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Berentsen, Aleksander and Markheim, Marina

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Aleksander Berentsen*
Marina Markheim†

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Abstract

Peer-to-peer lending platforms are increasingly important alternatives to traditional forms of credit intermediation. These platforms attract projects that appeal to socially motivated investors. There are high hopes that these novel forms of credit intermediation 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 where the terms of the loans are determined through bilateral bargaining. We find that altruistic investors do not improve financial inclusion in the sense that all projects that are financed by altruistic investors are also financed by rational investors. Altruistic investors offer, however, better borrowing conditions in the sense that the borrowing rates with altruistic investors are always lower in comparison to the ones obtained with rational investors. Furthermore, investors with strong altruistic preferences are willing to finance projects which generate an expected financial loss. We also introduce joint liability contracts and we find that they increase borrowing rates and have no effects on the surpluses of borrowers and investors. Finally, for a certain range of parameters the model's allocation is observationally equivalent to a model with rational investors that have low bargaining power. Outside of this range, the model generates equilibrium allocations that are not incentive feasible in a model with rational investors which is interesting from the point of view of pure bargaining theory.

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

*Univercity of Basel; Faculty of Business and Economics, Peter Merian-Weg 6, 4002 Basel; E-Mail: aleksander.berentsen@unibas.ch

†University of Basel and University of Regensburg, E-Mail: marina.markheim@unibas.ch

1 Introduction

In classical asset pricing models investors base their investment decisions on risk and expected returns. Recent empirical evidence suggest that investors also incorporate many non-financial considerations into their investment decisions such as religious, social and political values as well as social norms (Hong and Kacperczyk, 2009; Hong and Kostovetsky, 2011; Pfeifer, 2010). The Forum for Sustainable and Responsible Investment (US SIF) emphasizes that personal values have a large impact on individual investment decisions. Increasingly, socially responsible investors constitute an important part of financial markets. In 2018, roughly 12 (USD) trillion were invested with socially responsible investing mandates (US SIF, 2018).[1]

Peer-to-peer lending platforms and crowdfunding platforms have established themselves as an alternative to traditional forms of credit intermediation. These platforms attract projects that appeal to socially motivated investors, who do not only focus on the expected return and risk of a project but who also base their investment decision on other considerations.[2] There are high hopes, therefore, that these novel forms of credit intermediation improve financial inclusion and provide "fairer" terms for borrowers.

To study these hopes, we introduce altruistic investors and microentrepreneurs into a peer-to-peer model of credit intermediation. The terms of the loans are determined through bilateral bargaining. The key take aways are that altruistic investors do not improve financial inclusion in the sense that all projects that are financed by altruistic investors are also financed by rational investors. Altruistic investors offer, however, "fairer" borrowing conditions in the sense that the borrowing rates with altruistic investors are always lower in comparison to the ones obtained with rational investors. We also find that investor with strong altruistic preferences are willing to finance projects which generate an expected financial loss. Finally, for a certain range of the parameter that represents altruism, the model's allocation is observationally equivalent to a model with rational investors with low bargaining power. In this range, the model can replicate any allocation that can be achieved in

[1] Experimental evidence also suggest that investors' preferences for social norms affect their investment decisions. For instance, Riedl and Smeets (2017) find that social preferences are positively correlated to holdings in socially responsible investment mutual funds. Along the same lines, Brodback et al. (2019) investigate the effects of altruistic preferences on investment decisions and explain the coexistence of monetary and social returns. They show that altruistic persons are willing to accept financial losses for social returns.

[2] New technologies such as peer-to-peer lending platforms and crowdfunding platforms offer new forms of financial intermediation such as donation-based, equity-based and reward-based funding (e.g., Kiva.org).

a bargaining model with rational investors. Outside of this range, the model generates equilibrium allocations that are not incentive feasible in a model with rational agents which is interesting from the point of view of pure bargaining theory.

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 risky project in $t = 0$. The gross returns of the projects are random and stochastically independent: with probability p the gross return of a project is $y > 0$. With probability $1 - p$ the project fails and $y = 0$.

Borrowers are risk-neutral. In order to carry out their projects, each borrower needs to borrow one unit of an indivisible capital good. The real interest paid on the loan is r. We abstract from private information issues and assume that borrowers repay their loans if their projects succeed. In what follows we consider a match between a representative investor and a representative borrower.

The borrower's expected surplus is

$$S_b = p\left[y - (1 + r)\right] - u, \tag{1}$$

where u is an effort cost for implementing the project.[3] The term $p\left[y - (1 + r)\right]$ is the expected net return of the project since py is the expected return and $p(1 + r)$ is the expected payment to the investor. The borrower's participation constraint is

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

Each investor is endowed with one unit of and indivisible capital good in period $t = 0$. This unit can be either invested in a borrower's risky project or in a risk free project, where ρ is the economy wide risk-free real gross interest rate. The investors are risk neutral with altruistic preferences. The representative investor's expected surplus is

$$S_i = p(1 + r) + aS_b - \rho. \tag{3}$$

The investor's expected surplus depends on the expected return of his investment $p(1+r)-\rho$ plus the altruistic term aS_b. The altruistic parameter $1 > a \geq 0$ measures how strongly the investor cares about the borrower's surplus. Throughout the paper we call an investor with $a > 0$ an altruistic investor and we call an investor with

[3] An another interpretation of the term u is that it represents the borrower's reservation utility.

$a = 0$ a rational investor. This simple form of representing altruistic preferences is based on Levine (1998). In Section 3, we discuss it in more detail.

The investor's participation constraint is

$$S_i \geq 0. \tag{4}$$

Note that the investor's utility from the outside option is independent of the parameter a. This reflects the fact that the investor only has altruistic preferences towards certain projects or certain borrowers.

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 expected return py that covers the utility cost of the borrower u plus the outside option of the investor ρ. That is,

$$s \equiv py - \rho - u \geq 0. \tag{5}$$

One of the issues we discuss throughout the paper is whether inequality (5) 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.

We can rewrite the investor's participation constraint (4) as follows

$$p(1 + r) \geq \rho - \frac{as}{1 - a}. \tag{6}$$

If inequality (6) is satisfied, the investor is willing to provide the capital good. In a standard model of financial intermediation (for $a = 0$), the inequality reduces to $p(1 + r) \geq \rho$. In this case, the investor is willing to provide capital if the expected return $p(1 + r)$ covers at least the risk free rate ρ. The altruistic parameter a lowers the right-hand side of (6). This implies that an altruistic investor is willing to accept a lower interest rate for the project than an investor with no altruistic preferences.

In what follows, we define the expected profit of the investor as

$$\pi \equiv p(1 + r) - \rho \tag{7}$$

In a standard model of financial intermediation an investor requires a positive expected profit in order to be willing to invest.

From (6), there exists a critical interest rate $1 + r^*$ such that the investor is indifferent between providing and not providing the capital good:

$$p(1 + r^*) = \rho - \frac{as}{1 - a}. \tag{8}$$

The interest rate r^* is the interest rate that one would obtain in a model with many investors and few borrowers under Bertrand price competition. In such a market, the investor obtains no surplus. Note that the interest rate is decreasing in a and satisfies $\pi < 0$ for all $a > 0$. Thus, with altruistic preference and Bertrand price competition, investors are willing to accept a financial loss.

In what follows, we consider bilateral bargaining between an investor and a borrower (see Binmore et al., 1986). The parameter $1 \geq \theta \geq 0$ is the bargaining power of the investor. The Nash bargaining solution satisfies

$$r^n = argmax_r (S_i)^\theta (S_b)^{1-\theta},$$

and the first-order condition is

$$\frac{S_b}{S_i} = \frac{(1-\theta)}{\theta(1-a)}. \tag{9}$$

Use (1) and (3), to rewritten (9) as follows:[4]

$$\frac{py - p(1+r^n) - u}{p(1+r^n)(1-a) + a(py-u) - \rho} = \frac{(1-\theta)}{\theta(1-a)}. \tag{10}$$

Solving equation (10) for $p(1+r^n)$ yields

$$p(1+r^n) = \rho + \tilde{\theta} s, \tag{11}$$

where $\tilde{\theta} \equiv (\theta - a)/(1-a)$. Note that if the borrower has all the bargaining power ($\theta = 0$), then the interest rate equals the one that is obtained under Bertrand price competition (see (8)). Furthermore, if the investor has rational preferences ($a = 0$), then $p(1+r^n) = \rho + \theta s$. In this case, the investor makes an expected profit since $p(1+r^n) - \rho = \theta s \geq 0$. Finally, $\pi = 0$ if $\theta = a$.

Proposition 1 (Interest rate and Profits) *Properties of the bargaining solution: (i) r^n is decreasing in a. (ii) For $\tilde{\theta} < 0$ ($a > \theta$), the investor is willing to accept a financial loss. (iii) For $\tilde{\theta} > 0$ ($\theta > a$), the investor makes a financial profit and the model is observational equivalent to a model without altruistic investors ($a = 0$) and bargaining power $\tilde{\theta}$.*

[4] The second derivative with respect to r is negative if $s > 0$. Accordingly, the first-order condition (9) describes a maximum.

Proposition 1 summarizes the key properties of the model. According to (i), altruistic investor preferences lower the borrowing costs since $\tilde{\theta}$ is decreasing in a. This is consistent with experimental evidence reported in Brodback et al. (2019). According to (ii), for a sufficiently large a, the investor is willing to provide financing even though he makes an expected loss. This finding is consistent with the experimental findings in Riedl and Smeets (2017). Finally, according to (iii), if a is sufficiently small ($\theta > a$), the investor makes an expected profit. In this case, we get the same interest rate as in a model without altruistic preferences ($a = 0$) and bargaining power $\tilde{\theta} > 0$. For $\theta < a$, the interpretation of this equivalence is less straightforward because in this case the investor makes an expected financial loss which is not incentive feasible in a model without altruistic preferences.

In the following we discuss how altruistic investors affect financial inclusion. Recall from (5) that in standard model with rational investors all projects are financed 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 priory not impossible because according to Proposition 1 altruistic investors are willing to finance projects that make an expected loss.

Proposition 2 (Financial Inclusion) *Altruistic investors do not improve financial inclusion.*

One can easily show that the participation constraint of the investor is always satisfied since it only requires that $\theta \geq 0$. The borrower's participation constraint is satisfied if

$$s \geq 0. \tag{12}$$

To see this use equation (11) to rewrite the borrower's participation constraint (2) to get (12). Thus, neither the altruistic preference parameter a nor the bargaining parameter θ can lead to a situation where projects with $s < 0$ are carried out.

Proposition 2 has a straightforward interpretation with respect to financial inclusion. In a classic model with rational investors ($a = 0$), all projects with $s \geq 0$ are implemented. The same is true with altruistic preferences. 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 in the following sections.

Some additional properties of the bargaining solution are presented in Proposition 3.

Proposition 3 (Additional Properties) *Additional properties of the bargaining solution:*

(i) $\partial(1+r^n)/\partial y = \tilde{\theta} < 0$ *if* $a > \theta$;
(ii) $\partial(1+r^n)/\partial u = -\tilde{\theta}/p < 0$ *if* $\theta > a$;
(iii) $\partial(1+r^n)/\partial \rho = 1+\tilde{\theta} > 0$ *and* $\partial(1+r^n)/\partial\theta = s/(1-a) > 0$.

According to (i), the effect of an increase of the output y on r^n depends on the sign of $\tilde{\theta}$. If a is sufficiently large ($a > \theta$), then $\tilde{\theta} < 0$ and the interest rate is decreasing in y. In contrast, if $\theta > a$, then $\tilde{\theta} > 0$ and an increase in y increases the interest rate. According to (ii), the effect of an increase of the borrower's outside option u on r^n depends on the sign of $\tilde{\theta}$ as well. If $\theta > a$, then $\tilde{\theta} > 0$ and an increase in u decreases the interest rate (since s is decreasing in u). For $a = 0$, this is clearly the case. In contrast, if $\theta < a$, then $\tilde{\theta} < 0$, and an increase in u increases the interest rate. We will discuss this result in more detail when we study the investor and borrower surpluses. According to (iii), an increase in the investor's outside option ρ increases the interest rate r^n. Note also that an increase in the investor's bargaining power θ increase the interest rate r^n as well.

2.1 Total surplus effects

We now study how the total surplus and the individual surpluses react to various parameter changes. The total surplus is $TS = S_i + S_b$. Use equation (9) we can write it as follows:

$$TS = \frac{1-\theta a}{(1-\theta)} S_b = \frac{1-\theta a}{\theta(1-a)} S_i. \tag{13}$$

By using equations (1) and (11) we can write (13) as follows:

$$TS = \frac{1-\theta a}{1-a} s. \tag{14}$$

The following results emerge emerge from (14): First, for $a = 0$, $TS = s$. Second, the same result is also attained for $\theta = 1$. That is, if the investor has all the bargaining power, the altruistic preference parameter a has no effect on the total surplus of the match. Third, increasing a has a positive effect on TS. Fourth, increasing θ has a negative effect on TS. Finally, increasing s has a positive effect on TS.

2.2 Distributional effects

In order to derive the distributional effects of changes in parameters, we have to derive S_i and S_b. Use equation (14) to rewrite (13) as follows:

$$S_b = \frac{1-\theta}{1-a} s \text{ and } S_i = \theta s. \tag{15}$$

There are several interesting results that emerge from (15). First, the altruistic preference parameter a has no effect on the investor's surplus. It only affects the borrower's surplus positively. A constant S_i is only possible if an increase in a decreases the interest rate by the amount that holds the investor's surplus constant. That is, an investor obtains more direct utility from a higher a and lower utility from a lower interest r. Second, an increase in s benefits both agents. If $(1-\theta)/(1-a) > \theta$, the borrower benefits more than the investor. This is the case if the altruistic parameter is sufficiently large, that is if $a > 2 - 1/\theta$, or if the bargaining power of the investor is sufficiently low, that is $\theta < 1/(2-a)$. Third, increasing θ increases the investor's surplus and decreases the borrower's surplus.

3 Discussion and Extension

In this section we show how we can derive our preferences from the more general approach of Levine (1998). We also introduce joint liability contracts and show how they affect out results.

3.1 Altruistic preferences

A generally valid utility function representing social preferences does not exist.[5] For this paper, we have chosen a simple and well-known utility function to represent altruistic preferences. It has been proposed by Levine (1998) and formalizes altruistic preferences as follows:

$$U_i = u_i + \sum_{j \neq i} \frac{a_i + a_j \lambda}{1 + \lambda} u_j. \tag{16}$$

In a multiperson setting, the coefficient $-1 \leq a_i \leq 1$ for $i \in \{1, ..., I\}$ measures person i's altruistic preferences towards person j, $j \neq i$. The multiplicative term $a_i u_j$ simply means that agent i's utility depends on the utility of person j. The factor $0 \leq \lambda \leq 1$ is a weighting of the parameter a_i against a_j. If $\lambda > 0$ is positive, an altruistic agents with $a_i > 0$ sympathizes more strongly with agent j who has also altruistic preferences ($a_j > 0$) than with an agent j who has no altruistic preferences $a_j = 0$. For $a_i, a_j = 0$ equation (16) reduces to rational preferences.

[5]For instance, Fehr and Fischbacher (2002, C2-C4) characterize the term social preferences and they differentiate between the following emotional characteristics: (1) reciprocity, (2) aversion to inequality, (3) envy and malicious joy, and (4) altruism and (5) shame and guilt. In our paper we focus on altruistic preferences.

In our model, only the investor has altruistic preferences and so $a_j = 0$ and $\lambda = 0$. Thus, for an investor i matched with a borrower j equation (16) simplifies to

$$U_i = u_i + a_i u_j. \tag{17}$$

3.2 Extension: Joint liability

In this section we consider a joint liability contract. One investor is matched with two borrowers. If one borrower cannot repay the loan, then the other borrower if successful will have to pay c, with $0 \leq c \leq 1 + r$, to partially compensate the investor for the failure of one of the projects.[6] For this extension, we assume that c is exogenous. We can easily extend the analysis by assuming that c is also determined in bargaining problem that follows. We continue to assume that borrowers honor their promises if their projects are successful. In this setting a representative borrower's surplus with a joint liability loan contract is

$$S_b = p^2 [y - (1 + r)] + p (1 - p) [y - (1 + r) - c] - u. \tag{18}$$

With probability p^2 both borrowers are successful and borrower j pays $1 + r$. With probability $p(1-p)$ only borrower j is successful. In this case, she makes the payment $1 + r + c$. With probability $(1 - p)$ her project fails and she makes no payment. Simplifying equation (18) yields

$$S_b = p [y - (1 + r)] - u - p(1 - p)c. \tag{19}$$

The borrower's participation constraint is $S_b \geq 0$. Evidently, joint liability as expressed by the parameter c tightens the borrower's participation constraint for a given r.

The investor's surplus satisfies

$$S_i = 2 \left\{ p^2(1 + r) + p(1 - p)(1 + r + c) + aS_b - \rho \right\}. \tag{20}$$

With probability p^2 both projects are successful and both borrowers repay their debts. With probability $p(1 - p)$ only one project is successful and the investor receives the payment $1 + r + c$. With probability $(1 - p)^2$ both projects fail and no payment is made. The third term in equation (20) is the altruistic part of the investor's preferences as explained in the introduction. The multiplicative term 2

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

reflects the fact that the investor has invested into two projects. Equation (20) can be simplified as follows:

$$S_i = 2\left[p(1+r) + p(1-p)c + aS_b - \rho\right]. \tag{21}$$

The investor's participation constraint $S_i \geq 0$. Solving for $p(1+r)$ yields

$$p(1+r) \geq \rho - \frac{as}{1-a} - p\,(1-p)\,c. \tag{22}$$

Evidently, the joint liability parameter c relaxes the investor's participation constraint for a given r. There exists a critical interest rate $1 + r_J^*$, such that the investor is indifferent between providing and not providing the loan

$$p(1+r_J^*) = \rho - \frac{as}{1-a} - p\,(1-p)\,c. \tag{23}$$

Note that we obtain the same expression as in (8) except for the term $p\,(1-p)\,c$.

In order to derive the Nash bargaining solution, we assume that the two borrowers act as a single entity. The joint surplus of the two borrowers is $2S_b$ where S_b satisfies

$$S_b \equiv p\,[y - (1+r)] - p\,(1-p)\,c - u. \tag{24}$$

The Nash bargaining solutions is

$$r_J = argmax_r (S_i)^{\theta}(2S_b)^{1-\theta},$$

where $1 + r_j$ satisfies

$$p(1+r_J) = \rho + \tilde{\theta}s - p(1-p)c. \tag{25}$$

Comparing (25) with (11), we immediately see that the only difference is the term $p(1-p)c$: The only effect that the joint liability parameter c has is to reduce the interest rate. Accordingly, all results presented in Propositions 1 and 3 continue to hold. Furthermore, one can also one show that the borrower's participation constraint $py - p(1+r) - p(1-p)c \geq u$ continues to hold for $s \geq 0$. Thus, the joint liability parameter c does neither affect the type of projects that are implemented, that is it does not affect financial inclusion. Finally, we find that the joint liability parameter c does not affect the individual surpluses nor the total surplus. However, as discussed before, it decrease the interest rate. It does this in a way that keeps the individual surpluses constant.

4 Summary

We introduce altruistic investors and microentrepreneurs who need funding into a peer-to-peer model of credit intermediation. The terms of the loans are determined through bilateral bargaining. 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 wellbeing of the borrower. We find the following: First, altruistic preferences have no effect on the type of projects that are financed. Accordingly, altruistic investors do not promote financial inclusion. Second, an increase in a reduces the interest rate. Thus, altruistic preferences benefit borrowers by reducing the interest rates that are negotiated between investors and microentrepreneurs. Third, an investor with strong altruistic preferences is willing to accept an expected financial loss. Fourth, we find some interesting distributional effects. For example, the investor's surplus is independent of a. In contrast, the borrower's surplus is increasing in a.

The model also generates results that are of interest from the point of view of bargaining theory. For a certain range of the parameter a, the model's allocation is observationally equivalent to a model with rational preferences and low investor bargaining power. In this range, the model can replicate any allocation that a bargaining model with rational investors is able to attain. For some different range of a, however, the model generates allocations that are not incentive feasible in the same bargaining model with rational investors. Finally, we also introduce joint liability contracts but we find that they have no effects on the well-being of borrowers and investors as measured by their surpluses.

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