Can Group Lending Overcome Adverse Selection Problems?

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ABSTRACT:
This paper looks at the group formation game in joint liability lending. We show that the formation of homogenous groups is possible even with asymmetric information between all parties. This is achieved through a signalling mechanism of non-monetary side payments. Homogeneous group formation has non-trivial welfare implications. Sufficient conditions for it to be welfare improving are discussed.

JEL Classification: D82; L14; O12

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1. Introduction

In this paper, we look at joint liability contracts where banks as well as households have incomplete information. In this framework all parties are incompletely informed about the others — banks do not know the risk characteristics of the households (but they do know the distribution within the population) and the households do not know the risk characteristics of other households. We show that joint liability allows lenders to extract high repayment rates even when households are not able to offer any traditional form of collateral.

This paper is motivated by the rise of micro finance institutions around the developing world whose aim it is to lend to the poor who are traditionally not considered creditworthy. The best known of these institutions is the Grameen Bank in Bangladesh\(^2\) which has set the global bench mark for socially focused micro credit institutions. Growth in micro finance has been quite rapid with programs being set up across the developing world\(^3\) and also in the developed world\(^4\).

Programs such as the Grameen usually tend to make small loans to the poor, with no requirement for collateral. The interest rates tend to be around the same as those charged by commercial banks\(^5\) but Grameen does not lend to individuals on their own. Instead, loans are made to individuals who are part of a self-selected group, but the whole group is liable for the repayment of the loan. The mechanism microcredit seeks to harness is the social ties that bind communities together as a form of social collateral. Banks aim to use social collateral to overcome problems of adverse selection thereby improving their repayment rates and also pass on the burden and costs associated with monitoring loans to the borrowers themselves. The borrowers owing to their superior local information and location\(^6\) will have much lower costs of verification than the banks, and as a result will be quite happy to absorb the added burden of verification and possibly enforcement as well in return for cheaper loans. This mechanism works because the contracts that are on offer are of a joint liability nature – borrowers must repay their own loan and are also responsible for the loan of their group members if any member defaults. This joint responsibility can be viewed as a form of ex-post pledgeable income that is used as collateral rather than any traditional assets, such as jewellery or real estate that may be used as collateral. As a result we would expect that group members select their potential members carefully so as to reduce their expected costs.

In this paper, we are interested in the group formation game and what steps borrowers take to screen out potentially risky members. In particular, we look at the role of

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\(^2\) Grameen was started in the 1970’s by Mohammed Yunus an economics professor. Since its early modest beginnings Grameen has done very well with high reported repayment rates and a successful track record of poverty alleviation and wide reach in the Bangladeshi rural areas. Morduch (1998) suggests that the repayment rates may be lower than those officially stated by Grameen, but deems these to be still higher than 90%.

\(^3\) At present there are 10 million households being served by Microfinance around the world. In 1997 it was agreed that $10 billion would be raised in 10 years towards the set up and maintenance of micro finance programs.

\(^4\) Owing to the Community Reinvestment Act of 1977 in the US, financial institutions are obliged to fund socially worthwhile lending and Microfinance is being used as a means to deliver the aims of this act.

\(^5\) Or more crucially the rates charged are a lot lower than the usurious rates that are charged by moneylenders.

\(^6\) Branches of Microfinance Banks typically tend to serve a cluster of villages, which makes state verification of projects and gathering information expensive.
non-monetary side payments\textsuperscript{7} as a signalling mechanism\textsuperscript{8}. This is within the constraint that all parties have information asymmetries between them.\textsuperscript{9} Previous literature has looked at the group formation game but have assumed that households have full information about each other (Ghatak, 2000). Armendariz and Gollier (2000) on the other hand present a model where there is informational asymmetry between all parties. However rather than focusing on mechanisms that might induce assortative matching they look at the reduction in costs coming from verification with random matching. We show that group lending can lead to homogenous group formation with a pooling credit contract, if side-payments are used as a signalling mechanism. We also show that separating credit contracts are not possible as the existence of these violate ex-post incentive compatibility. Group lending with signalling is also shown to have non trivial welfare implications. Conditions for it to be welfare improving are discussed in the paper (see proposition 2).

Section 2 of this paper sets out the ingredients of the model and lays out the parameters and assumptions that are driving the model. In section 3 we look at the equilibrium and welfare implications arising from individual lending contracts under full information and also when there is adverse selection present leading to underinvestment. In section 4, we move from there to look at the equilibrium under group lending with random group matching and the welfare properties of this equilibrium. We show that the welfare properties are not an improvement on individual lending, however repayment rates are shown to be higher\textsuperscript{10}. Section 4 looks at joint liability contracts with side payments which allows for homogenous group formation. We show that households are able to use the level of side-payments to form homogenous groups with other households that have the same risk characteristics as themselves. The welfare properties are shown, if anything, to be better under homogenous group formation than under random matching or under individual lending with information asymmetry. This implies that homogeneous group formation through signalling may help solve the problem of under-investment. In the final section we show that separating contracts are not feasible as the conditions for their feasibility violate ex-post incentive compatibility.

2. The model

We consider a credit market populated by a continuum of size 1 of households and many lenders which we refer to as banks. Each household is endowed with a risky investment project which requires one unit of capital and labour. Each household commits its own labour to the project. The households lack the capital investment required to enter the project as they have no wealth and will have to finance this through borrowing by means of a debt contract. Projects once started will yield either a high return or will fail and yield

\textsuperscript{7} Ghatak (2000) suggests that there may be a rationale for making side payments even though by definition the poor have no assets. He suggests that households may be able to make transfers between them that may not be possible with banks like labour transfers or lending of agricultural implements.

\textsuperscript{8} We restrict our attention to labour as a form of non-monetary collateral in our model, but this is by no means the only possible non-monetary collateral that can be used and other forms of collateral can be just as easily used in the model without any material change to the results.

\textsuperscript{9} We can assume a urban credit market where households may have less information about each other than in a rural setting.

\textsuperscript{10} While welfare is not an improvement on individual lending, typical microfinance are unlikely to be offered individual loans from commercial banks and are more likely to borrow from moneylenders at usurious and ruinous rates. Based on this scenario joint liability is certainly an improvement.
0, we call these outcomes — success and failure respectively.\(^{11}\) Households are indexed into two groups\(^{12}\), safe (s) and risky (r) depending on the type of project, r, or s, they are endowed with. The term \(p_i\) represents the probability of success of the project of type \(i\). The gross return of a project of type \(I = s,r\) is as follows:

\[
\tilde{R} = \begin{cases} 
R_i & p_i \\
0 & 1 - p_i 
\end{cases} 
\]

with \(i = s, r\)

We assume

\[0 < p_r < p_s < 1\]

so that, consistent with our notation, type-s projects are the safe ones, since they have a higher probability of success. As for the expected returns, we impose:

\[R_s p_s = R_r p_r = \tilde{R} > 1\]

According to our assumptions, risky and safe households have the same mean return as per Stiglitz & Weiss (1981), but the risky projects have a greater spread around the mean.\(^{13}\) Safe and risky households exist in the proportions \(\lambda\) and \(1 - \lambda\) respectively. Project outcomes are independently distributed across households. The opportunity cost of investing in the project is \(u\), which may be viewed as an alternative labour income the household would be able to produce if not committed to any project.

Both banks and households act as price-takers in the credit market. The opportunity cost of capital for the banks is measured by the riskless gross interest rate \(\rho\). This is the return on the financial investment alternative to financing households. We assume that financial capital, \(K\), is relatively abundant compared to the mass of projects to be financed, \(\rho\); formally \(K > 1\) holds.\(^{14}\)

The banks do not know the type of the households. Also, we explicitly assumed that households do not know each others types either. We also have a limited liability constraint whereby we assume that households have no wealth and as such have no collateral to post as security to the bank.

### 3. Individual Liability Lending

Given the model’s assumptions, under a situation of perfect information there exist two separate credit markets: one for the safe households and another for the risky households. Since projects are scarce compared to financial capital, competition will force the interest rates in these two markets down until the zero profit condition (ZPC) for the banks is reached. Consequently the equilibrium interest rates in the two markets would be derived from the ZPC as follows:

\(^{11}\) In practice projects may not necessarily yield nothing upon failure, but for theoretical analysis we make this simplifying assumption.

\(^{12}\) We take the types of households as exogenously given to be consistent with adverse selection models, if we change this parameter to be endogenous within the model we would be faced with a moral hazard problem.

\(^{13}\) Stiglitz and Weiss use the notion of mean preserving spreads where there is second order stochastic dominance.

\(^{14}\) This implies that projects are scarce resource which could lead to social losses if projects are not financed.
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\[
\begin{align*}
    r_s &= \frac{\rho}{p_s} \\
    r_r &= \frac{\rho}{p_r}
\end{align*}
\]

We can see that safe households enjoy a lower rate of interest as they are more likely to repay the loan.

In situations where it is not possible to identify the different types of borrowers all lending must occur at the same interest rate. Hence, we will have a unique credit market where the heterogeneous households all borrow (assuming they do) at the same interest rate. Under such circumstances, if, in equilibrium, that both types of households decide to borrow, the interest rate that satisfies the ZPC of the representative bank will be given by:

\[
\bar{r} = \frac{\rho}{\bar{p}}
\]  

(1)

where \(\bar{p} = \lambda p_s + (1 - \lambda) p_r\)

is the average households' individual probability of success. Since banks cannot identify the households’ type each of them will extend loans to a sample of households whose composition would be the same as that of the overall population. The market will then set the equilibrium borrowing rate in such a way that, given the average probability of success of the households financed by each bank, which is \(\bar{p}\), banks just break-even.

Given the equilibrium interest rate, the net individual payoff for a borrower of type \(i\) is

\[
U_i = \bar{R} - \bar{r} p_i
\]

It is worth noting that \(\bar{r}\) would be higher than the rate that the safe types enjoyed under full information and be lower for the risky types. In effect the risky households are being cross-subsidised by the safer households in a pooling equilibrium:

\[
r_s < \bar{r} < r_r
\]

As we already noted, compared to the full information case, the interest rate charged has risen for the safe household and fallen for the risky ones. This makes safe households worse off and risky households better off compared to the full information case.

Moreover, it is important to note that the expected cost of interest rate is higher for safe households as opposed to risky households since the former have a higher probability of success than the latter. This has a crucial implication for the credit market: there will be values of the borrowing rate such that only risky borrowers have incentives to demand loans while safe borrowers will walk out of the market. To see this, for a type-\(i\) borrower, define the maximum interest rate at which it would be (weakly) convenient to demand a loan as that level of interest rate such that \(U_i = u\). Formally,

\[
r_i^* = \frac{\bar{R} - u}{p_i}
\]

Then, we immediately see that \(p_s > p_r\) implies \(r_s^* < r_r^*\), so that for any \(r\) greater than \(r_s^*\) and lower or equal \(r_r^*\) only risky borrowers are left on the credit market. The
intuition being that since the safe households have a higher probability of success they also have a higher probability of repayment and therefore higher expected loan-costs.

Clearly, if \( r > r_s^* \), \( r \) cannot be an equilibrium. In this case, safe borrowers will exit the market and the equilibrium interest rate will be

\[
r_r = \frac{\rho}{p_r}
\]

and the repayment rate is equal to \( p_r \). This situation is referred to as the under-investment problem in credit markets with adverse selection (Stiglitz & Weiss, 1981).\(^{15}\)

4. Joint Liability
The banks are dealing with households who have no wealth to post any form of collateral. However, the banks could lend on the basis of a joint liability mechanism whereby borrowers form groups of two and guarantee the other members loans and assume liability in case of default by one member of the group.\(^{16}\) According to this contractual arrangement, borrowers within the group are using ex-post pledgeable income as guarantee to secure individual loans. The contract between the bank and a group of borrowers is represented by a pair \((r,c)\) where \( r \) is the interest rate and \( c \) is the level of guarantee, which we call collateral for simplicity.

Given the contract structure, assuming both type decide to borrow, the ZPC for the representative bank becomes:

\[
\rho = r\overline{\rho} + \overline{p}(1 - \overline{\rho})c
\]

This equality is a necessary condition for any pair \((r,c)\) to be an equilibrium contract. Hence, solving the above equality for \( r \) gives the equilibrium relationship between any equilibrium level of interest rate, \( \hat{r} \), and the correspondent value of collateral, \( \hat{c} \),

\[
\hat{r} = \frac{\rho}{\overline{p}} - (1 - \overline{\rho})\hat{c}
\]  \(\text{(2)}\)

Clearly, the borrowing rate under joint liability lending is lower than that under individual lending: in the RHS of equation (2) there is an extra (negative) component compared to equation (1) the borrowing rate under group lending is lower than individual lending rates.

Equation (2) describes a continuum of pairs \((\hat{r}, \hat{c})\) that, in principle, are all candidates as pooling equilibrium contracts in the credit market provided that all types of borrowers are willing to borrow given those contracts. However, if banks cannot verify if borrowers have been successful, but only if they have failed, then the ZPC is not the only necessary condition that a pair \((\hat{r}, \hat{c})\) should satisfy in order to be an equilibrium. The idea of non-verifiability of success conditional on loan repayment follows from the fact that if borrowers claim to have been successful and repay the interest rate on the two individual loans under the joint liability scheme, there is no reason why the bank should be able to take the borrowers to court on the grounds that they have been cheating in saying they have been successful. They are repaying their loan, and therefore they are fulfilling their

\(^{15}\) We could extend our analysis to the case of over-investment as defined by DeMeza and Webb (1987) where the project returns are the same across types.

\(^{16}\) We restrict our attention to groups of two but the same framework can be used with groups larger than two. There is also scope for further analysis of what is the optimum group size.
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obligation independently of whether they are cheating or not. Differently, it is plausible to assume that failure is verifiable: if the borrowers both claim to have failed and do not repay their loan, the bank can verify this in court.

The fact that success is not verifiable conditional on loan repayment has important consequences. In particular,

**Result 1.** If banks cannot verify success conditional on loans’ repayment, to be incentive compatible, a contract should satisfy $c \leq r$. All contracts with $c > r$ are not ex post incentive compatible (eICC) for households. The maximum equilibrium value of $c$ which satisfies the eICC is

$$c_{\text{Max}} = \frac{p}{p + \overline{p}(1 - \overline{p})}$$

**Proof.** Consider a situation in which the equilibrium contract is $(r, c)$ with $c > r$. Assume that one group member fails. The bank would expect to receive the amounts $r$ and $c$ respectively. However, as the bank cannot verify success upon loans repayment, the households have no incentives to reveal the truth. They would rather collude and declare that they both succeed so that they repay the amount $2r$ rather than $r + c$, thereby saving $c - r$. Note that the maximum feasible $c$ is when $c = r$. Imposing this restriction on the ZPC for the representative bank we get $c_{\text{Max}} = \frac{p}{p + \overline{p}(1 - \overline{p})}$

According to result 1 we rule out any contract where the collateral is greater than the interest payment. Therefore, in order to be an equilibrium a pair $(r, c)$ should satisfy not only equation (2) but also the ex-post incentive compatibility constraint (eICC)

$$r \geq c \quad \text{(eICC)}$$

Finally, as we already mentioned, in order to fully identify the set of equilibrium contracts, we should focus on borrowers incentives to participate in the credit market as well as on their ex post ability to repay loans. Given an equilibrium contract $(\hat{r}, \hat{c})$, the participation constraint of a borrower of type $i$ is defined as

$$u \leq \overline{R} - p_i(\hat{r} + (1 - \overline{p})\hat{c})$$

with $i = s, r$

Once again, we note that the expected cost of borrowing $p_i(\hat{r} - \hat{c}(1 - \overline{p}))$ is higher for a safe borrower than for a risky borrower. It then follows that so long as the above participation constraint is satisfied for the safe types, both types of borrowers will be in the market. Finally $(\hat{r}, \hat{c})$, must be such that the ex post limited liability constraint LLC is also satisfied. Given that $\hat{r} > \hat{c}$ must hold for any equilibrium pair $(\hat{r}, \hat{c})$ the LLC constraint can be rewritten as

$$\overline{R} \geq 2\hat{r}$$

since $2\hat{r}$ is the maximum amount that a successful borrower might be asked to repay under a feasible joint liability contract. Note that the repayment $\hat{r} + \hat{c}$ is always lower or equal to $2\hat{r}$.

Finally, the set of equilibrium contracts such that all types of borrowers are on the market is defined by those contracts which satisfy all the above mentioned constraints.

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17 Note that if the bank tried to carry out state verification for all borrowers irrespective of success then their costs would spiral out, negating the informational benefits of group lending.
More importantly, the fact that there exist values of \((\hat{r}, \hat{c})\) such that only risky borrowers stay on the market, tells us that joint liability with random matching at the group formation stage does not eliminate the possibility of underinvestment. The question that is now posed is, can joint liability lending ameliorate the under-investment problem compared to what we saw in the previous section?

**Proposition 1.** The expected utility from the group-lending contract is equivalent to the expected utility from the individual lending contract.

*Proof.* As we know the the individual net utility from a joint liability contract is given by:

\[
U_i = \overline{R} - p_i(\hat{r} + (1-p)\hat{c})
\]

Substituting for \(\hat{r}\) as a function of \(\hat{c}\) using equation (2) this reduces to

\[
U_i = \overline{R} - \frac{p_ip}{p}
\]

which is the same as the utility under individual liability.

So, even though borrowing rates are lower and repayments rate are higher, the utility is the same as under individual lending; the expected gain that results from the lower rates is offset by the expected joint liability payment.

5 Signalling Mechanisms

A. POOLING EQUILIBRIUM

Under joint liability contracts we saw in the previous section that the utility was strictly the same as in individual lending. Joint liability lending occurred with random matching during group formation. However the question arises of the possibility of assortative matching during group formation through the use of a signalling mechanism.

Signalling may induce safe households to pair up with other safe borrowers, which would reduce their expected costs and increase their expected utility. Here we investigate the possibility of a signalling mechanism based upon a system of ex post side payments.

As the borrowers do not have any assets to post as collateral they may use some form of non-monetary asset as a side payment. This may take different forms from lending of tractor during harvest time to promising labour in case of failure. We will use labour collateral to represent non-monetary side payments. Labour side payment can be intuitively understood as an obligation to provide some labour in case of failure – this may take the form of helping with the setting up of next project (eg tilling the fields or helping with the harvest, or providing manual labour for any labour intensive task). This is consistent with the idea of social collateral as the borrowers are more likely to be able to enforce these agreements and take advantage of this form of non-monetary collateral. The labour side payment is pledged to a group member and in the event of default, the defaulter will fulfil her obligations towards her partner.

Assuming that the credit market equilibrium implies an unique lending contract \((r, c)\), homogenous group formation requires an equilibrium pair of side payments \(s_s\) and \(s_r\), where:

1. \(s_s\) is different from \(s_r\);
2. Type-i borrowers have incentive to play \(s_i\).
The payoff of an agent of type \( i \) playing \( s_i \)

\[ U_i^j = \bar{R} - (p_r r + p_i (1 - p_i) c) - p_i (1 - p_i) s_i + p_i (1 - p_i) s_i \]

Notice that the side payments cancel out with each other and only the costs from the joint liability loan remain.

The payoff of an agent of type \( i \) playing \( s_j \)

\[ U_j^i = \bar{R} - (p_r r + p_i (1 - p_i) c) - p_j (1 - p_j) s_j + p_j (1 - p_j) s_j \]

Now the side-payments may have a net positive or negative expected cost depending on the type of the household. Intuitively risky households will have negative expected side-payments if they pair up with a safe household. This is because risky households will succeed less often and hence are more likely to have to fulfil their side-payment obligations. On the other hand, conditional on being successful, risky households gain when matching with safe ones because the latter fail less often, which entails less collateral repayments. In order for risky households to have no incentive to cheat and pretend to be safe, the side payment level, \( s_r \), played by safe households should be large enough.

However quite surprisingly the introduction of side-payments means that above some value of \( s_r \) the safe households may find it beneficial to claim they are risky. Again this is due to the fact that they are less likely to fail than the risky households and hence less likely to make the side-payments. As a result the level of side payment played by the risky households, \( s_r \), should be low enough for safe households to have no incentives to cheat.

Given the equilibrium actions \( s_s \) and \( s_r \) played by the other agents, in order for the individual safe household to have incentive to stick to the strategy \( s_s \) rather than deviate and play \( s_r \), thereby pretending of being type-s in order to match with another type-s the following ICC must hold:

\[ \bar{R} - (p_r r + p_s (1 - p_r) c) = \bar{R} - (p_r r + p_s (1 - p_r) c) + p_s (1 - p_r) s_r - p_r (1 - p_s) s_r \]

\[ \iff \]

\[ (p_r r + p_s (1 - p_r) c) \leq (p_r r + p_s (1 - p_r) c) - p_s (1 - p_r) s_r + p_r (1 - p_s) s_r \]

This yields ICC1:

\[ s_r \leq s_r^{\text{max}} = \left( \frac{p_s p_r - p_r^2}{p_s - p_r} \right) c \]

So, in order for safe households to have no incentives to cheat and pretend they are risky, the level of \( s_r \) played by risky households should not exceed \( s_r^{\text{max}} \). Risky households would have to post this amount as a maximum as by posting more they would attract safe households.

We now check the no-cheating condition for risky households in order to identify a critical value for the levels of side-payments played by safe households to be compatible with a separating equilibrium. Given the equilibrium actions \( s_s \) and \( s_r \) played by the other agents, in order for an individual risky household to have incentive to stick to the strategy \( s_r \) rather than deviate and play \( s_s \) thereby pretending of being type-s in order to match with another type-s the following ICC must hold:
This yields ICC2:

\[ s_s \geq s_s^{\text{min}} = \frac{p_s p_r - p_r^2}{p_s - p_r} \]

The above represents the minimum side-payments that safe households would have to post in order for risky households to have no incentives to pretend they are safe. Side payments below this amount would induce risky households to cheat and pair up with safe households.

It is important to note that \( s_s^{\text{min}} = s_r^{\text{max}} = \hat{s} \) so that any pair \((s_s, s_r)\) with \( s_s \geq \hat{s} \) and \( s_r \leq \hat{s} \) constitutes a separating equilibrium as for such values of the side payments both safe and risky households would have incentives to stick to their equilibrium level of side payment rather than deviate and cheat with regard to their true type.

To be more precise there is a continuum of pairs \((s_s, s_r)\) with \( s_s \geq \hat{s} \) and \( s_r \leq \hat{s} \) which constitutes a continuum of separating equilibria of the signalling game which takes place at the group formation stage for any given pooling equilibrium contract in the credit market, \((r, c)\). Even though we have a continuum of equilibria there will be no pareto-dominant equilibria as the net cost of the side-payments is zero with homogenous group formation. In other words the equilibrium cannot be pareto ranked.

The ZPC of the representative bank is the same as before:

\[ \rho = \hat{r} \hat{p} + p (1 - \hat{p}) \hat{c} \]

Any equilibrium contract \((\hat{r}, \hat{c})\) satisfies the above equality exactly as in the case of joint liability without signalling at group formation stage. Hence, the equilibrium relationship between \( \hat{r} \) and \( \hat{c} \) described by equation (2) still holds.

While households are able to form homogenous groups through the use of side-payments, the banks are not privy to this information. The credit market still cannot identify the type of individual they are lending to and as a result the contract is still based on the average probability of success of the households. This means that the households still face the same contract as before the signalling mechanism of side-payments.

The individual utility of safe households engaging in homogeneous lending groups is

\[
U_s^s = \overline{R} - (p_s \hat{r} + p_s (1 - p_s) \hat{c}) + p_s (1 - p_s) \hat{s}_s - p_s (1 - p_s) \hat{s}_r \\
= \overline{R} - (p_s \hat{r} + p_s (1 - p_s) \hat{c})
\]

Similarly, the utility of risky households paired in homogeneous groups is

\[
U_r^r = \overline{R} - (p_r \hat{r} + p_r (1 - p_r) \hat{c}) + p_r (1 - p_r) \hat{s}_r - p_r (1 - p_r) \hat{s}_r \\
= \overline{R} - (p_r \hat{r} + p_r (1 - p_r) \hat{c})
\]
Homogenous group formation is now occurring owing to the use of side-payments as a signal. Comparison of the above expressions with the individual utilities of the two types under joint liability without signalling yields the following.

Substituting for \( \hat{\rho} \) into equation (3) using equation (2) we have

\[
U_s^i = R - (p_s \frac{\rho}{\bar{p}} - (1 - p_s)\hat{c}) + p_s(1 - p_s)\hat{c})
\]

\[
= R - (\frac{p_s\rho}{\bar{p}} - p_s\hat{c}(p_s - \bar{p}))
\]

The individual utility of type i under joint liability without signalling at group formation stage (see proposition 1) is given by

\[
U_i = R - \frac{p_i\rho}{\bar{p}}
\]

Using this expression together with equation (5) we immediately see that

\( U_s^i > U_s \). Under joint liability, safe households are better off in homogeneous groups than when matched with lending groups at random. The probability of default by a partner is lower for safe groups and as a result the expected costs are lowered for safe groups, thus increasing their expected payoff and expected utility.

Similarly, substituting for \( \hat{\rho} \) into equation (4) using equation (2) we have

\[
U_r^i = R - (p_r\frac{\rho}{\bar{p}} - p_r(1 - \bar{p})\hat{c}) + p_r(1 - p_r)\hat{c})
\]

\[
= R - (\frac{p_r\rho}{\bar{p}} + p_r\hat{c}(\bar{p} - p_r))
\]

Again, using the above expression for the individual utility under joint liability without signalling it is simple to verify that \( U_r^i < U_r \). Risky households are worse off under homogeneous group formation than under random matching. This is due to the fact that risky groups have a greater probability of default than random groups. As a result the expected costs of the risky borrower goes up and consequently expected payoffs and utility are lower.

If the utility of safe households goes up with homogeneous group formation this improves the chances that these households stay in the market. To this extent, other things being equal, this improves the underinvestment problem. However, since the utility of the risky households goes down, we might have a situation in which homogeneous group formation pushes the risky types out of the market and the group lending equilibrium would no longer be sustainable. We note that the utility of risky households declines in the level of collateral. Therefore there will be a value of \( \hat{c} \) such that the utility of risky households under homogeneous group formation equals \( u \), i.e. \( U''_{rr} = u \) holds for that given level of \( \hat{c} \). We know that any equilibrium contract \((\hat{\rho}, \hat{c})\) must satisfy \( \hat{c} \leq c^{Max} \), where \( c^{Max} \) is defined in result 1. Otherwise the eICC is not satisfied.

**Result 2.** For all equilibria where \( \hat{c} \leq c^{Max} \) (eICC), risky households will always remain in the market as long as the safe households are in the market.

\[
R - p_s\hat{\rho} - p_s(1 - p_s)\hat{c} < R - p_r\hat{\rho} - p_r(1 - p_r)\hat{c}
\]

We can substitute equation 2 for \( \hat{\rho} \) into the above equation to show that risky households have decreasing costs at lower levels of \( \hat{c} \):
where $\hat{c} \leq c^{\text{Max}}$

**Proof.** Substituting for $c^{\text{Max}}$ into $\hat{c}$ (where $\hat{r} = c^{\text{Max}}$) we have:

$$ps\left(\frac{\rho}{\hat{p} + \hat{p}(1-\hat{p})}\right) + ps(1 - ps)\left(\frac{\rho}{\hat{p} + \hat{p}(1-\hat{p})}\right) > pr\left(\frac{\rho}{\hat{p} + \hat{p}(1-\hat{p})}\right) + pr(1 - pr)\left(\frac{\rho}{\hat{p} + \hat{p}(1-\hat{p})}\right)$$

$$\Rightarrow 2ps - p_s^2 > 2pr - p_r^2$$

which is true where $1 > p_s > p_r$

This shows that expected costs are always going to be lower for the risky households than for safe households within the bounds of the eICC. At levels of collateral lower than $c^{\text{Max}}$ risky households will actually have a reduction in their expected costs. Hence, we can conclude that for any equilibrium contract risky households will never be forced out of the market by homogeneous group formation through signalling so long as the safe are in the market. If both safe and risky are in the market, thanks to the fact that homogeneous group formation improves the utility of safe households, the only possible welfare effect of homogeneous group formation must be positive\(^{18}\). If anything, homogeneous group formation guarantees the access to the credit market to safe households in cases where they were crowded out of the market in the absence of signalling.\(^{19}\) Obviously, this effect is not guaranteed, as the improvement in safe households’ utility might not be strong enough for them to find it beneficial to borrow even under homogeneous group formation. However this begs the question of what happens when this effect is not strong enough to rectify underinvestment problems? And what are the welfare consequences of group lending in such a situation?

**Proposition 2.** Group lending with homogenous group formation through signalling improves welfare if anything, although welfare can stay the same we will not see welfare decreasing.

**Proof.** If safe households enter the market due to homogenous group formation, then we know from Result 2 that under investment is eliminated. So, as the safe have been brought back into the market overall net welfare is increased. Suppose now that homogenous group formation does not result in a big enough improvement. If safe borrowers stay out of the market and no joint liability equilibrium exists, the risky households will merely revert back to borrowing through individual lending. This would not improve welfare, but it would not make the situation any worse either. As a result we can conclude that group lending is, if anything, welfare improving.

**B. SEPARATING CONTRACTS WITH SIGNALLING**

Separation of groups was possible through side payments. However can assortative matching due to side payments result in separating lending contract suited toward each type of borrower? In equilibrium this would involve two equilibrium contracts with homogenous groups. The aim of the banks is therefore to offer a set of contracts that are compatible with the incentives of the borrowers. The contract would have to be structured

\(^{18}\) Even if the safe households were already in the market joint liability lending has a redistribute effect.

\(^{19}\) Note that group lending also solves the problem of over-investment as specified by De-Meza and Webb.
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in such a way that each type of borrower is offered a contract that is consistent with their profile and also that they have no incentive to cheat and deviate from this contract i.e. it is consistent with their ICC.

The ZPC of the bank now becomes:

\[ p_s r_s + p_s (1 - p_s) c_s = \rho \]
\[ p_r r_r + p_r (1 - p_r) c_r = \rho \]  

Consequently rates would be determined as follows, with the contract being the same as at full information levels.

\[ r_i = \frac{\rho}{p_i} - (1 - p_i) c_i \]
\[ c_i = \frac{(\rho/p_i) - r_i}{1 - p_i} \]

The participation constraint of the safe households is as follows:

\[ u \leq R - (p_s r_s + p_s (1 - p_s) c_s) + p_s (1 - p_s) s_s - p_s (1 - p_s) s_s \]

The incentive compatibility constraint would be as follows:

\[ (p_r r_r + p_r (1 - p_r) c_r) - p_r (1 - p_r) s_r + p_r (1 - p_r) s_r \]
\[ \leq (p_r r_s + p_r (1 - p_r) c_s) - p_r (1 - p_r) s_s + p_r (1 - p_r) s_s \]

In order to identify the set of separating contracts we first of all identify the pooling contract, \((\hat{r}, \hat{c})\) This corresponds to the intersection points of the individual indifference curves of risky and safe households respectively (see point A, figure 1), and it is given by (we explicitly solve equation 6 to derive the intersection point).

\[ \hat{r} = \frac{\rho (p_r + p_c - 1)}{p_s p_r} \]
\[ \hat{c} = \frac{\rho}{p_s p_r} \]

The slope of the indifferences curves of a borrower of type \(i\) is

\[ \frac{dc}{dr} = \frac{1}{1 - p_i} \]

Given this expression, it is immediate to verify that relatively to risky households, safe households will prefer contracts with higher collateral payments. The reason for this is safe households when partnered with another safe household will have a lower probability of having to pay the collateral amount, while risky households will be more likely to pay this amount. As a result risky would show a preference for contracts with lower collateral.

Hence, any equilibrium pair of loan contracts \((r_s, c_s), (r_r, c_r)\) such that \(r_s < \hat{r}\) and \(c_s > \hat{c}\), together with \(r_r > \hat{r}\) and \(c_r < \hat{c}\), will result in separation. Safe households would subscribe the contract \((r_s, c_s)\) and the risky households would instead go for contract \((r_r, c_r)\). This uses the single crossing property, which is a necessity in order for separating contracts to be feasible in equilibrium. The figure below shows the continuum of contracts and the single crossing point, A, through which separation occurs.
In this equilibrium all participants get their full information contracts and utility and repayment rates are also same as under full information. However while we have defined a continuum of contracts which are feasible in equilibrium subject to the constraints that we have imposed, the equilibrium violates our eICC condition, principally that $\hat{r} < \hat{c}$.

**Proposition 3.** Optimum separating contracts are not feasible as separation would imply contracts which violate the eICC (see result 1).

**Proof.**

\[
\hat{r} = \frac{\rho(p_r + p_c - 1)}{p_s p_r},
\]

\[
\hat{c} = \frac{\rho}{p_s p_r},
\]

s.t. $1 < p_r + p_s < 2$

Subject to the above constraint $\hat{r} \leq \hat{c}$. As a result separation cannot occur because contracts where $r_s < \hat{r}$ and $c_s > \hat{c}$ are not feasible as $r_s < \hat{r}$ would imply that $p_s + p_r > 2$, which violates our constraint. This would imply that only contracts below the crossing point are feasible, which would mean that separation is not possible.

If we now relax the eICC from result 1, where $c > c^{\text{Max}}$, we could have an equilibrium with separating credit contracts similar to the model presented by Ghatak (2000). However for this to be realistic we have to assume that banks can carry out state verification costlessly. We already know the single crossing point of the households indifference curve (represented by point A in figure 1). We also know that the slope of the
safe households with respect to collateral is steeper than that of the risky households. This means that safe households will be willing to take on more collateral than the risky households. Using this information banks can offer a set of incentive compatible contracts of the line segments BA and AC for safe and risky households respectively. This mechanism of screening by the bank allows for a separating equilibrium with separate credit contracts for both safe and risky households in homogenous groups.

6. Conclusion

This paper has proposed a model whereby self-selection of peer groups is possible even with group members having no a priori information about others. We show that a signalling mechanism using side-payments of non-monetary assets can lead to assortative matching. This is consistent with the ideas of social collateral and harnessing of local knowledge, as the costs of enforcement and verification are passed on entirely to the borrowers, due to which the bank is able to offer lower rates to the borrowers. Non-monetary assets that would have little use in an individual lending contract can serve to improve welfare in group lending by essentially creating a local market for insurance. This insurance policy insulates group members from the cost of collateral. Furthermore with the use of side-payments, a market for assets, which previously had no value as collateral, can be used for the benefit of the households to acquire loans.

Empirical studies have shown that groups that are self-selected perform better than groups that are selected by the bank itself. This paper shows how self-selection through signalling is preferable to random matching, as problems of under-investment may be ameliorated and repayment rates are also improved.

However the use of side payments raises an interesting question – Does microfinance really serve the poorest poor or the better off poor? It is feasible that the poorest in the economy could not afford to post side payments as the labour income foregone could be the only supporting income for an entire family. However the better-off poor may find it easier to sacrifice some labour income for entering into the loan agreement and financing their project. This would be consistent with some of the evidence to arise from studies on who micro finance serves. It could also point to the fact that often borrowers of microfinance loans tend to be female. The female borrowers are usually not the main breadwinners, but demand loans to raise extra income for the family. Women who have no other work commitments may find it easier to post side-payments of labour as upon default they would not necessarily have to forgo other income to fulfil their contractual obligations.
REFERENCES


Bardhan, P and Udry, C. ‘Development Microeconomics: Chapter 7’, 1999, Oxford University Press (OUP)


Freixas, X & Rochet, J.C. ‘Microeconomics of Banking’ Textbook, 1999, MIT Press


