Peer-to-Peer Lending and Financial Inclusion with Altruistic Investors

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Abstract

Peer-to-peer lending platforms are increasingly important alternatives to traditional forms of credit intermediation for small value loans. There are high hopes that they improve financial inclusion and provide better terms for borrowers. To study these hopes, we introduce altruistic investors into a peer-to-peer model of credit intermediation. We find that altruistic investors do not improve financial inclusion but that the borrowing rates are lower than the ones obtained with self-interested investors. Furthermore, investors with strong altruistic preferences are willing to finance projects which generate an expected loss to them. For a certain range of parameters, the model's allocation is observationally equivalent to a model with self-interested investors with low bargaining power. Outside of this range, the model generates allocations that are not incentive feasible in a model with self-interested investors.

Keywords:altruistic preferences, financial intermediation, financial inclusion, peer-to-peer platforms

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1 Introduction

Borrowing peer-to-peer from friends and family is still highly relevant today. According to a report by the World Bank "globally in 2017, 47 percent of adults reported having borrowed money in the past 12 months [and] that borrowers in developing economies are most likely to turn to family or friends (Demirgüç-Kunt et al., p. 9 and p. 67)."[1]

More recently, crowdfunding and peer-to-peer lending platforms have enabled loans between lenders and borrowers that don't know each other personally. These online platforms match lenders with borrowers and have established themselves as alternatives to traditional forms of credit intermediation for small value loans. For example, Kiva operates in 78 countries and has 3.3 million borrowers and 1.8 million lenders (see kiva.org). The total volumes of loans intermediated is 1.32 billion USD.[2]

Increasingly, microfinance institutions are using these platforms to promote financial inclusion. According to McIntosh (2012), they "lend to loss-making market segments that would be unserved in a purely profit-driven market, and these financial losses are justified by the social impact of the activity. The sources of funding for microfinance [...] typically have at least partially humanitarian objectives (p.11)."[3]

There are high hopes that these platforms improve financial inclusion by providing funds to microentrepreneurs that have no access to the traditional financial sector and that the interest rates on these loans are below market rates. To study these hopes, we introduce altruistic investors and microentrepreneurs into a peer-to-peer model of credit intermediation. In order to determine the terms of the contract we focus on Pareto efficient pricing mechanisms.

Our key findings for any Pareto efficient pricing mechanism are the following: First, altruistic investors do not promote financial inclusion because all projects that are financed by altruistic investors would also be financed by self-interested investors. Second, altruistic investors offer better terms to borrowers than self-interested investors.[4] Third, investors with strong altruistic preferences are willing to finance

[1] Historically, peer-to-peer lending among family and friends has been the norm and precedes the develpoment of financial instituions.

[2] Other peer-to-peer lending platforms are Companisto, FundedByMe and Fundingcircle. Zopa.com was the first peer-to-peer lending website world wide.

[3] According to McIntosh (2012), "an estimated 5 billion US dollars has flowed from the developed world to microfinance lenders over the past decade (p.11)."

[4] Riedl and Smeets (2017) report experimental evidence that socially motivated investors are willing to forgo financial performance. Freedman and Jin (2017) analyze transaction level data from prosper.com which is the largest peer-to-peer consumer lending platform in the US. They find that "lenders are more likely to fund and provide lower interest rates to loans with social networking

projects which generate an expected financial loss to them.

We also explore the terms of the loans obtained from the asymmetric Nash bargaining solution. Here we find that for a certain range of the parameter that represents altruism, the model's allocation is observationally equivalent to a model with self-interested investors with low bargaining power. In this range, the model can replicate any allocation that can be achieved in a bargaining model with self-interested investors. Outside of this range, the model generates allocations that are not incentive feasible in a model with self-interested agents.

There is little known about the terms of the loans that are negotiated between friends and family because of the informality of these borrowing arrangements. However, the basic characteristics of such borrowing is that the lender and the borrower know each other well, and it is likely that the lender is motivated by objectives aside from profit maximization. Rather, lenders might positively value the well-being of the borrowers and for this reason it is likely that our key results apply in these situations.

Peer-to-peer lending platforms may attract projects that appeal to socially motivated investors (McIntosh, 2012). However, there is an important difference between lending among friends and family and lending through online platforms because peer-to-peer online platforms suffer from severe private information problems. For this reason, Freedman and Jin (2017) provide two distinct interpretations for their finding that lenders provide lower interest rates to loans with social networking attributes: either lenders miscalculate the expected returns because of private information problems or they are motivated by objectives aside from profit maximization such as altruistic preferences. In order to distinguish between these two possibilities, they consider how lenders change their lending behavior in response to missing payments in their loan portfolio. They find that "charity is not the only motivation for funding social loans and lenders attempt to increase their profits in response to discovering poor outcomes for these types of loans (p. 212)."[5]

The reminder of the paper is organized as follows. Section 2 introduces the model and presents the results. Section 3 discusses extensions and Section 4 concludes.

attributes, despite many of these loans being less likely to repay on time (p. 210)."

[5]In an earlier paper, Freedman and Jin (2010) also find that the funding of low return loans is due to "mistakes" rather than a form of "charity."

2 Model

The economy is populated with a large number of identical microentrepreneurs or borrowers and a large number of identical investors. There are two periods $t = 0, 1$. Each borrower is endowed with a project in $t = 0$ that yields output y in $t = 1$.[6] In order to carry out their projects, each borrower needs to borrow one unit of an indivisible capital good. We abstract from limited commitment and private information issues and assume that borrowers repay their loans with certainty. Denote x_I the quantity obtained by the investor and x_B the quantity retained by the borrower with $y = x_I + x_B$.

In what follows we consider a match between a representative investor and a representative borrower. The borrower's surplus is

$$S_B = x_B - u, \tag{1}$$

where u is an effort cost for implementing the project.[7] The term $x_B = y - x_I$ is the net return of the project for the borrower since y is the return and x_I is the payment to the investor. The borrower's participation constraint is

$$S_B \geq 0. \tag{2}$$

Each investor is endowed with one unit of labor that can be used to produce an indivisible unit of a capital good at disutility ρ in period $t = 0$.[8] Accordingly, define the profit of the investor from producing and investing the capital good in a borrower's project as

$$\pi \equiv x_I - \rho. \tag{3}$$

The investors are risk neutral with altruistic preferences. The representative investor's surplus is

$$S_I = \pi + aS_B. \tag{4}$$

The investor's surplus depends on the profit of the investment π plus the altruistic term aS_b. The altruistic parameter a measures how strongly the investor cares about

[6] An alternative assumption is that the gross returns of the projects are random and stochastically independent. In an earlier version of the paper we derived the model under this assumption and found equivalent results.

[7] In the extension section we explore the implications of the interpretation that the term u represents the utility the borrower gets when he implements the project by himself.

[8] An alternative interpretation is that the investor is endowed with the capital good and has an alternative riskless investment opportunity that yields ρ. The implications of this alternative interpretation are investigated in the extension section.

the borrower's surplus. This simple form of representing altruistic preferences is based on Levine (1998).

We impose the following condition on a:

$$0 \leq a \leq \rho(y-u)^{-1}. \tag{5}$$

Throughout the paper we call an investor with $a > 0$ an altruistic investor and we call an investor with $a = 0$ a self-interested investor. Furthermore, we call an investor, who is willing to make a loss, an investor with strong altruistic preference. Finally, for $a > \rho(y-u)^{-1}$ the investor is willing to offer the capital good for free and to provide additional ressources to the borrower. Condition (5) rules this case out, but in reality we might observe such behavior between close relatives such as parents who are willing to help their children to found a start-up project.

The investor's participation constraint is

$$S_I \geq 0. \tag{6}$$

In a standard model of financial intermediation (for $a = 0$), it is easy to show that it is socially optimal to carry out all projects with an return y that covers the cost of the borrower u plus the cost of the investor ρ. That is,

$$S \equiv y - \rho - u \geq 0. \tag{7}$$

One of the issues we discuss throughout the paper is whether inequality (7) continues to hold with altruistic investors. In particular, would an altruistic investor be willing to finance a project with $S < 0$? This question relates to financial inclusion. If altruistic investors also finance projects with $S < 0$, then more microentrepreneurs have access to credit which promotes financial inclusion. We will come back to this question throughout the paper.

Using (3) and (7) we can rewrite the surpluses as follows:

$$S_B = S - \pi \text{ and } S_I = aS + (1-a)\pi. \tag{8}$$

For both participation constraints to hold, the investor's profit must lie in the interval

$$S \geq \pi \geq \frac{-aS}{1-a}. \tag{9}$$

In a standard model of financial intermediation (for $a = 0$), the interval reduces to $S \geq \pi \geq 0$. The investor is willing to provide the capital good if and only if his profit is nonnegative.

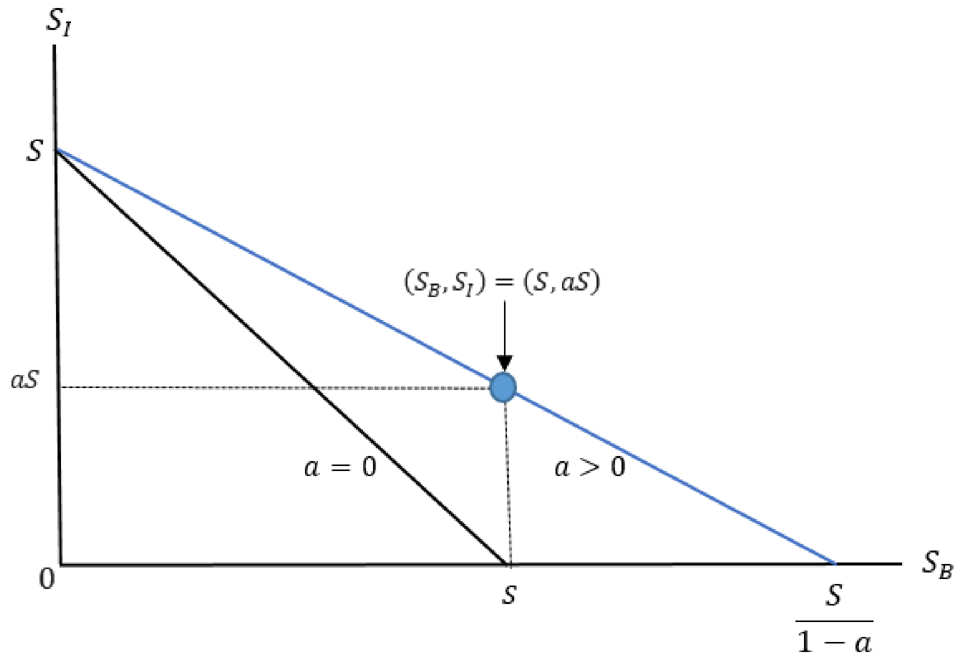

Figure 1: Pareto frontiers for $\alpha = 0$ and some $\alpha > 0$.

2.1 Pareto frontier

We begin with a description of the Pareto frontier. The Pareto frontier can be derived from (8) as follows:[9]

$$S_I = S - (1 - a)S_B. \tag{10}$$

The investor's profit π does not affect the shape of the Pareto frontier since (10) is independent of π. However, it affects the individual surpluses (8). Figure 1 plots the Pareto frontier for $a = 0$ and some $a > 0$. The black line is the Pareto frontier for $a = 0$ and the blue line is the Pareto frontier for some $a > 0$. Any efficient pricing protocol selects surplus pairs on these frontiers.

Proposition 1 (Pareto frontier) *Consider any efficient pricing mechanism that selects a surplus pair (S_B, S_I) on the Pareto frontier. Then, the following is true for $a > 0$: (i) Iff $S_B < S$, $\pi > 0$. (ii) Iff $S_B = S$, $\pi = 0$. (ii) Iff $S_B > S$, $\pi < 0$.*

The main result of Proposition 1 is that any pricing model that selects a point $\frac{S}{1-a} \geq S_B > S$ will yield a negative profit for the investor. The proof follows straightforward from $S_B = S - \pi$ (see (8)). The investor is willing to accept a financial loss

[9]A formal definition of the Pareto frontier is in the Appendix.

as long as $S_I = aS + (1-a)\pi$ remains positive. Note that the results in Proposition 1 require altruistic preferences since for $a = 0$, the investor's participation constraint does not allow for a negative profit; that is, $S_I = \pi \geq 0$. Figure 1 also shows how a change of a affects the Pareto frontier. An increase in a tilts the Pareto frontier up and to the right.

One pricing mechanism that yields negative profits for investors is Bertrand price competition. Assume a model with many altruistic investors and few borrowers, where investors compete for financing projects. In such a market, the investors obtain no surplus, that is $S_I = aS + (1-a)\pi = 0$ implying that $\pi = -\frac{aS}{1-a} < 0$. Thus, with Bertrand competition and altruistic preferences investors are willing to accept a financial loss.

2.2 Feasibility

We have not yet determined whether all surplus pairs (S_I, S_B) on the Pareto frontier are feasible. Feasibility requires that every surplus pair respects $0 \leq x_I \leq y$.

Proposition 2 (Feasibility) *If $a \leq \rho(y-u)^{-1}$, then every Pareto-efficient allocation is feasible.*

According to Proposition 2, feasibility requires that the altruistic parameter a is not too large.[10] Under this condition any surplus pair (S_B, S_I) on the Pareto frontier is feasible. The condition $a \leq \rho(y-u)^{-1}$ implies that $x_I \geq 0$ for any surplus pair on the Pareto frontier.

To get some intuition for this condition, consider the surplus pair $(S_I = 0, S_B = \frac{S}{1-a})$. For this element on the Pareto frontier we obtain $\pi = -\frac{aS}{1-a}$ and the following quantities:

$$x_I = \rho - \frac{aS}{1-a} \text{ and } x_B = y - \rho + \frac{aS}{1-a}.$$

The investor makes a loss since $\pi = x_I - \rho = -\frac{aS}{1-a} < 0$. However, the condition $a \leq \rho(y-u)^{-1}$ implies that x_I remains positive.

Next, consider the surplus pair $(S_I = aS, S_B = S)$. For this element on the Pareto frontier we obtain $\pi = 0$, and the following quantities:

$$x_I = \rho \text{ and } x_B = y - \rho.$$

For this surplus pair, there is no condition on a since x_I is positive for all possible values of a. Thus, the condition $a \leq \rho(y-u)^{-1}$ makes sure that the quantity x_I is

[10]The proof for Proposition 2 is in the Appendix. Note that $\rho(y-u)^{-1} < 1$.

positive for any possible surplus pair on the Pareto frontier. For most elements on the Pareto frontier, it is a sufficient condition, but not necessary.

The allocation $x_I = 0$ and $x_B = y$ is a donation since the capital good is provided for free. It yields the surpluses

$$S_I = -\rho + a(y - u) \text{ and } S_B = y - u.$$

Individual rationality requires that $S_I \geq 0$. That is, $a \geq \rho(y - u)^{-1}$. Then, our feasibility constraint $a \leq \rho(y-u)^{-1}$ implies that a donation is feasible and individual rational if $a = \rho(y - u)^{-1}$.

The condition $a \leq \rho(y - u)^{-1}$ rules out that $x_I < 0$ in the model. In practice, however, in particular when considering borrowing peer-to-peer among friends and family, one can imagine that an investor with deep pockets and very strong altruistic preference offers the capital good for free and makes an additional financial contribution to the borrower; i.e. $x_I < 0$. A donation of the capital good plus an additional contribution is individual rational for the investor for large a. To provide an example, assume $a = 1$ and the allocation $x_I = -u$ and $x_B = y + u$. For this case the surpluses are

$$S_I = -u - \rho + y = S \geq 0 \text{ and } S_B = y.$$

2.3 Nash bargaining solution

In what follows we study the Nash bargaining solution that also selects surplus pairs on the Pareto frontier. It is frequently used to model bilateral bargaining (see Binmore et al., 1986). In the context of our model, the investor and the borrower negotiate about the interest rate $r = \pi/\rho$ (or equivalently the investor's profit) that the borrower has to pay for the loan. The parameter $1 \geq \theta \geq 0$ is the bargaining power of the investor. The Nash bargaining solution satisfies

$$\pi^N = \arg\max_{\pi} (S_I)^{\theta} (S_B)^{1-\theta} \tag{11}$$

and the first-order condition is

$$\frac{S_B}{S_I} = \frac{(1 - \theta)}{\theta(1 - a)}. \tag{12}$$

Use (8) to rewrite (12) as follows:[11]

$$\frac{S - \pi^N}{aS + (1 - a)\pi^N} = \frac{(1 - \theta)}{\theta(1 - a)}. \tag{13}$$

[11]The second derivative with respect to π is negative if $S > 0$. Accordingly, the first-order condition (12) describes a maximum.

Solving equation (13) for π^N yields

$$\pi^N = \tilde{\theta} S, \tag{14}$$

where $\tilde{\theta} \equiv (\theta - a)/(1-a)$. Recall that the interest rate satisfies $r^N = \pi^N/\rho$. Hence, the investor's profit and the interest rate are increasing in θ and decreasing in a. If the borrower has all the bargaining power ($\theta = 0$), then the investor's profit equals the one that is obtained under Bertrand price competition (namely, $\pi = -\frac{aS}{1-a}$). If the investor is self-interested ($a = 0$), they make a positive profit since $\pi^N = \theta S \geq 0$.

Proposition 3 (Interest rate and profits) *Properties of the bargaining solution: (i) π^N is decreasing in a. (ii) For $a > \theta$, $\pi^N < 0$. (iii) For $\theta = a$, $\pi^N = 0$. (iv) For $\theta > a$, $\pi^N > 0$.*

Proposition 3 summarizes the key properties of the Nash bargaining solution. According to (i), altruistic investor preferences lower the borrowing costs since π^N and r^N are decreasing in a. This is consistent with experimental evidence reported in Riedl and Smeets (2017) and Freedman and Jin (2017). According to (ii) for a sufficiently large a, the investor is willing to provide financing even though he makes a loss. Finally, according to (iv), if a is sufficiently small, the investor makes a profit.

From (14), $\partial\pi^N/\partial S = \tilde{\theta}$. This has some interesting implications. For example, if $\theta < a$, then an increase in y reduces the investor's profit. Furthermore, it implies that the interest rate can be decreasing ($\theta < a$) or increasing ($\theta > a$) in y. In contrast, with self-interested investors ($a = 0$), the interest rate is always increasing in y.

Proposition 4 (Equivalence result) *For $\theta \geq a$ the model is observational equivalent to a model with self-interested investors ($a = 0$) that have bargaining power $\tilde{\theta} < \theta$.*

According to Proposition 4 if $\theta \geq a$, the model is observational equivalent to a model where the investor has no altruistic preferences ($a = 0$) and bargaining power $\tilde{\theta}$ since the two models deliver the same interest rates and the same nonnegative profits. Furthermore, from (8), the borrower surplus is the same in both models. This result allows as to show graphically the equivalence result in Figure 2. For $\theta < a$, this replication is not possible because the investor makes a financial loss which is not incentive feasible in a model without altruistic preferences.

2.4 Financial inclusion

In the following we discuss how altruistic investors affect financial inclusion. Recall from (7) that in standard model with self-interested investors all projects are financed

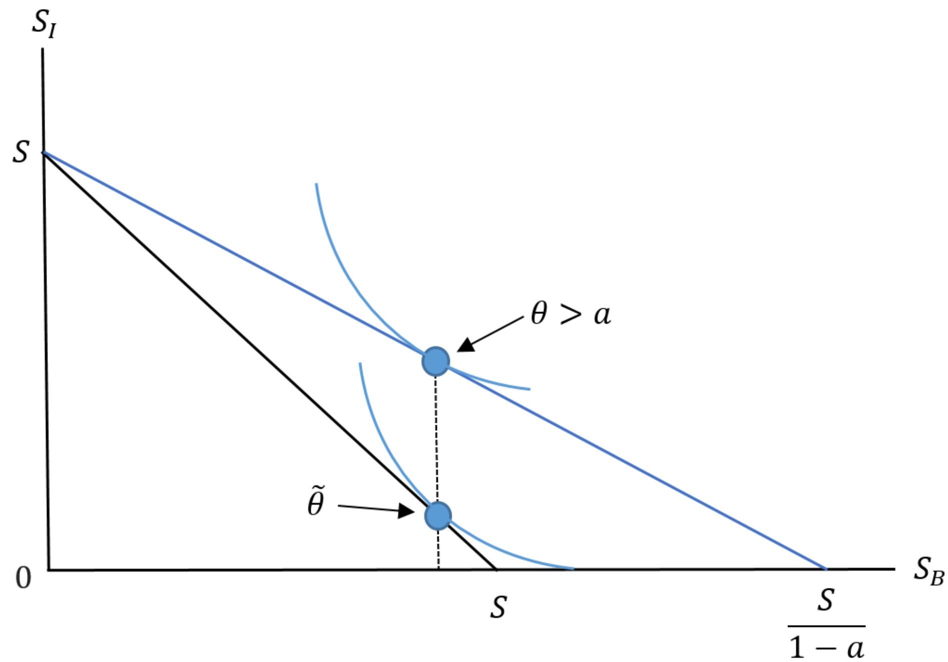

Figure 2: Equivalence result.

that satisfy $S \geq 0$. Improving financial inclusion would require that investors are willing to finance additional projects; i.e., projects with $S < 0$. This is a priori not impossible because as previously shown altruistic investors are willing to finance projects that are not profitable to them.

Proposition 5 (Financial inclusion) *Consider any efficient pricing mechanism. Then, altruistic investors do not improve financial inclusion.*

According to Proposition 5, altruistic investors do not improve financial inclusion for any efficient pricing mechanism. To see this, rewrite (10) as follows:

$$S = S_I + (1-a)S_B. \tag{15}$$

Financing a project with $S < 0$ would require that either $S_I < 0$, $S_B < 0$, or both. However, any of these cases would be inconsistent with individual rationality. Thus, with altruistic preference only projects with $S \geq 0$ are financed. The same projects also receive funding in a model with self-interested investors ($a = 0$). This clearly shows that altruistic preferences do not affect the type of projects that are financed. They have, however, important distributional consequences which we discuss further below.[12]

2.5 Distributional effects

We now study how the individual surpluses react to various parameter changes for the asymmetric Nash bargaining solution. In order to derive closed form solutions for the individual surpluses, use (14) to rewrite (8) as follows:

$$S_B = \frac{1-\theta}{1-a} S \text{ and } S_I = \theta S. \tag{16}$$

Interestingly, the altruistic preference parameter a has no effect on the investor's surplus. It only affects the borrower's surplus positively. $S_I = \theta S$ implies that all benefits of an increase of the altruistic preference parameter a accrue to the borrower. A constant S_I is only possible if an increase in a decreases the investor's profit by the amount that holds the investor's surplus constant.

3 Extensions

In this section we first explore in more depth the relation of our model to the Nash bargaining solution. We then introduce non-zero threats points and discuss the effects of joint liability.

3.1 Nash bargaining

A few shortcuts have been taken when deriving the model and the results. Here we connect our analysis more closely to the Nash bargaining model (Nash, 1953). As described in Binmore et al. (1986) "in a two-person bargaining situation, there is a set X of possible agreements, where $x \in X$ specifies the physical consequences to the two parties if x is agreed upon by both." In the context of our model, the possible agreements are how to divide the output of the project y. Accordingly, the set of possible agreements is

$$X \equiv \{(x_I, x_B) \geq (0,0) : x_B + x_I \leq y\},$$

[12] In an earlier version of the paper the gross returns of the project were random and stochastically independent. We also found that altruistic preferences do not affect the type of projects that are financed. This confirms the finding of Freedman and Jin (2017), which emphasize that loans to borrowers who miss payments is a mistake which supports the argument that altruism does not intentionally expand access.

where we assume that is not possible to allocate negative amounts. This implicitly requires that the altruistic preference parameter is not too large, see condition (5).

Furthermore, according to Binmore et al. (1986) Nash describes the "bargaining problem by using only the information contained in a pair of utility functions u_1, u_2, which represent the parties' preferences over X, and a pair of utility levels that are referred to variously as the status quo, the disagreement point, or the threat point." In the context of our application, the bargaining problem is represented by the pair (d, U) where

$$U \equiv \{(u_I(x_I), u_B(x_B)) : (x_I, x_B) \in X\}$$

is the bargaining set and $d \in U$ is the disagreement point.

The symmetric Nash bargaining solution is the unique element in U that maximizes the Nash product[13]

$$\left(x_I^N, x_B^N\right) = \arg\max(u_I(x_I) - d_I)(u_B(x_B) - d_B).$$

The unique pair $\left(x_I^N, x_B^N\right)$ that maximizes the Nash product is called the symmetric Nash bargaining solution. The generalized Nash bargaining solution removes the symmetry axiom (Roth, 1979) from the axiomatization of the Nash bargaining solution. It solves

$$\left(x_I^N, x_B^N\right) = \arg\max(u_I(x_I) - d_I)^{\theta}(u_B(x_B) - d_B)^{1-\theta},$$

where θ introduces different weights to the players. Binmore et al. (1986) show that the asymmetric Nash bargaining solution can be approximated by assuming that the players have different time intervals for making counter offers in the strategic alternating offer bargaining game.

Our main departure from the standard use of the asymmetric Nash bargaining solution is that we assume that the investor's utility depends not only on the absolute gains that he may achieve, but also on the gain achieved by the borrower. That is, we solve

$$\left(x_I^N, x_B^N\right) = \arg\max(u_I(x_I, x_B) - d_I)^{\theta}(u_B(x_B) - d_B)^{1-\theta}.$$

Furthermore, we assume that the threat points are $(d_I, d_B) = (0, 0)$ and that the utilities satisfy

$$(u_I(x_I, x_B), u_B(x_B)) = (x_I - \rho + a(x_B - u), x_B - u).$$

Finally, recall our definitions $S \equiv y - u - \rho$ and $\pi \equiv x_I - \rho$. This allows us to rewrite the utilities (surpluses) as in equation (8).

[13]Nash (1953) demonstrated that this is the unique bargaining solution satisfying the axioms of scale invariance, symmetry, efficiency, and independence of irrelevant alternatives.

3.2 Positive threat points

Binmore et al. (1986) show that the Nash bargaining solution can be attained from an explicit strategic bargaining model of the sort developed by Rubinstein (1982) when the time between offers and counteroffers vanishes, where U and d depend on details of the strategic environment. The specification of the disagreement point d in the bargaining depends on whether there is a risk of an exogenous breakdown in Rubinstein's alternating offer bargaining game. One example for an exogenous breakdown is when individuals continue to meet other potential trading partners between bargaining rounds and might switch partners as in Berentsen et al. (2002). In this case, there is a chance that the bargaining partner meets an other player and leaves the bargaining table and the abandoned player consumes his threat point. If there is no risk of an exogenous termination, then $d = (0,0)$. This is what we assumed in (11).

If there is an exogenous probability that the negotiation is terminated, then the threat point d should reflect what the players get if such a breakdown occurs (see Binmore et al. (1986)). To explore this possibility, we assume that $d = (d_I, d_B) \in U$. For example, assume that the borrower gets utility d_B from implementing the project himself. Assume further that the investor gets utility d_I from investing in an alternative project.

With these assumptions the surpluses satisfy $S_B = S - \pi - d_B$ and $S_I = aS + (1-a)\pi - d_I$, and the solution to the bargaining problem π^N yields

$$\pi^N = \tilde{\theta} S - \theta d_B + \frac{(1-\theta)}{1-a} d_I, \tag{17}$$

which is consistent with the well known result that an increase of a player's threat point benefits that player. Note that $\frac{\partial \pi^N}{\partial a} = -\frac{1-\theta}{(1-a)^2}(S - d_1)$. Thus, the disagreement point d_I dampens the negative effect that an increase of the altruistic parameter a has on the investor.

3.3 A negative threat point for the investor

In the main part of the paper we have assumed that the threat points are $(d_I, d_B) = (0,0)$ and that the utilities satisfy

$$(u_I(x_I, x_B), u_B(x_B)) = (x_I - \rho + a(x_B - u), x_B - u).$$

It is easy to show that the following alternative assumptions yield exactly the same results, namely $(d_I, d_B) = (-a(x_B - u), 0)$ and that the utilities satisfy

$$(u_I(x_I), u_B(x_B)) = (x_I - \rho, x_B - u).$$

There are two changes. First, the investor has no altruistic preferences. Second, he has a negative threat point. The Nash bargaining solution requires that $(d_I, d_B) \in U$. This is not the case here but we could change X to allow for negative quantities x_I for the investor. This change would imply that the investor has some extra resources available that he can add to the bargianing table.

What is the interpretation of a negative threat point? The investor's threat point is the utility he obtains if the negotiation breaks down because the borrower finds another bargaining partner. With $d_I = -a(x_B - u)$, his threat point depends on the utility that the borrower will get from the ne partner multiplies by the parameter a. We conclude our discussion here and leave the interpretation of a negative threat point to future research.

3.4 Joint liability

In an extension of the model Berentsen and Markheim (2019) introduce joint liability contracts and stochastic returns of the projects by assuming that one investor is matched with two borrowers.[14] If one borrower cannot repay the loan, then the other borrower if successful will have to pay c, with $0 \leq c \leq x_I$, to partially compensate the investor for the failure of one of the projects. We find that the joint liability parameter c does not improve financial inclusion.

4 Summary

We introduce altruistic investors and microentrepreneurs who need funding into a peer-to-peer model of credit intermediation. In order to determine the terms of the loans we consider efficient pricing mechanisms. The model sheds light on how new technologies such as peer-to-peer lending platforms with altruistic investors affects borrowing conditions, financial inclusion and the surpluses of investors and borrowers.

The altruistic preference of the investor is captured by the altruistic parameter a where a higher a means that the investor cares more about the well-being of the borrower. We find the following: First, for any efficient pricing mechanism altruistic investors do not promote financial inclusion. Second, altruistic investors offer better terms to borrowers since an increase in a reduces the interest rate. Third, an investor

[14] Armendariz (2010) and Markheim (2018) provide an overview into the modeling of debt contracts with joint liability in the context of microfinance.

with strong altruistic preferences is willing to finance a project that generates a loss to him.

Using the asymmetric Nash bargaining solution to determine the interest rate we find that for a certain range of the parameter a, the model's allocation is observationally equivalent to a model without altruistic preferences and low investor bargaining power. In this range, the model can replicate any allocation that the bargaining model without altruistic investors is able to attain. For some different range of a, however, the bargaining model generates allocations that are not incentive feasible in the same bargaining model without altruistic investors.

5 Appendix

Proof of Proposition 2 Define the set of Pareto efficient surplus pairs as follows:

$$\mathcal{P} \equiv \{(S_I, S_B) \geq (0,0) : S_I = S - (1-a)S_B\},$$

where

$$S_I \in [0, S] \text{ and } S_B \in \left[0, S(1-a)^{-1}\right].$$

The sets of feasible surplus pairs is defined as follows:

$$\mathcal{F} \equiv \{(S_I, S_B) : y = x_I + x_B \text{ and } x_I \in [0, y]\}.$$

Using (1) and (4) one can show that feasibility requires that.

$$S_I \in [aS - (1-a)\rho, S + (1-a)u)] \text{ and } S_B \in [-u, y-u].$$

Feasibility of all Pareto efficient surplus pairs requires that $\mathcal{P} \subseteq \mathcal{F}$. Consider the borrower first. Here, feasibility requires that

$$\left[0, S(1-a)^{-1}\right] \subseteq [-u, y-u]$$

Evidently, the lower bound of the first interval is an element of the second interval since $0 \geq -u$. The upper bound of the first interval is an element of the second interval if $S(1-a)^{-1} \leq y - u$. Rewrite this inequality to get $a \leq \rho(y-u)^{-1}$.

Along the same line, the investor's surplus must satisfy

$$[0, S] \subseteq [aS - (1-a)\rho, S + (1-a)u)]$$

Evidently, the upper bound of the first interval is an element of the second interval. The lower bound of the first interval is an element of the second interval if $aS - (1-a)\rho \leq 0$. For this inequality to hold, we also need $a \leq \rho(y-u)^{-1}$. Finally, note that $\rho(y-u)^{-1} \leq 1$ since $S \geq 0$.

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