r}{\pi}, L\right) = \pi^2 + 2\pi(1-\pi) > \pi$. The function is decreasing in L and returns a value of zero for sufficiently large L. Therefore (using the Intermediate Value Theorem) we can find a loan size – let us call it L^* – which satisfies the following condition:

$$\hat{D}\left(\frac{r}{\pi}, L^*\right) = \pi$$

Therefore, the break-even interest rate for a joint liability loan of size L^* is $\frac{r}{\pi}$. Using the definition of the function $\hat{D}\left(\frac{r}{\pi}, L\right)$, we can show that

$$L^* \gtreqless L_0 \iff F\left(\frac{2L_0\frac{r}{\pi} - K_b}{g(\lambda_0)}\right) \gtreqless \frac{1}{2}$$

$$L^* \gtreqless L_{pool} \iff F\left(\frac{2L_{pool}\frac{r}{\pi} - K_b}{g(\lambda_0)}\right) \gtreqless \frac{1}{2}$$

For loan sizes smaller than L^*, we have $\hat{D}\left(\frac{r}{\pi}, L\right) > \pi$, and therefore the break-even interest for a joint-liability loan would be smaller than $\frac{r}{\pi}$. It is not guaranteed that joint liability loans larger than L^* would be feasible in equilibrium. The reason is that as the interest rate is raised, so will the probability of default in state GG and the states GB and BG. Raising the interest further to compensate for increased default would raise the rate of default even further, so that the bank may never break even. However, if loans larger than L^* are feasible, we have the following result.

Lemma 4 *If joint liability loans of size larger than L^* are feasible, then they must involve an interest rate higher than $\frac{r}{\pi}$.*

Proof. We provide a proof by contradiction. Suppose it is possible to provide a loan of size $L' > L^*$ at an interest rate $r' \leq \frac{r}{\pi}$. By construction, we have $\left[\frac{r}{\pi}\hat{D}\left(\frac{r}{\pi}, L^*, K_b, \lambda_0\right)\right] = r$. Since, $\hat{D}(.)$ is decreasing in r and L, we have $r'\hat{D}(r', L', K_b, \lambda_0) < r$. Therefore, the bank will not break even if it offers a joint liability contract (L', r'). ■

6.1 Comparing Individual Loans and Group Meeting Loans

On the basis of the analysis in sections 3 and 4 and Lemma 1, we can state the following result.

Proposition 1 *For loans of size below L_0 (given by equation 8), the rate of default, the break-even interest rate and the expected utility of borrowers are identical for individual loans and individual liability loans disbursed in group meetings. Loans of size greater than L_0 are not feasible as individual loans, while larger loans of size of at least $L_{pool} > L_0$ can be disbursed as individual liability loans in group meetings.*

Proposition 1 provides a rationale for disbursing individual liability loans in group meetings. Since the behaviour of borrowers can reveal information about themselves to the wider community, the group meeting can create social pressure even though default by one borrower has no contractual implications for other group members. This social pressure ensures that individuals are willing to comply with the terms of a loan of size $L \in (L_0, L_{pool}]$ when they receive it in a (individual liability) group although an individual loan would have resulted in default. The informational mechanism highlighted here removes the link between joint liability and social sanctions that appears in Besley and Coate (1995) and provides an alternative justification for providing individual liability loans in groups to that proposed by De Quidt, Fetzer and Ghatak (2012).

For every γ-type, a successful borrower would repay an individual loan for $L < L_o$ and a group meeting loan for $L < L_{pool}$. Therefore, for $L \leq L_o$, the two types of loans are effectively identical and potential borrowers will be indifferent between the two types of contracts. For $L_o < L \leq L_{pool}$, individual loans are not feasible, while group meeting loans are available at an interest rate $\frac{r}{\pi}$. Since individual loans are identical to group meeting loans whenever they are feasible, hereafter we compare only group meeting loans with joint liability loans.

6.2 Comparing Joint Liability with Group Meeting Loans

In this section, we consider whether joint-liability loans are, in any sense, superior to group meeting loans if social sanctions are feasible in both cases. We compare the probability of repayment for a loan contract with terms (L, r_b).

Note first that, from the discussion preceding Lemma 3, a critical condition is whether condition (18) will be satisfied. In particular, if:

$$H\left(\frac{2Lr_b - K_b}{g(\lambda_0)}\right) > t(n, \lambda_0) \geq H\left(\frac{Lr_b - K_b}{g(\lambda_0)}\right)$$

then, given the community's beliefs, someone defaulting on an individual contract is perceived as having a sufficiently high probability of being a low θ-type to be excluded. The same condition implies that, under group lending, a successful member who refuses to repay his own loan and the loan of an unsucessful co-borrower is believed by the community to have a large enough probability of being a high θ-type to be retained for the communal activity. Given this belief, successful borrowers are ready to pay for their own loan but not for the failures. Under joint liability, this implies that in all realizations such that only one member succeeds, the group as a whole will not repay. This occurs with probability $2\pi(1-\pi)$. In this case, group meetings always dominate, in the sense that, for the same loan size, the default rate and the interest rate charged by the bank will be lower.

By contrast, if

$$t(n, \lambda_0) \geq H\left(\frac{2Lr_b - K_b}{g(\lambda_0)}\right)$$

a member refusing to repay both loans is believed by the group to have a sufficiently high probability of being a low θ-type to be excluded and group loans are repaid if at least one success occurs in the group. In this case, we can compare the probability of repayment of a loan (L, r_b) under joint liability and individual liability with social sanctions (i.e. group meeting) by subtracting the expression in (12) from (20), to obtain

$$2\pi(1-\pi)\left[1 - F\left(\frac{2Lr_b - K_b}{g(\lambda_0)}\right)\right] - \pi(1-\pi)\left[1 - F\left(\frac{Lr_b - K_b}{g(\lambda_0)}\right)\right] \qquad (21)$$

Intuitively, the advantage of joint liability is that it can deliver repayment of both loans in state GB whenever the borrower with a successful project has $\gamma > \frac{2Lr_b - K_b}{g(\lambda_0)}$. In the case of an individual loan contract, in the same situation, the borrower with the unsuccessful project would default.

However, the disadvantage of joint liability is that it results in default in state GB if the successful borrower has γ between $\frac{Lr_b - K_b}{g(\lambda_0)}$ and $\frac{2Lr_b - K_b}{g(\lambda_0)}$. In the case of an individual loan, in the same situation, the borrower with the successful project would repay.

The expression in (21) is positive if and only if

$$\left[1 - F\left(\frac{2Lr_b - K_b}{g(\lambda_0)}\right)\right] > \frac{1}{2}\left[1 - F\left(\frac{Lr_b - K_b}{g(\lambda_0)}\right)\right] \qquad (22)$$

Therefore, joint liability leads to increased probability of repayment compared to individual liability with social sanctions if, on average, the 'pride' or 'sense of shame' of community members are sufficiently strong to induce them to repay two loans rather than one. If the condition in (22) holds, it means that, for a given contract (L, r_b), joint liability will lead to higher repayment than individual liability.

Proposition 2 *If it is possible to offer an individual loan contract* (L, r_b) *in the presence of social sanctions (i.e. a group meeting loan) in a competitive market, then group loans with joint liability can also be offered in a competitive market if the condition in (22) holds. Moreover, the equilibrium interest rate for the joint liability loan will be lower if and only if (22) holds.*

7 A Market with both Joint Liability and Group Meeting Loans

It is important to note that Proposition 2 does not describe which loan borrowers would actually choose when both a joint liability loan and a group meeting loan are made available in a competitive market. When both types of loans are available, potential borrowers who differ in terms of their valuation of the communal activity (different γ-types) may also differ in their preference between the two types of loans. And this will lead to sorting between the two types of contracts.

Consider a group meeting contract (L, r_{gm}) and a joint liability contract (L, r_{jl}). Suppose $t(n, \lambda_0) \geq H\left(\frac{2Lr_{jl}-K_b}{g(\lambda_0)}\right)$, so that if a borrower in a joint liability contract refuses to pay both loans when he has a successful project, there is, potentially, a credible threat of social sanctions.

Threshold Values: Let γ_{gm} be the value of γ at and above which successful borrowers would be willing to repay a group meeting loan. Let γ_1 and γ_2 be the threshold values of γ at and above which a successful borrower would be willing to repay one and two loans, respectively. From these definitions, we have

$$\gamma_{gm} = B\left(\frac{Lr_{gm} - K_b}{g(\lambda_0)}\right) \tag{23}$$

$$\gamma_1 = B\left(\frac{Lr_{jl} - K_b}{g(\lambda_0)}\right) \tag{24}$$

$$\gamma_2 = B\left(\frac{2Lr_{jl} - K_b}{g(\lambda_0)}\right) \tag{25}$$

where the function $B(.)$ is defined as follows: $B(x) = x$ if $x \in [\gamma_{\min}, \gamma_{\max}]$; $B(x) = \gamma_{\min}$ if $x < \gamma_{\min}$ and $B(x) = \gamma_{\max}$ if $x > \gamma_{\max}$.

Expected Utilities: The expected utility from a group meeting contract across different γ-values is as follows:

For $\gamma \geq \gamma_{gm}$

$$W_{gm} = \pi \left(\rho s - L r_{gm}\right) + (1-\pi)\left(-K_b\right) \tag{26}$$

For $\gamma < \gamma_{gm}$

$$W_{gm} = \pi \left(\rho s - K_b - \gamma g\left(\lambda_0\right)\right) + (1-\pi)\left(-K_b\right) \tag{27}$$

Let ζ_1 be the proportion of borrowers in joint liability contracts who default when both projects have been successful. Let ζ_2 be the proportion of borrowers in joint liability contracts who default when only their own project has been successful. The values of ζ_1 and ζ_2 are determined in equilibrium as individuals might sort themselves into the two different types of contracts. Given ζ_1 and ζ_2, the expected utility from a joint liability contract across different γ-values is as follows:

For $\gamma \geq \gamma_2$

$$\begin{aligned} W_{jl} &= \pi \left[\pi \left\{1-\zeta_1\right\}\left(\rho s - L r_{jl}\right) + \pi \zeta_1 \left(\rho s - K_b\right) + (1-\pi)\left(\rho s - 2 L r_{jl}\right)\right] \\ &\quad + (1-\pi)\left[\pi \zeta_2 \left(-K_b\right) + (1-\pi)\left(-K_b\right)\right] \end{aligned} \tag{28}$$

For $\gamma_1 \leq \gamma < \gamma_2$

$$\begin{aligned} W_{jl} &= \pi \left[\pi \left\{1-\zeta_1\right\}\left(\rho s - L r_{jl}\right) + \pi \zeta_1 \left(\rho s - K_b\right) + (1-\pi)\left(\rho s - K_b - \gamma g\left(\lambda_0\right)\right)\right] \\ &\quad + (1-\pi)\left[\pi \zeta_2 \left(-K_b\right) + (1-\pi)\left(-K_b\right)\right] \end{aligned} \tag{29}$$

For $\gamma < \gamma_1$

$$\begin{aligned} W_{jl} &= \pi \left[\pi \left(\rho s - K_b - \gamma g\left(\lambda_0\right)\right) + (1-\pi)\left(\rho s - K_b - \gamma g\left(\lambda_0\right)\right)\right] \\ &\quad + (1-\pi)\left[\pi \zeta_2 \left(-K_b\right) + (1-\pi)\left(-K_b\right)\right] \end{aligned} \tag{30}$$

Using (26)-(30), we can determine how the expected utility from each contract changes with γ:

$$\frac{\partial W_{jl}}{\partial \gamma}\Big|_{\gamma \geq \gamma_2} = 0 \tag{31}$$

$$\frac{\partial W_{jl}}{\partial \gamma}\Big|_{\gamma_1 \leq \gamma < \gamma_2} = -\pi (1-\pi) g\left(\lambda_0\right) \tag{32}$$

$$\frac{\partial W_{jl}}{\partial \gamma}\Big|_{\gamma_1 < \gamma} = -\pi g\left(\lambda_0\right) \tag{33}$$

Furthermore, we have

$$\frac{\partial W_{gm}}{\partial \gamma}|_{\gamma \geq \gamma_{gm}} = 0 \tag{34}$$

$$\frac{\partial W_{gm}}{\partial \gamma}|_{\gamma < \gamma_{gm}} = -\pi g(\lambda_0) \tag{35}$$

From (31)-(35), we see that as γ increases, the expected utility from both contracts declines. This is because, by definition, being subject to social sanctions is more costly to individuals with higher values of γ. However, individuals with higher values of γ are more likely to pay their dues; and so the risk of being exposed to social sanctions is lower. Therefore, the expected utility declines more slowly for higher values of γ.

Utility Comparisons: We must compare the utility obtained from each type of contract across different γ-values to determine how individuals will sort themselves, if at all.

The utility from each contract depends, obviously, on the equilibrium interest rates, which we are yet to determine. To proceed with the analysis, let us denote by $\bar{r}_{jl}$ the equilibrium interest rate in a joint liability contract if it was the only type of contract available (i.e. there was no technology to provide group meeting contracts). Let us denote by $\bar{r}_{gm}$ the equilibrium interest rate in a group meeting contract if it was the only type of contract available (i.e. there was no technology to provide joint liability contracts).

We can use (26)-(30) to plot the expected utility from these two contracts. If the expected utility from one exceeds that from the other for all γ values in the interval $[\gamma_{\min}, \gamma_{\max}]$, then obviously each individual will opt for the former contract. And, in the event of 'full sorting' the equilibrium interest rates will correspond to those which would occur if the contract in question were the only one available (in the case of the contract that is not taken up by anyone, a sequential equilibrium requires the condition that any individual who deviates to this contract is equally likely to belong to any part of the original distribution $F(.)$; it can then be shown that the break-even interest rate will be the same as when it is the only type of contract available, i.e. $\bar{r}_{jl}$ or $\bar{r}_{gm}$).

Next, we discuss the case where the expected utility curves for the contracts $(L, \bar{r}_{jl})$ and $(L, \bar{r}_{gm})$ cross at some $\gamma_x \in [\gamma_{\min}, \gamma_{\max}]$. The case where loan sizes are sufficiently small such that all γ-types are willing to repay at least their own loan is relatively simple. And therefore, we start with this case.

7.1 The Case of 'Pooling' in the Group Meeting Contract

Let us consider first the case where $L < L_{pool}$. Then, as we saw previously, we can have a 'pooling equilibrium' when a group meeting contract is offered on its own; specifically, all individuals with successful projects repay their dues, an amount equal to $L\frac{r}{\pi}$. From (23), we obtain $\gamma_{gm} = \gamma_{\min}$. The utility curve for the group meeting contract is simply a straight

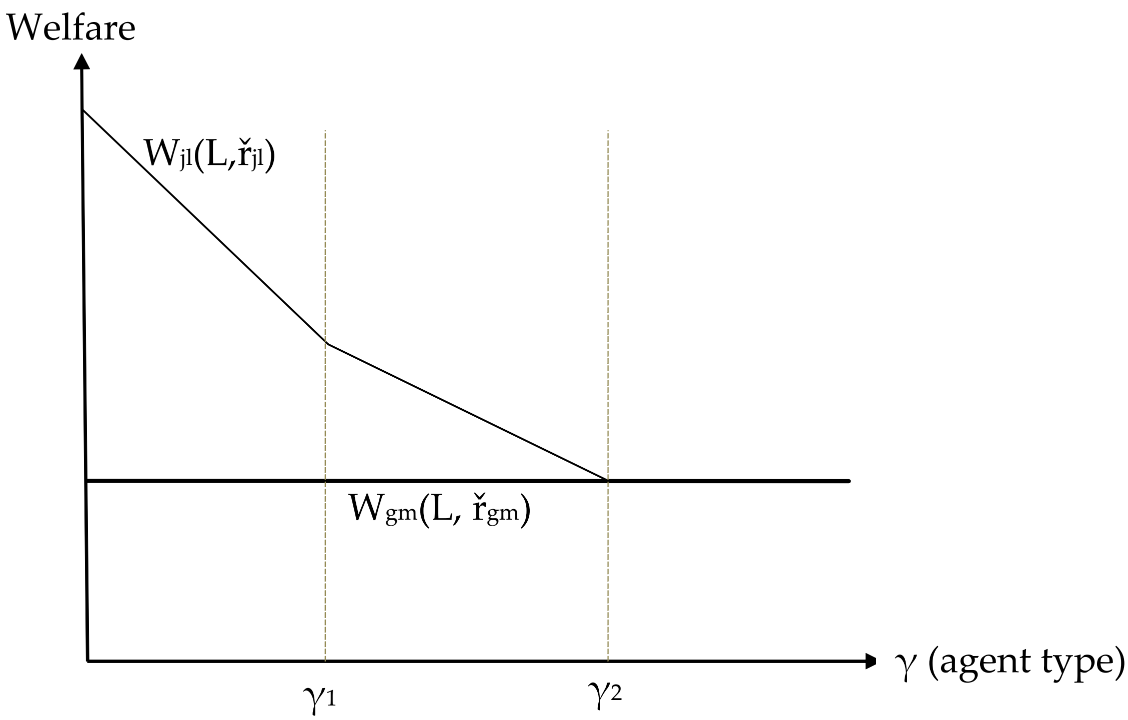

Figure 1: Individuals above γ_2 indifferent between the two contracts.

line, and all γ-types receive the same expected utility. If the two utility curves cross, it will be at some $\gamma_x \leq \gamma_2$. Figures 1 and 2 below show the two possible cases.

If $\gamma_x = \gamma_2$, then all individuals at or above γ_2 are indifferent between the group meeting contract $(L, \bar{r}_{gm})$ and $(L, \bar{r}_{jl})$; and all individuals below γ_2 prefer the joint liability contract. Then, we can have an equilibrium where all individuals opt for the joint liability contract and the two contracts are offered at the interest rates $\bar{r}_{jl}$ and $\bar{r}_{gm}$ respectively. (Note that if any individuals at or above γ_2 opt for the group meeting contract, then it would not be possible to break even on the joint liability contract by offering an interest rate $\bar{r}_{jl}$).

If $\gamma_x < \gamma_2$, then any individual who, in a joint liability contract, would be willing to repay for a partner in state GB (i.e. his own project has been successful but his partner's project has not) actually prefers the group meeting contract. So, no cross-subsidisation would take place in the joint liability contract if the two contracts are offered simultaneously. Then, it would not be possible to break even by offering the joint liability contract at interest rate $\bar{r}_{jl}$. On the other hand, a bank would still break even by offering the group meeting contract at interest rate $\bar{r}_{gm} = \frac{r}{\pi}$, since all borrowers continue to repay when they have been sucessful.

Offering the joint liability contract at an interest rate *lower* than $\bar{r}_{jl}$ would make it more attractive to individuals with high γ values. But (31)-(34) imply that if some γ-type prefers the joint liability contract to the group meeting contract, all lower types will do the same.

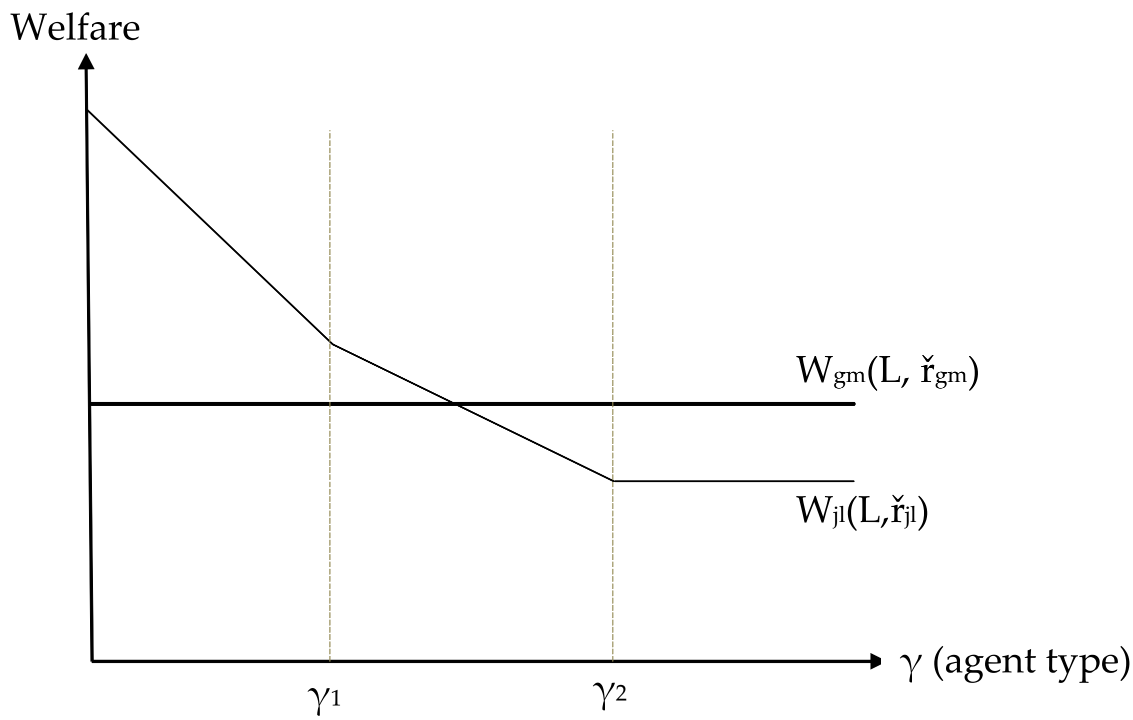

Figure 2: All individuals at or above γ_2 prefer the group meeting contract.

Therefore, the probability of repayment in the joint liability contract can be no higher than in the case where it is offered at the interest rate $\bar{r}_{jl}$ and it is the only contract available. So, it is not possible to break even on the joint liability contract by offering it at a lower interest rate.

Offering the joint liability contract at an interest rate *higher* than $\bar{r}_{jl}$ would make it even less attractive compared to the group meeting contract $(L, \bar{r}_{gm})$. However, it may enable the bank to break even. The conditions necessary to obtain such an equilibrium are as follows:

$$\zeta_1 = \frac{F(\gamma_1)}{F(\gamma_x)} \tag{36}$$

$$\zeta_2 = 1 \tag{37}$$

$$\zeta_{gm} = 0 \tag{38}$$

$$r_{jl} = \frac{r}{\pi^2 (1-\zeta_1)^2} \tag{39}$$

$$r_{gm} = \frac{r}{\pi} \tag{40}$$

$$\pi (\rho s - L r_{gm}) + (1-\pi)(-K_b) = \pi Z_1 + (1-\pi)(-K_b) \tag{41}$$

$$\gamma_1 < \gamma_x < \gamma_2 \tag{42}$$

where, for ease of notation, we have used

$$
\begin{aligned}
Z_1 &= \pi (1-\zeta_1)(\rho s - L r_{jl}) + \pi \zeta_1 (\rho s - K_b) \\
&\quad + (1-\pi)(\rho s - K_b - \gamma_x g(\lambda_0))
\end{aligned}
$$

.

7.2 The Case of 'Separation' in the Group Meeting Contract.

If $L > L_{pool}, L^*$, then, by construction, some individuals will default on the group meeting contract $\left(L, \frac{r}{\pi}\right)$. Recall also that the equilibrium interest rate in the joint liability contract will be higher than $\frac{r}{\pi}$. So, some individuals will default on the joint liability contract even when both projects have been successful, and they are required to pay $L\bar{r}_{jl}$ to the bank. Therefore, we have $\gamma_1, \gamma_{gm} > \gamma_{\min}$. Individuals with $\gamma < \gamma_1, \gamma_{gm}$ do not repay anything in either contract. Therefore, if they have a positive probability of being cross-subsidised in the joint liability contract (i.e. $\zeta_2 < 1$) then, using (27) and (30), we see that they will obtain a higher utility from a joint liability contract than the group meeting contract. So, the expected utility curve for a joint liability contract lies *above* that of a group meeting contract for small values of γ. Therefore, the expected utility curve for the group meeting contract $(L, \bar{r}_{gm})$ will either lie entirely below that of the joint liability contract $(L, \bar{r}_{jl})$ or the two curves will cross for some value of γ in the interval $[\gamma_{\min}, \gamma_{\max}]$. These two cases are shown in figures 3 and 4 below.

If the two curves cross, it must be at some value of γ at which the slope of W_{gm} as a function of γ exceeds that of W_{jl}. From (31)-(35), we see that this holds true only in the interval $\left[\gamma_{gm}, \gamma_2\right]$ assuming $\gamma_{gm} < \gamma_2$. If the 'crossing point' is at $\gamma = \gamma_2$, we see from (31) and (34) that all individuals above γ_2 are indifferent between the joint liability contract $(L, \bar{r}_{jl})$ and the group meeting contract $(L, \bar{r}_{gm})$. Then, we can have a market equilibrium where these same contracts are being offered simultaneously and *all* individuals opt for the joint liability contract. (Note, as before, that if any individuals at or above γ_2 opt for the group meeting contract, then it would not be possible to break even on the joint liability contract by offering an interest rate $\bar{r}_{jl}$).

If the crossing point is at some $\gamma < \gamma_2$, it means that any individual who would have been willing to repay two loans in a joint liability contract would actually prefer the group meeting contract. Then, no cross-subsidisation occurs in the joint liability contract; i.e. $\zeta_2 = 1$. Then, using (27) and (30), we see that for $\gamma < \gamma_1, \gamma_{gm}$, individuals receive the same utility from both contracts since they never repay anything. Therefore, they will be indifferent between the two contracts. If a sufficient large number of them opt for the group meeting contract, then the bank may, in fact, break even or make a positive profit by offering the joint liability contract at interest rate $\bar{r}_{jl}$. Then, there may be a market equilibrium in which a fraction

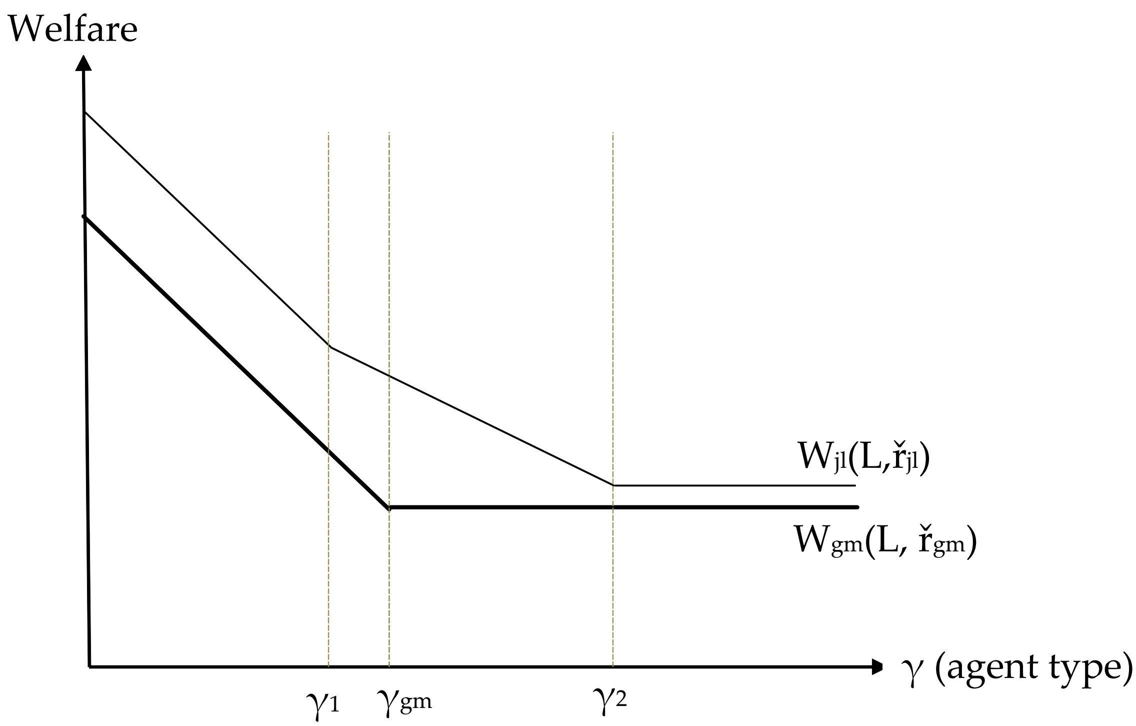

Figure 3: High γ-types prefer the joint liability contract.

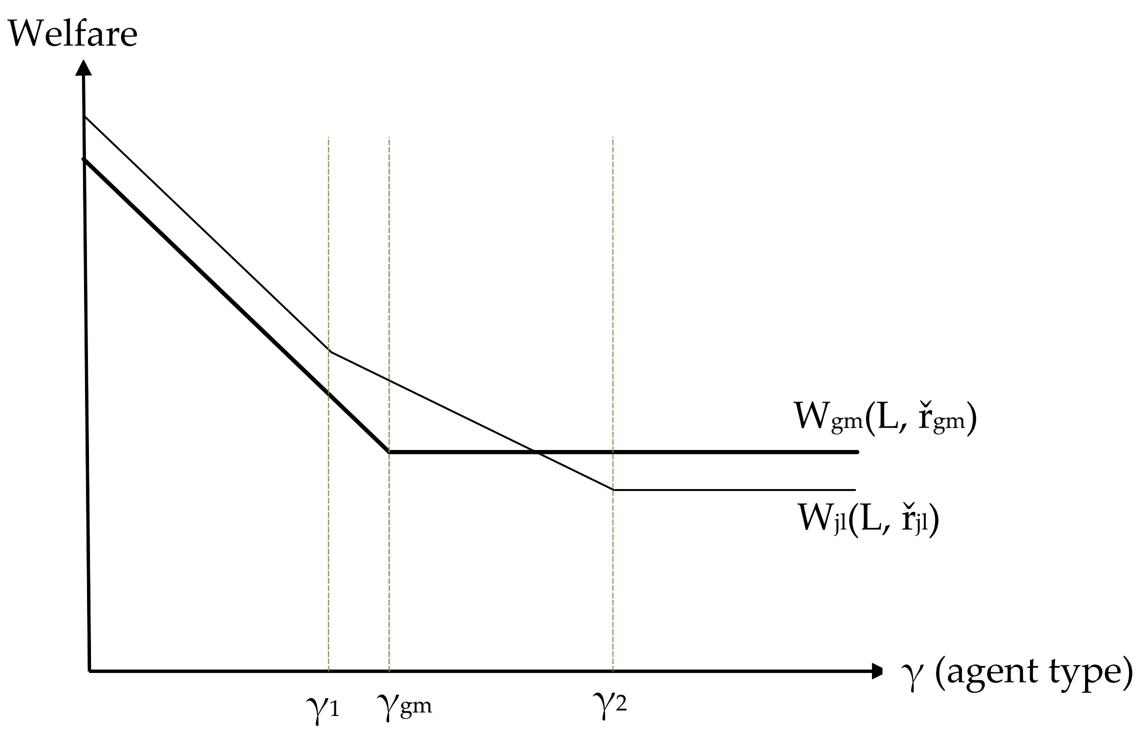

Figure 4: Low γ-types prefer the joint liablity contract.

$\theta_0 > 0$ of individuals below γ_1 opt for a joint liability contract and the remainder opt for the group meeting contract. Such an equilibrium must satisfy the following conditions.

$$\zeta_1 = \frac{\theta_0 F(\gamma_1)}{\theta_0 F(\gamma_1) + [F(\gamma_x) - F(\gamma_1)]} \tag{43}$$

$$\zeta_2 = 1 \tag{44}$$

$$\zeta_{gm} = \frac{(1-\theta_0) F(\gamma_1)}{(1-\theta_0) F(\gamma_1) + 1 - F(\gamma_x)} \tag{45}$$

$$r_{jl} = \frac{r}{\pi^2 (1-\zeta_1)^2} \tag{46}$$

$$r_{gm} = \frac{r}{\pi \left(1-\zeta_{gm}\right)} \tag{47}$$

$$\pi(\rho s - L r_{gm}) + (1-\pi)(-K_b) = \pi Z_1 + (1-\pi)(-K_b) \tag{48}$$

$$\gamma_1 < \gamma_x < \gamma_2 \tag{49}$$

where, for ease of notation, we have used

$$\begin{aligned} Z_1 = {} & \pi(1-\zeta_1)(\rho s - L r_{jl}) + \pi \zeta_1 (\rho s - K_b) \\ & + (1-\pi)(\rho s - K_b - \gamma_x g(\lambda_0)) \end{aligned}$$

A second possibility is that the equilibrium interest rates r_{gm} and r_{jl} are such that the utility curves cross at $\gamma_x = \gamma_2$. Then, for $\gamma \geq \gamma_2$, individuals receive the same utility from the two contracts. Suppose a fraction θ_2 of these individuals opt for the joint liablity contract in equilibrium. Then, the conditions for the equilibrium are as follows:

$$\zeta_1 = \frac{F(\gamma_1)}{F(\gamma_2) + \theta_2 [1 - F(\gamma_2)]} \tag{50}$$

$$\zeta_2 = \frac{F(\gamma_2)}{F(\gamma_2) + \theta_2 [1 - F(\gamma_2)]} \tag{51}$$

$$\zeta_{gm} = 0 \tag{52}$$

$$r_{jl} = \frac{r}{\pi^2 (1-\zeta_1)^2 + 2\pi(1-\pi)(1-\zeta_2)} \tag{53}$$

$$r_{gm} = \frac{r}{\pi} \tag{54}$$

$$\pi(\rho s - L r_{gm}) + (1-\pi)(-K_b) = \pi Z_2 + (1-\pi)[\pi \zeta_2 (-K_b) + (1-\pi)(-K_b)] \tag{55}$$

where, for ease of notation, we have used

$$\begin{aligned} Z_2 = {} & \pi \{1-\zeta_1\} (\rho s - L r_{jl}) + \pi \zeta_1 (\rho s - K_b) \\ & + (1-\pi)(\rho s - 2 L r_{jl}) \end{aligned}$$

7.3 Summary

In summary, if the 'technology' for both joint liability and group meeting contracts are available, then the following scenarios may arise in a market equilibrium.

1. All individuals opt for the joint liability contract and the equilibrium interest rates for the two contracts correspond to $\bar{r}_{jl}$ and $\bar{r}_{gm}$.

2. All individuals opt for the group meeting contract and the equilibrium interest rates for the two contracts correspond to $\bar{r}_{jl}$ and $\bar{r}_{gm}$.

3. There is take-up of both contracts; all individuals who would have been willing to pay for both loans in a joint liability contract opt for the group meeting contract. The group meeting contract, offered at interest rate $\frac{r}{\pi}$, experiences no default by borrowers with successful projects. The joint liability contract is offered at interest rate higher than $\bar{r}_{jl}$.

4. There is take-up of both contracts; all individuals who would have been willing to pay for both loans in a joint liability contract opt for the group meeting contract; while individuals who would default on either contract split themselves between the two options. The equilibrlum interest rates may be higher or lower than $\bar{r}_{jl}$ and $\bar{r}_{gm}$.

5. There is take-up of both contracts; individuals willing to pay for both loans in a joint liability contract are indifferent between the two contracts; they split themselves between the two contracts. Individuals who would default on either contract opt for the joint liability contract because of the positive probability of cross-subsidisation. The group meeting contract is offered at interest rate $\frac{r}{\pi}$ while the interest rate for the joint liability contract is higher than $\bar{r}_{jl}$.

For loan sizes smaller than L_{pool}, the presence of group meeting contracts makes it more difficult to sustain joint liability contracts and, even if they are feasible, it pushes up the interest rate. The intuitive reason is that any joint liability contract is less attractive to those who find social sanctions more costly, and they are, therefore, more likely to opt for the group meeting contracts. This reduces cross-subsidisation in joint liability contracts and raises the rate of default, thus making it more difficult to offer them in equilibrium.

For loan sizes larger than L_{pool}, the presence of group meeting contracts has a similar effect on joint liability contracts. However, we have identified a possible case where there is no cross-subsidisation in the joint liability contract; so that individuals who would default on any contract are indifferent between the two; such that if a sufficiently large portion of these individuals opt for the group meeting contract, this would allow the interest rate of the joint liability contract to be kept low. Taking these results together, we have established the following result.

Proposition 3 *Suppose that there is available technology for offering both group loans with joint liability and group 'meeting' loans with individual liability. If, for loans of a given size, both types of loans are taken up in equilibrium, and there is cross-subsidisation in the joint liability groups (i.e. successful borrowers repaying for unsuccessful group members), then the joint liability loans will involve an interest rate higher than* $\bar{r}_{jl}$ *– the equilibrium interest rate when this is the only type of contract available in the market.*

8 Discussion

Our theoretical model highlighted a particular mechanism through which group loans can improve the repayment incentives of borrowers. A common feature of group lending is that the loan officer meets the borrowers in a group, such that their dealings immediately become public information. To the extent that a borrower's decision whether or not to repay a loan signals something about his or her 'quality' – competance, trustworthiness, productivity, etc. – the very nature of the group meeting can provide social pressure for a borrower to comply with the terms of the loan even if the contract does not entail joint liability.

This mechanism allows us to distinguish, theoretically, between group loans with joint liability, group loans with individual liability and individual loans (where, presumably, the afore-mentioned social pressures are absent). Whenever a bank is willing to offer an individual loan of a particular size, it would be willing to disburse loans of the same size through individual liability groups, at the same interest rate. But the social pressures associated with groups increases the size of loans that can be disbursed: the largest feasible loan that can be disbursed in a individual liability group is larger than that that can be disbursed as individual loans.

However, the ranking between group loans with and without joint liability is ambiguous: joint liability can lower the rate of default because of the possibility of cross-subsidisation between members of the group (as highlighted in the previous literature) but, on the other hand, default on an individual liability loan may have more informational content, and thus provide stronger incentives for repayment.

More importantly, we show that when both types of group loans are offered in a market, there will be a sorting of borrowers between them. In particular, individuals who are more concerned about their reputation will sort into group loans with individual liability, leaving the borrowers who are more likely to default to opt for the group loans with joint liability. This type of sorting will raise the rate of default and interest rates for joint liability loans above what they would be if they were the only type of group loan that were (technologically) feasible.

While there has been much debate about the relative merits about individual liability versus joint liability in group loans, the sorting effect highlighted here has not been given sufficient attention. Financial service providers must also bear in mind that offering group loans with individual liability will adversely affect the performance of group loans with joint liability already on offer.

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9 Appendix

Lemma 5 *If* $h'(\gamma) > 0$*, then* $H'(\gamma) > 0$*.*

By definition,

$$H(\gamma) = \int_{\gamma_{\min}}^{\gamma} h(x) f(x|x \leq \gamma) \, dx$$

Using Bayes' Rule, we obtain $f(x|\gamma) = \frac{f(x)}{F(\gamma)}$. Hence, we can write

$$H(\gamma) = \frac{1}{F(\gamma)} \int_{\gamma_{\min}}^{\gamma} h(x) f(x) \, dx \tag{56}$$

$$\Longrightarrow F(\gamma) H(\gamma) = \int_{\gamma_{\min}}^{\gamma} h(x) f(x) \, dx \tag{57}$$

Differentiating throughout (57) w.r.t. γ, we obtain

$$f(\gamma) H(\gamma) + F(\gamma) H'(\gamma) = h(\gamma) f(\gamma)$$

$$\Longrightarrow H'(\gamma) = \frac{f(\gamma)}{F(\gamma)} (h(\gamma) - H(\gamma)) \tag{58}$$

Since $h'(\gamma) > 0$, using (56), we obtain

$$\begin{aligned} H(\gamma) &< \frac{1}{F(\gamma)} \int_{\gamma_{\min}}^{\gamma} h(\gamma) f(x) \, dx \\ &= \frac{h(\gamma)}{F(\gamma)} \int_{\gamma_{\min}}^{\gamma} f(x) \, dx \\ &= h(\gamma) \end{aligned}$$

Using this last inequality in (58), we obtain $H'(\gamma) > 0$.