Sequential Lending: A mechanism to raise repayment rates in group lending?

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Abstract

This paper compares sequential and simultaneous group lending mechanisms in their ability to harness social sanctions when contract enforcement is incomplete. Sequential group lending entails giving credit to one borrower at a time under the condition that the previous borrower repaid her loan. We find that under weak official contract enforcement sequential lending has a higher repayment rate than either simultaneous or individual lending. However the benefit of using sequential lending disappears as official contract enforcement improves. Under sufficiently strong official contract enforcement simultaneous lending achieves the highest repayment rate of all three lending mechanisms.

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1 Introduction

The purpose of this paper is to explore the relative merits of sequential and simultaneous group lending in an environment where lenders have limited sanctions against delinquent borrowers. Sequential group lending entails giving credit to one borrower at a time under the condition that the previous borrower repaid her loan while simultaneous group lending consists of giving credit to all borrowers at the same time.

We find that if contract enforcement is very weak then sequential lending has a higher repayment rate than either individual or simultaneous group lending. If contract enforcement on the other hand is not a serious problem, then simultaneous lending achieves the highest repayment rate out of all three lending mechanisms.

Unlike the majority of the existing literature on microfinance, we abstract from informational asymmetries and focus solely on the problem of contract enforcement. Under a weak legal system borrowers may have an incentive to simply abscond with the entire project returns even if they have the funds to repay.

Besley and Coate (1995) show in a seminal paper how joint liability loans have the potential to improve repayment rates when contract enforcement is weak. If borrowers are jointly liable for each other's loan, the decision of one group member to strategically default imposes a negative externality on the rest of the group. If group members have the ability to sanction each other for this kind of voluntary default, Besley and Coate (1995) find that group lending can raise the repayment rate through harnessing social collateral.

In this paper we extend the Besley and Coate (1995) model by analyzing how the repayment game is altered when loans within a group are made sequentially instead of simultaneously. While the theoretical literature on joint liability is abundant [1] , it has almost exclusively focused on models in which all borrowers receive credit simultaneously. In practice however, microfinance in-

[1] For two surveys see Ghatak and Guinnane (1999) and Armendáriz de Aghion and Morduch (2005)

stitutions follow both, sequential and simultaneous group lending mechanisms. Borrowers of the Grameen Bank in Bangladesh for example receive their loans sequentially, while ACCION affiliated institutions allocate credit within groups simultaneously.

With few exceptions, the incentive implications of sequential group lending have, however, not received much attention in the literature. Ray (1999) motivates sequential group lending as a mechanism for mitigating coordination problems created by joint liability lending. Aniket (2005) shows how sequentiality can help in alleviating the problem of moral hazard. By temporally separating the monitoring and the effort decision of a group member, the lender does not have to incentivise the group as a whole but only individually. Similarly Roy Chowdhury (2005) shows that if monitoring and effort decisions are strategic complements then simultaneous lending can break down. By distributing loans sequentially borrowers will always have incentives to monitor each other.

We complement this literature by analyzing how the strategic default decision as first studied by Besley and Coate (1995) is altered when loans are disbursed sequentially. As borrowers wait their turn to be allocated their loan, they threaten their partner with social sanctions should they strategically default. Similarly, once borrowers have repaid their share of the loan, they will pressure their peer into repaying, else they would be liable for repayment of a second loan. Under simultaneous lending borrowers might jointly decide to strategically default while sequential lending precludes this.

The idea of harnessing social collateral using sequential lending is not new. Rotating savings and credit associations (ROSCAs) are based on a very similar principle. A ROSCA is a group of people who each contribute a specific amount to a savings pot each period. The money such accumulated is randomly allocated to a winner. The ROSCA continues with the winner of the pot excluded from receiving the pot in the future and it terminates when every single member has received the pot once.

Without social pressure from other ROSCA members, there would be little incentive to keep on contributing after a member has won the pot [2] . Besley et al. (1993) argue that it is the social connectedness amongst the group members and the threat of social sanctions which insures against such default problems. In this paper we argue that the sequentiality observed in ROSCAs is crucial and that the same mechanism could be exploited by microfinance institutions.

While this paper focuses entirely on the repayment rate, it is important to bear in mind that a high repayment rate in itself does not translate to higher welfare. For a general equilibrium analysis of the Besley and Coate model see Arnold et al. (2009) who show that repayment rates alone do not provide a complete picture of the credit market. However since both sequential and simultaneous lending mechanisms are commonly used in microfinance it is important to understand the partial equilibrium effects they have on borrowers' repayment incentives before turning to a general equilibrium analysis.

The next section introduces a variant of the original Besley and Coate model. Section 3 analyzes the repayment game under simultaneous repayment and section 4 under the sequential group lending mechanism. Section 5 concludes.

2 Individual Lending

Borrowers are risk neutral and have access to a project which requires one unit of capital and yields x units of income where x is distributed on $[0, \overline{x}]$ with a continuous distribution function $F(x)$. Borrowers are wealthless and therefore must borrow the capital from a lender who requires a repayment of $r > 1$ after the project has been realized. We assume that the interest rate is exogenously given and the lender cannot lower or raise the required repayment of r.

The borrower has no means of influencing the project's return or its probability of success. We therefore focus exclusively on the enforcement problem and abstract from all other forms of market imperfections and informational asymmetries.

[2] For a recent and very interesting behavioral explanation see Basu (2008)

2.1 The Repayment Decision

To capture the idea of imperfect contract enforcement we assume the lender has access to an incomplete penalty $p(x) < x$. Following Besley and Coate (1995) we assume $p(x)$ to be increasing in x but at a decreasing rate with $p(0) = 0$, that is $p'(\cdot) > 0$ and $p''(\cdot) < 0$. For example this could represent confiscation of a certain fraction of the project returns as well as the exclusion from future access to capital. This incomplete penalty function is what causes the market imperfection and drives all results: even under complete information where the lender knows the exact output realization, he can only enforce repayment of a fraction thereof.

After the project outcome has been realized the borrower will repay the loan as long as the cost of doing so is less than the cost of defaulting i.e. if and only if $r < p(x)$ This implicitly defines a cut-off value for x below which the borrower will default and above which the borrower will repay the loan. For all realizations of $x > p^{-1}(r) \equiv \phi(r)$ the borrower will repay her loan. The repayment rate in the case of individual lending is therefore given by

$$\Pi_{ind} = 1 - F(\phi(r)) \tag{1}$$

3 Simultaneous Group Lending

Groups are composed of two borrowers B_1 and B_2 respectively. The group is allocated two units of capital and both members of the group are jointly liable to repay $2r$ at the end of the period. Project returns are assumed to be independently and identically distributed with distribution function $F(x)$ on $[0, \overline{x}]$.

3.1 The Repayment Decision

Besley and Coate (1995) model the repayment decision as a sequential game. In the first stage both borrowers decide wether to repay 0 or r to the lender. If one of the borrowers decides to repay nothing, the game enters a second stage in which her partner can decide wether or not to bail her out by repaying another r.

Before solving this game it is worth noting that the sequential structure is a non-trivial assumption. If repayment and bail out decisions are made simultaneously there will always be a Nash equilibrium in which both borrowers repay 0 as long as both have a return less than $\phi(2r)$. That is, in a simultaneous move game borrowers can simply fail to coordinate on the pareto dominant equilibrium and repayment may in fact be lower than under individual lending.

As Ray (1999) argues this coordination failure is only a problem in simultaneous group lending. The repayment game in a sequential group lending mechanism necessarily is sequential and this problem disappears.

However to allow for a more direct comparison we follow Besley and Coate (1995) in assuming that the repayment game, even under simultaneous group lending, is of a sequential nature. Decisions are made non-cooperatively and group members have no means of side contracting amongst themselves. There are four possible states of the world:

1. Both borrowers realize a return too low to induce repayment: $x_i < \phi(r)$ for $i = 1, 2$. In this case neither borrower wants to repay their loan and the group jointly defaults.

2. One borrower realizes a return to low to induce repayment $x_i < \phi(r)$ while the other borrower realizes a return high enough to induce repayment for one loan, but not for both $x_j \in [\phi(2r), \phi(r)]$. In this case the group jointly defaults.

3. One borrower has a return greater than $\phi(2r)$ in which case the loan will be repaid

4. Both borrowers have a return x_i such that $\phi(r) < x_i < \phi(2r)$. In this case each wants to repay her own share of the loan but not both. There are two equilibria: both repay or neither repays.

In the last case Besley and Coate (1995) assume that borrowers manage to coordinate on the pareto superior equilibrium where both repay. While this is probably a reasonable assumption it is worth noting that this coordination failure again disappears under sequential group lending.

Assuming borrowers manage to coordinate the repayment rate will be:

$$\Pi_{sim} = 1 - [F\phi(r)]^2 - 2F[\phi(r)][F(\phi(2r)) - F(\phi(r))] \tag{2}$$

The first term which is subtracted is simply the probability of state 1 occurring and the second term the probability of state 2 which are the only cases when the loan is not repaid.

3.2 Social Sanctions

In case 2 one borrower not repaying her share of the loan represents a negative externality on the other group member who would like to repay her loan. She will either have to bail out her partner or she will be sanctioned by the bank although she would like to repay by herself. Besley and Coate (1995) show that this creates the potential for the lender to leverage social sanctions as an additional punishment.

We assume that a group member who strategically defaults on a repayment will face social sanctions s from her peers, while a borrower who is known to have defaulted out of no fault of her own will be spared from punishment. In practice these social sanctions can take many forms, ranging from social isolation and reporting the bad behavior to other members of the community to physical retribution.

Unlike Besley and Coate (1995) we assume that it is a discrete decision to sanction someone and hence s is a constant. Although in practice the degree to which group members sanction each other may depend on several factors, we focus on the case where group members either punish their partner s or not at all. One could alternatively assume that the punishment is increasing in the amount of damaged caused by the strategic default or increasing in the defaulting borrower's return. None of the results in this paper are substantially affected if social sanctions are modeled in these ways. All that is needed for the results to go through is that social sanctions inflict an additional cost of defaulting.

When a borrower considers strategic default, she weighs up the benefits against the costs which now consist of two punishments: the official punishment

$p(x)$ and the additional punishment s. A borrower is only going to voluntarily default if $p(x) + s < r$. This defines a new threshold level of $x = \phi(r - s)$. For all realizations of x above this value a borrower will repay her loan and for all realizations of x below it she will default although she is being socially sanctioned by her peer.

However, if a borrower simply does not have the means to repay the loan, that is if she involuntarily defaults, then no amount of social sanctioning can induce repayment as she is physically unable to repay and protected by limited liability.

These social sanctions only enter the repayment decision when there is disagreement about repaying the loan, i.e case 2 above is now broken into several subparts:

2.
   a. $x_i \in [\phi(r), \phi(2r)]$ and $x_j < r$. In this case the loan will not be repaid because one borrower does not find it optimal to pay for both loans while the other does not have the means to repay and will default even if she is socially sanctioned.

   b. $x_i \in [\phi(r), \phi(2r)]$ and $x_j \in [r, \phi(r - s))$. In this case the loan will again not be repaid as one borrower does not find it optimal to pay for both loans while the other borrower strategically defaults although she is being sanctioned for it.

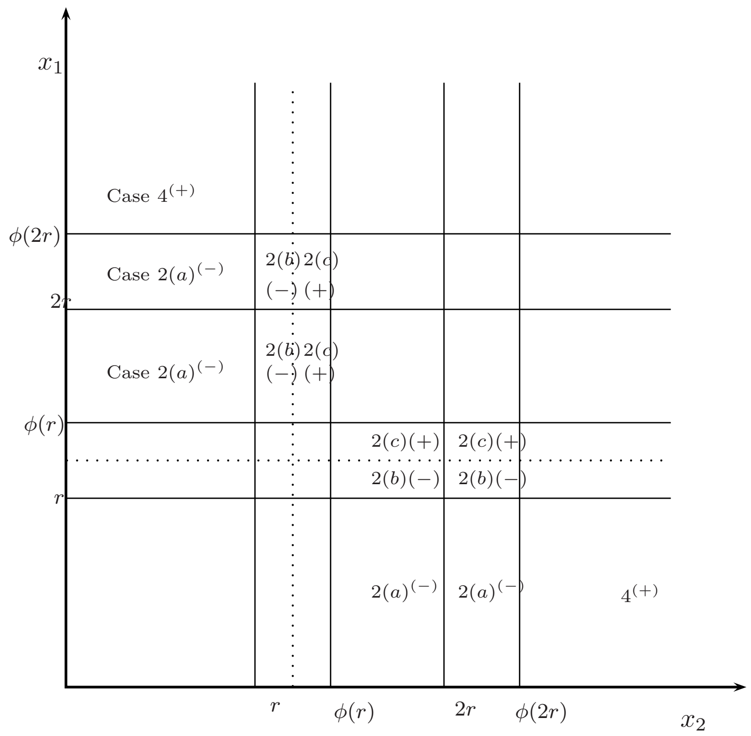
   c. $x_i \in [\phi(r), \phi(2r)]$ and $x_j \in [\phi(r - s), \phi(r))$. In this case the loan will be repaid. One borrower does not find it optimal to pay for both loans and the other borrower would strategically default under individual lending, however the threat of social sanctions induce her to repay.

Group lending clearly is beneficial when one borrower can bail out the other (case 4 above) and in cases where social sanctions induce repayment (case 2c). However at the same time group lending can have a negative effect: due to the burden imposed by a defaulting partner, the other borrower finds herself unable or unwilling to repay both loans and instead lets the group jointly default (cases

2a and 2b).

The repayment decision of the group is depicted below in Figure 1. for all possible combinations of x_1 and x_2. Areas marked with a $(-)$ illustrate combinations of output realizations under which group lending causes default, where at least one borrower would have repaid under individual lending. Areas marked with $(+)$ illustrate output realizations where group lending results in the loan being repaid where under individual lending at least one borrower would have defaulted.

Figure 1: *Repayment Decisions under joint and individual lending*



The repayment rate under simultaneous group lending with social sanctions is therefore given by:

$$\begin{aligned}\Pi_{sim} &= 1 - [F\phi(r)]^2 - 2F(r)[F(\phi(2r)) - F(\phi(r))] \\ &\quad -2[F(\phi(r-s) - F(r)][F(\phi(2r)) - F(\phi(r))]\end{aligned}$$

The first term which is subtracted is again the case where both borrowers agree to default. The second term is the case where one cannot repay her loan and the other is not willing to pay for both. The final term is the case in which one does not want to repay although she could and although she is socially sanctioned for it and her partner is not willing to pay for both.

Under strong social sanctions, i.e. letting s tend to r, the final term in the above expression disappears (as $\phi(0) = 0$) and the repayment rate is given by:

$$\lim_{s \to r} \Pi_{sim} = 1 - [F\phi(r)]^2 - 2F(r)[F(\phi(2r)) - F(\phi(r))] \tag{3}$$

Comparing the repayment rate under simultaneous group lending with strong social sanctions to the repayment rate under individual lending, we get

$$\begin{aligned} \Pi_{sim} - \Pi_{ind} &= 1 - [F\phi(r)]^2 - 2F(r)[F(\phi(2r)) - F(\phi(r))] - (1 - F(\phi(r)) \\ &= F[\phi(r)][1 - F(\phi(r))] - 2F(r)[F(\phi(2r)) - F(\phi(r))] \end{aligned} \tag{4}$$

Proposition 1 *For high risk of involuntary default, i.e. high $F(r)$, simultaneous group lending has a lower repayment rate than individual lending. The converse holds for low risks of involuntary default.*

The first term in equation (4) is clearly positive and favors group lending. However, the second term works in the opposite direction. Whether the negative effect due to increased liability or the positive effect due to borrowers helping each other out in bad times is greater cannot be said a priori. Which mechanism will result in a higher repayment rate depends on the relative size of the areas depicted in Figure 1.

The only difference between our result and Besley and Coate's result that group lending outperforms individual lending is the second term in the above expression. By assuming away involuntary default $F(r)$ is implicitly set equal to zero. Hence, the second term completely disappears and group lending always dominates individual lending.

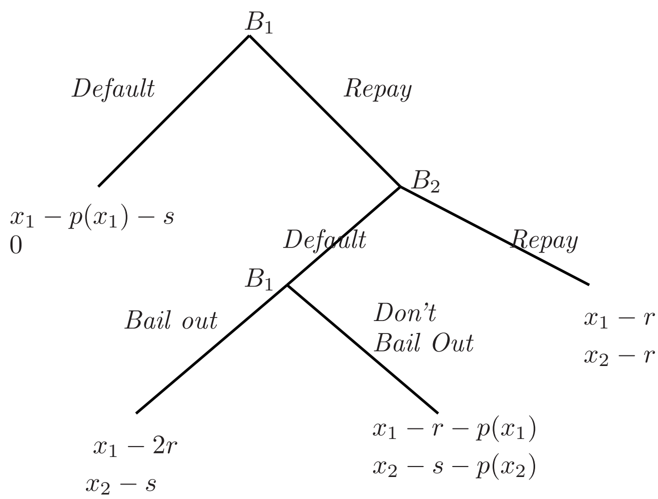
4 Sequential Group Lending

Under sequential group lending the lender initially only lends one unit of capital to the group which is randomly allocated to one borrower (B_1). If this initial loan is not repaid the game terminates and both borrowers are excluded from future access to credit and both are punished by the lender. Upon successful repayment of r at the end of the first period however, the group is given a second unit of capital which is allocated to the second borrower (B_2). At the end of period two the group is jointly liable for another repayment of r to the lender.

4.1 The Repayment Decision

If the first borrower defaults on her loan, strategically or not, the second borrower is deprived from the opportunity of even undertaking her project. Hence every single time the first borrower fails to repay her loan, it represents a negative externality to the second borrower. Conversely, if the first borrower has

Figure 2: *The Sequential Repayment game*



repaid her part of the loan, any default on behalf of the second borrower represents a negative externality to the first borrower. This is because she has already repaid r to the lender and her group member defaulting means she is either going to get punished although she repaid her half or she is going to have to repay for her partner as well.

The repayment game is shown in Figure 2 and is solved by backwards induction. In the final stage, which only occurs if B_2 has not repaid her loan, B_1 can decide whether or not to bail out her defaulting partner. In the second stage, B_2 decides whether or not to repay her loan and in the first stage B_1 decides whether or not to repay her's.

At t=3 Borrower 1 decides whether or not to bail out a defaulting partner

$$x_1 > \max\{\phi(r), 2r\} \tag{5}$$

At t=2 Borrower 2 decides whether or not to repay.

- If she observes $x_1 > \max\{\phi(r), 2r\}$ she will default for all $s < r$
- If she observes $x_1 < \max\{\phi(r), 2r\}$ she will default for all $x_2 < \max\{r, \phi(r)\}$

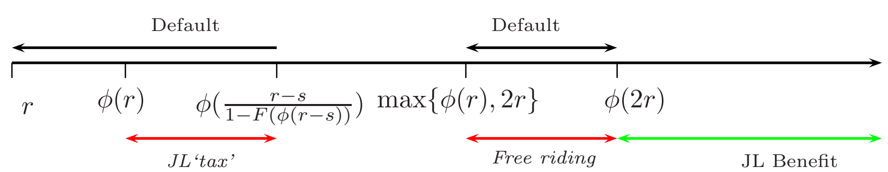
At t=1 Borrower 1 decides whether or not to repay

- She will default for very *high* output such that $x > \max\{\phi(r).2r\}$
- She will default for very *low* output such that $x < \phi(\frac{r-s}{1-F[\phi(r-s)]})$

At the first stage of the game the B_1 will default for low output realizations because the cost of default is low and for high output realizations because she anticipates that the second borrower may try to free ride on her success.

The repayment decision for B_1 is depicted in Figure 3.

Figure 3: Borrower 1's repayment decision



There are still negative and positive effects due to joint liability. The first borrower is less likely to repay for two reasons: she expects to be liable for her partner with a certain probability which results in a joint liability 'tax' and she expects that the second borrower will free ride if her output in the first period is very high. However there is still the positive benefit that the first borrower can potentially bail out her partner.

The difference to simultaneous lending is that social sanctions have a different effect in this game. For sufficiently strong social sanctions the negative effects of joint liability completely disappear. To see this, consider the case that social sanctions are high such that $s \to r$.

The first borrower will repay whenever she can, otherwise she will receive social sanctions and be punished by the bank. The second borrower will always repay whenever she can for exactly the same reason. Note that this relies on the fact that the bank the ability to punish the *first* borrower when the *second* borrower is due to repay her loan. By having the ability to punish the partner, the bank leverages social sanctions which are stronger than the banks limited enforcement ability.

Therefore there are three states of the world:

1. $x_1 < r$ and B_1 has to default. The game terminates and the bank is paid back nothing

2. $x_2 < r$ which means B_2 cannot repay and $x_2 \in [r, \max\{2r, \phi(r)\}]$ in which case the B_1 either cannot or does not want to bail out her partner. In this case the first loan was repaid but the group defaults on the second repayment

3. In every other state of the world the loan is repaid

The expected repayment under sequential lending is therefore:

$$1 \times \underbrace{F(r)[F(\tilde{x}) - F(r)]}_{\text{Case 2}} + 2 \times \{\underbrace{F(r)[1 - F(\tilde{x})]}_{B_1 \text{ bails out } B_2} + \underbrace{[1 - F(r)]^2}_{\text{Both repay}}\} \tag{6}$$

Where $\tilde{x} \equiv \max\{2r, \phi(r)\}$. The expected number of units of capital lent out is $2 - F(r)$. The expected repayment rate is given by:

$$\Pi_{seq} = \frac{\text{Expected Repayment}}{\text{Expected units of capital lent out}}$$

$$\Pi_{seq} = 1 - F(r) + \frac{F(r)(1 - F(\tilde{x}))}{2 - F(r)} \tag{7}$$

Which is clearly higher than the repayment rate under individual lending $\Pi_{ind} = 1 - F(\phi(r))$.

Proposition 2 *Under sufficiently strong social sanctions sequential lending always has a higher repayment rate than individual lending.*

Intuitively this result is straightforward: In the sequential lending game, social sanctions are invoked more often, in fact, every single time a borrower wants to default although she could repay, she will be sanctioned. If these sanctions are sufficiently strong no borrower will choose to default if she has the chance not to. In addition, there is also the possibility that the first borrower will bail out her struggling partner which would not happen under individual lending.

Proposition 3 *Under weak official penalties* $\Pi_{seq} > \Pi_{sim}$. *Under stronger official penalties* $\Pi_{sim} > \Pi_{seq}$.

The intuition behind this result is that under very weak official penalties, the likelihood that both borrowers jointly want to default is high. By separating the repayment decisions temporally, borrowers can no longer make this decision jointly and strategic default is reduced. If on the other hand official penalties are sufficiently high, then the benefits of borrowers being able to assist each other outweighs the reduced incident of strategic default.

To see this formally we compare

$$\Pi_{seq} - \Pi_{sim} = [F\phi(r)]^2 + 2F(r)[F(\phi(2r)) - F(r) + \frac{F(r)(1 - F(2\tilde{x})}{2 - F(r)} \tag{8}$$

which can be positive or negative depending on the relative size of $F(\phi(r))$, $F(r)$ and $F(2r)$. For example assuming $F(\phi(r)) > F(2r) > F(r)$ implies $\Pi_{seq} > \Pi_{sim}$ while the opposite is true for $F(\phi(r))$ close to $F(r)$.

5 Conclusion

This paper has demonstrated that different lending mechanisms have very different effects on the strategic default decision of borrowers. We find that simultaneous lending may or may not raise the repayment rate, while a sequential lending mechanisms has the potential to eliminate strategic default completely.

However a disadvantage of sequential lending is that the there is less scope for mutual assistance among borrowers. If contract enforcement was no problem at all, then simultaneous lending would clearly achieve the highest repayment rate in our model.

However the mere fact that social sanctions may be large and negative in equilibrium may well deter risk averse agents from even participating in the mechanism. The choice between sequential, simultaneous or individual lending is therefore not a trivial one. Even if the lender's sole objective is to maximize the repayment rate and he does not care about borrower welfare, he might find it profitable to chose a lending mechanisms which does not discourage risk averse borrower's with profitable projects from participating in the credit market.

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