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University of Kent

Charitable Giving or Signalling? Voluntary Contributions by Microcredit Borrowers in Pakistan

December 2018

Abstract

This paper investigates charitable giving by atypical donors in an unusual setting: the donors are microfinance recipients who provide charitable contributions to their lender, a non-profit institution. The institution provides interest-free loans but encourages its borrowers to make a voluntary contribution of any amount with the monthly instalment for principal repayment. Analysis of these monthly voluntary contributions suggests that the institution rewards borrowers for their contributions by giving them repeat loans. In particular, borrowers on joint liability loans in poorly performing groups make larger contributions using individual contributions to override a group-level signal. We develop a theory to show that this giving behaviour is consistent with borrowers signalling their level of success with the loan, but inconsistent with other explanations, including purely altruistic motives for giving. We argue that this mechanism of signalling success can provide the basis for a potential innovation in providing financial services in the presence of informational asymmetries.

JEL codes: O12, O16, D64

Keywords: Microfinance, Charitable Giving, Signalling, Altruism, Non-Profit Organisations

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Declarations of interest: none

1 Introduction

Contracting problems serve as a significant impediment to the efficient functioning of financial markets in developing countries (Stiglitz and Weiss, 1981; Besley, 1994; Banerjee, 2003). A well-established literature has identified problems of contract enforcement, limited liability, adverse selection and moral hazard as major reasons behind failure in credit and insurance markets. A range of contractual arrangements in traditional settings (e.g. interlinked transactions, long-term contracts, quasi-credit) has been considered as second-best solutions to these contracting problems (Basu, 2003; Ray, 1998; Bardhan and Udry, 1999). Contractual innovations such as group lending, index insurance and dynamic incentives in a variety of settings, have been assessed in terms of their potential to mitigate these problems (Karlan and Morduch, 2010).

In this paper we examine, both theoretically and empirically, an innovative mechanism for addressing the problem of imperfect information in credit markets that hitherto has received little attention in the literature: signalling via voluntary contributions by borrowers. Our work explores this issue by examining a unique, detailed database from a microfinance institution (MFI) in Pakistan. The MFI does not charge interest on loans but encourages borrowers to make voluntary contributions every month together with instalments for loan repayment. These voluntary contributions amount to an implicit interest rate of about 4.5%.[1] By comparison, South Asian MFIs charge interest rates of about 15% to 20%.[2] The revenues generated by these voluntary contributions are smaller than those obtained from typical fixed interest loan products used by MFIs in the region, but the amounts are not insignificant. Monthly data on borrowers' voluntary contributions through the loan cycle, together with data on repayment and repeat borrowing, provides a rich source of information to investigate possible motives behind these contributions.

We develop a theoretical model where voluntary contributions by borrowers give them

[1] The annualised monthly implicit rate is calculated as the ratio of the average monthly contribution to the average monthly repayment instalment.

[2] Microfinance Information Exchange.

satisfaction (due to a 'warm glow' effect) but also signal to the lending organisation their level of success with existing loans. The organisation updates its beliefs about the borrower's ability based on voluntary contributions which, in turn, affect repeat lending decisions.

Our empirical analysis of voluntary contributions uncovers a number of patterns consistent with a signalling story. First, towards the end of the loan cycle, a divergence emerges in voluntary contribution behaviour between borrowers who go on to take another loan and those who do not. We hypothesise that in this period a signalling motive provides the dominant reason for giving; those who have been successful in their investment projects give more to signal their quality. Second, controlling for repayment discipline, higher voluntary contributions during a loan cycle increase the probability of loan renewal, and - in the case of joint liability loans - correlate with better repayment discipline[3] in the next loan cycle. Thus, consistent with a signalling story, voluntary contributions provide the lending institution with information that can be used to identify better-quality borrowers, above what can be inferred from information on repayment discipline alone.

Our findings indicate that voluntary contributions play a more important role in the case of joint liability loans (as a determinant of loan renewal and repayment discipline in subsequent loan cycles). This is consistent with the hypothesis that there is informational content in voluntary contributions, given that these contributions are made at the individual level while loan repayment occurs at the group level. In fact, we find that borrowers on joint liability loans make larger contributions when their group is not on time in making payments. This suggests that voluntary contributions provide borrowers with a way to signal individual quality independently of their group, and that signalling becomes more important when the group is performing poorly.

The MFI we study switched from individual to group lending during the sample period covered by the administrative dataset. Using the switch as a natural experiment, Mahmud (2015) finds that repayment behaviour, on average, is more disciplined under

[3]We measure repayment discipline using the percentage of instalments paid on time during a loan cycle.

joint liability compared to individual liability, potentially because of implicit risk-sharing within joint liability groups. While group repayment typically makes it difficult for a lender to observe the performance of individual borrowers, the present paper shows how voluntary contributions are implicitly being used to offset this informational disadvantage of joint liability.

Although we study voluntary contributions in the context of interest-free loans, we argue that our findings suggest potential innovations in a wider range of contracting situations in which there may be informational asymmetries regarding the ability of agents. One such situation is in factor market transactions in which payment for an input follows production. Voluntary contributions can be used to signal output that a lender or landlord may not otherwise observe; thus, these contributions potentially provide information about the producer's ability, and facilitate repeat transactions.

In the context of microfinance, Iyer et al. (2016) argue that providing borrowers the opportunity to send a credible signal can be useful for the screening process. Opoku-Agyemang and Foltz (2012) consider a borrower's behaviour in the repayment of a traditional savings product to be a signal for the optimal loan size for that borrower. While savings behaviour typically serves as a one-time signal, we argue that a system of voluntary contributions provides scope for borrowers to signal their quality in each loan cycle. In the conventional 'Grameen Bank-style' microcredit model, repayment discipline exhibited in a loan cycle arguably provides such a signal and is, typically, critical to the decision over whether to provide another loan. But this lending model has been the subject of significant criticism in recent times due at least in part to excessively high interest rates and the coercive methods often used to elicit repayment.[4] Our analysis suggests that a mechanism of voluntary contributions, coupled with lower interest-rate charges, can provide a more precise signal of borrower ability to the lender, and can produce cross-subsidisation between high- and low-ability borrowers. Additionally, such a mechanism can reduce the cost of collecting information to assess potential clients' quality; this, in turn, can have significant implications for the interest

[4]See Bateman and Chang (2012) for a comprehensive review.

rates that MFIs charge (Banerjee and Duflo, 2010). Borrowers may signal their ability to the lender by other means, but we argue these are not necessarily a close substitute for voluntary contributions. For example, while early loan repayment may also signal borrower ability, this is likely to be a costlier signalling method available only to the most successful borrowers.[5]

This paper is also related to the wider literature on charitable giving to institutions. Such donations constitute a significant expenditure out of individual disposable incomes in developed countries, and serve as a significant source of revenue for these institutions (Andreoni, 2006; Andreoni and Payne, 2013). The practice of giving is far more extensive than what models of pure altruism alone would predict (Andreoni, 1989). Recent literature provides evidence consistent with a variety of other motives, including social prestige (Harbaugh, 1998), wealth signalling (Glazer and Konrad, 1996) and social pressure (DellaVigna et al., 2012). In the case of developing countries, there is extensive research on charitable giving within the extended family and social networks (reviewed, for example, by Cox and Fafchamps (2007)). However, relatively little is known about charitable giving to institutions. Our setting is distinctive not only in terms of the relationship of the donor to the receiving institution, but also in terms of the financial status of the donors, who are members of a socio-economic group that is often the recipient rather than the provider of charity. While the existing literature has identified situations in which charitable giving is used to signal wealth and to acquire prestige, we are not aware of any evidence on charitable giving serving as a signal of productive ability.

The rest of the paper is organized as follows: Section 2 provides details about the lending organisation. Section 3 develops a model of the credit market in which voluntary contributions can potentially have a signalling motive. Section 4 presents the data., Section 5 describes the empirical strategy. We discuss the results in sections 5 and 6, and provide robustness checks in Section 7 using survey data. Section 8 examines whether alternative hypotheses, such as solidarity, reciprocity, or social

[5]In our dataset, only 14% of first-time borrowers pay off their loan early.

pressure, can account for our empirical findings. We provide conclusions in Section 9.

2 Organisational Background

In this section, we provide a brief description of the history, philosophy and lending practices of Akhuwat, the lending organisation that is the subject of our research. The description is based on information provided by branch office staff.

Akhuwat is a non-profit institution that began operations in 2001, in Lahore, Pakistan. The loan product is a small, interest-free loan to be repaid in equal, monthly instalments.[6] This is modelled around 'qarz-e-hassna' (literally, an interest free good loan), which refers to helping the poor through interest-free loans rather than through charitable gifts. In the initial years of operation, Akhuwat was essentially a philanthropic exercise to investigate how interest-free microfinance would fare. As the loan portfolio grew, the institution was formalised and registered under the Societies Registration Act of Pakistan. Today, the institution funds its operations through donations, and it holds several fund-raising events across the country (and in several other parts of the world).

Apart from providing loans with this interest-free feature, the institution operates like a regular MFI. Until March 2011 the loans had individual liability and required a guarantor, typically a neighbour of the borrower. The guarantor could not borrow until the completion of the loan cycle of the person he or she had guaranteed. The MFI switched to a joint liability model following complaints from the guarantors regarding this restriction. Group formation is based on self-selection but cannot include immediate family members. There is no restriction on the gender composition of the groups. Loans are disbursed simultaneously to all group members. The loans have strict joint liability in the sense that repayment instalments are accepted only if the payment corresponds to the full amount due for the group. When renewing loans, borrowers are not obliged to maintain the same group as before, but they can, and

[6]For example, for a loan of 10,000 rupees for a 10-month period, the amount due each month would be 1,000 rupees. If this is paid regularly over 10 months, then the loan cycle would be considered complete. There is no fixed charge over and above these monthly payments.

often do, form new groups. All instalments, whether individual or group, have to be paid at the local Akhuwat branch. The institution gives loans for what they define as 'productive' and 'non-productive' reasons. Loans given for non-productive reasons include all loans for personal expenditures (such as education or health), and loans taken out for businesses that the institution believes do not have the potential to grow (examples include vendors who sell fruits and vegetables on carts). Clients are permitted to borrow only once for a non-productive reason.

The MFI carries out a thorough background check of both the household and enterprise of loan applicants. All applications have to be accompanied by a National Identity Card, photos, and a recent utility bill. Once the application is complete, Akhuwat staff visit the applicant's household, where a Social Appraisal Form is completed. This form serves as a verification of the applicant's address, and also ensures that family members have knowledge of the loan application. The spouse or the parent of the borrower countersigns on the application. Thus, the entire family is involved in the decision. For productive loan applications, a business appraisal is conducted and detailed information on fixed and working capital is collected in order to assess the applicant's repayment ability. The Akhuwat staff also record the expected breakdown of expenditures from the total loan amount. The most salient eligibility criteria are the viability[7] of the proposed use of the loan, and the income adequacy of the household.[8]

An important feature that distinguishes the institution from other MFIs is its emphasis on social inclusion. *Akhuwat* means brotherhood in Urdu, and the institution's philosophy includes fostering a feeling of unity and a sense of ownership of the organisation in the communities where it works. The MFI regards voluntary contributions by borrowers â€“ who are asked to consider giving so that others like them can benefit from the organisation's work - as the final step in establishing a

[7]This is based on checks of the breakdown of the utilisation of the loan such as a check on the cost of any asset that the borrower has proposed to purchase.

[8]The household was required to have income above the threshold for being classified as 'very poor'. But, in conversations with the organisation, we found that the 'very poor' designation was not strictly defined, and we also found that such definitions varied among branches.

partnership with its clients. Contributions are made individually, typically when borrowers pay the monthly instalment, although contributions at other points in the loan cycle are also permitted. The organisation issues individual receipts for the exact contribution by each borrower, even if a single group member hands over the contributions of all borrowers in the group.

3 A Model of Voluntary Contributions

We develop a model of the credit market in which borrowers may have incentives to signal their ability by paying the lender (MFI) beyond the market interest rate. The argument is akin to that in Spence's signalling model (Spence, 1973) where workers invest in education to signal their ability to potential employers. Only borrowers who are able to earn a return above a certain threshold are able to make these contributions, thereby signalling their quality. They have an incentive to do this so as to obtain a larger repeat loan from the lender. MFIs have an incentive to screen on the basis of voluntary contributions because the process allows them to identify potential repeat borrowers who can take on larger projects at low risk.

Model Setup: Consider a population that can pursue different types of projects indexed by $j = 1, 2, ..., n$. A project of type j requires a total investment of size X_j and we assume that $X_j > X_{j-1}$ for each $j > 1$. Each individual in the population has an attribute we call 'ability', given by $k \in \{k_l, k_h\}$ where k_l denotes 'low ability' and k_h denotes 'high ability'. When an individual with ability k invests in a project of type j, it generates a stochastic output $\tilde{Y}_j$ which take values Y_j^h, Y_j^l and 0 – where $Y_j^h > Y_j^l > 0$ – with probabilities π_{jk}^h, π_{jk}^l and π_{jk}^f respectively. We assume that $\pi_{jh}^f < \pi_{jl}^f$ and $\frac{\pi_{jh}^l}{\pi_{jh}^h + \pi_{jh}^l} < \frac{\pi_{jl}^l}{\pi_{jl}^h + \pi_{jl}^l}$ for each j. In words these inequalities mean that, compared to an individual with low ability, an individual with high ability is less likely to 'fail' in a project (i.e. $\tilde{Y}_j = 0$) and, conditional on success, less likely to generate low output (i.e. $\tilde{Y}_j = Y_j^l$). Output from the project is obtained in two stages: at stage zero, an individual who invests in a project of type j obtains Y_j^l for successful projects

and zero for unsuccessful projects; at stage one, the individual obtains $\left(Y_j^h - Y_j^l\right)$ for projects with high output and zero otherwise. Thus, at stage zero, the individual learns whether the project is 'successful' or not and, at stage one, she learns, for successful projects, whether output will be 'low' or 'high'.

For simplicity, we assume that individuals have no liquid assets of their own that can be invested in the project and no intertemporal technology to save income from a preceding period. This assumption can be justified based on the argument and related evidence that poor households have difficulty saving up for lump sum investments due to temptations or pressures arising from social obligations (e.g. Banerjee and Mullainathan, 2010; Baland et al., 2011). We discuss the implications of relaxing this assumption in the Theoretical Appendix. In the absence of liquid assets, an individual needs a loan of size X_j to be able to invest in a project of type j.

There is a lender offering a menu of loan contracts of the form (X_j, R_j) for $j = 1, 2, ...$ where X_j denotes the size of the loan and R_j is the gross interest rate.[9] The lender's gross cost of capital is R_0. We consider individual liability loans as well as joint liability loans awarded to groups of two borrowers. We assume that $X_j R_j < Y_j^l < 2X_j R_j < Y_j^h$ and that repayment is due in two equal instalments, at stages zero and one of the loan cycle. Repayment[10] occurs whenever there are sufficient resources available for this purpose, i.e. ex-post moral hazard, as considered in Besley and Coate (1995), is absent in this setting. Therefore, in an individual liability contract, repayment occurs as prescribed if and only if the project has been successful. In a joint liability contract, repayment occurs as prescribed if both borrowers have achieved at least low output; if one project has failed while the other has achieved high output, no payment is made at stage zero but full repayment occurs at stage one as the high output is sufficient to cover the group's total debt. Besides repaying the loan, a borrower has the option of making voluntary contributions to the lender at the same time that repayment instalments are due. We assume that such contributions

[9] Note that we do not assume a zero interest rate, as offered by Akhuwat, but allow the interest rate to be determined endogenously by the model.

[10] As far as the model is concerned, 'full payment' means 'repayment on time'. In practice, it is likely that even borrowers with failed projects eventually repay their loans.

potentially provide 'warm glow' utility (Andreoni, 1989) to the borrower.

Specifically, individual preferences are defined over total voluntary contributions (A) and consumption (C) in each period according to the following Cobb-Douglas utility function:

$$U(A, C) = A^{\alpha} C^{1-\alpha} \tag{1}$$

where α is distributed according to a c.d.f. $F(.)$ with support over the interval $[0, \alpha_{\max}]$, $\alpha_{\max} < 1$. Each period corresponds to a loan cycle and a (successful) borrower must satisfy the per-period budget constraint: $C + A \leq \tilde{Y}_j - X_j R_j$. Utility in future periods is discounted at a rate $\beta < 1$ per period.

The lender does not observe the ability k or preference parameter α of a loan applicant, but has knowledge of $F(.)$ and beliefs represented by $\theta = \Pr(k = k_h)$; where θ may be based on the distribution of ability in the pool of potential borrowers as well as information obtained during the application process.[11] The lender observes repayment status but not output. Therefore, in the case of individual liability, the lender can distinguish between project failure, which will result in no repayment, and success; but, in case of success, the lender cannot distinguish between high and low output. In the case of joint liability, repayment provides less information about a project's outcome because repayment may occur even if an individual project fails.

Repayment Status and Borrower Ability: Given the setup above, it is straightforward to show that the lender will update beliefs about a borrower's ability at the end of the loan period. In the case of an individual liability loan, repayment discipline or full loan repayment indicates that the borrower achieved at least low output, which is more likely for a high-ability borrower by assumption. In the case of a joint liability loan, repayment discipline at stage zero means that both borrowers achieved at least low output; while full repayment means that at least one borrower achieved high output, or that both achieved at least low output. These outcomes are more likely in the case of high-ability borrowers. Thus, we obtain the following result.

[11] Note that we assume, implicitly, that the lender does not contract upon θ. This may be because doing so makes the paperwork prohibitively expensive or because θ is observable but not verifiable.

Lemma 1 *(i) Loan repayment raises the posterior probability that a borrower (with an individual or joint liability loan) has high ability. (ii) Repayment discipline during the loan cycle also raises the posterior probability for borrowers with either type of loan.*

We can also show that whether a loan application is approved depends on the lender's belief about the applicant's ability. In particular, for each j, there is a threshold $\underline{\theta}_j$ such that a profit-maximising lender will approve a loan application for a project of type j if $\theta \geq \underline{\theta}_j$. Combining this result with the lemma above, we obtain the following:

Result 1 *In the case of both individual and joint liability loans, repayment discipline and loan repayment raise the probability that a repeat loan application is approved.*

Signalling: While the lender makes inference about a borrower's ability from the loan repayment status, it does not provide full information about an individual project outcome. For example, in the case of an individual liability loan, repayment may mean that the borrower has either high or low output. In the case of a joint liability loan, repayment may occur even if an individual project has failed, as long as a group member has achieved high output. Therefore, the lender may look for, and respond to, other information about the project outcome and, thus, the borrower's own ability. In particular, voluntary contributions to the lender may provide additional information about the project outcome. For example, in the case of an individual liability loan, if total voluntary contributions exceed $Y_j^l - X_j R_j$, then it is evident that the borrower has achieved high output because she would not have the resources to make such a contribution if output were low. In general, if voluntary contributions are sufficiently high, it raises the lender's posterior probability that the borrower has high ability. In addition, we can show that the lender is *more responsive* to voluntary contributions under joint liability than under individual liability. The reason is that, under joint liability, *any* positive contribution by a group member signals that her project has been successful; while, under individual liability, the lender already has this information based on the loan repayment status. We summarise these results as follows.

Result 2 *(i) For both individual and joint liability loans, conditional on repayment discipline, higher voluntary contributions during a loan cycle increase the probability that a repeat loan application is approved. (ii) Loan renewal is more responsive to individual voluntary contributions under joint liability than under individual liability.*

This result means that borrowers who are interested in renewing a loan may have an *incentive* to make voluntary contributions greater than that implied by 'warm glow' alone. In the Theoretical Appendix, we provide conditions under which these incentives are sufficiently strong for voluntary contributions to be made with a signalling motive.

Contributions through the Loan Cycle: As modelled above, borrowers have two opportunities to make voluntary contributions, at stage zero and stage one of the loan cycle. By assumption, at stage zero, the borrower learns whether her project will be successful. If successful, she will make a contribution motivated by 'warm glow'.

In the case of an individual liability loan, a successful borrower has no incentive to make an additional contribution for signalling purposes at stage zero because her repayment discipline will be sufficient to indicate to the lender that the project has been successful. In the case of joint liability loans, repayment discipline at stage zero indicates to the lender that *both* projects have been successful and so, once again, there is no signalling motive to make an additional contribution at this stage. However, if the group is unable to make a payment at stage zero, then a borrower with a successful project has an incentive to make a positive contribution to signal that her *own* project has been successful.

At stage one, successful borrowers learn whether they have achieved high or low output. Those who achieve high output have the incentive to make an additional contribution to signal their high output as described above and to 'purchase' additional 'warm glow' with their extra income. Those who obtain a low output have no such incentives and, therefore, make no additional voluntary contributions. We can summarise these results on contributions through the loan cycle as follows:

Result 3 *Successful borrowers make voluntary contributions at stage zero of the loan cycle according to the extent of 'warm glow' in their preferences. Borrowers*

with high output make voluntary contributions at stage one of the loan cycle for signalling purposes and/or for 'warm glow'. In joint liability groups that are unable to make payment at stage zero, successful borrowers have the incentive to make positive contributions to signal their project status.

Result 3 has two implications regarding voluntary contributions during a loan cycle. First, it implies - both for borrowers with individual and joint liability loans - that voluntary contributions will decline over the loan cycle as all successful borrowers contribute at stage zero while only those with high output contribute at stage one. Second, because signalling is concentrated in the latter stages of the loan cycle, those who make voluntary contributions at both stages zero and one are more likely to obtain a repeat loan than those who contribute at stage zero only.

4 Data

The data for this study come from the Akhuwat administrative database, which contains information on loan size, credit period, issue and expiry dates, and timing and amount of instalment payments for all loans issued. In addition, it has information on each voluntary contribution made by a borrower. A receipt is issued every time a voluntary contribution is made. The date and amount of the contribution with the borrower's unique identification number is recorded in the database. This provides a unique and distinctive dataset of voluntary contributions behaviour by borrowers.

4.1 Sample Selection

Testing our hypotheses on voluntary contributions behaviour required data over a time span sufficiently long to observe borrowers over multiple loan cycles, and a mix of first-time and repeat borrowers. At the time that data were requested for this study (in 2013), Akhuwat had 14 branches that had been in operation for three or more years in Lahore, the city where it began operations from.[12] We use this threshold to select

[12]Lahore is the provincial capital and the second largest city in Pakistan with an estimated population of around 11 million. These branches are geographically spread across the city.

the sample for our analysis. The dataset we use is comprised of information on all borrowers from these 14 branches during the period July 2010 to June 2013.

4.2 Sample Description

The administrative dataset contains information on 46,535 loans issued by 14 branches during the sample period. For this study, we use a sample of 27,427 completed loans.[13] We restrict the sample to completed loans for two reasons. First, borrowers may behave differently (both in terms of their giving behaviour and instalment payments) at different points in the loan cycle. Second, it allows us to analyse repeat borrowing behaviour. Table 1 shows the distribution of these loans by loan cycle; 66% of the sample consists of first-time loans. Loan size and duration increase in subsequent loan cycles.

Table 2 shows the distribution of loans across branches, and the gender composition of borrowers. Although the gender ratio among borrowers shows only a slight overrepresentation of men (55%), some of the branches are dominated by a single gender. For example, women account for more than two-thirds of the borrowers at the residential area Walton and Badar Colony branches, but less than one-third of the borrowers at the commercial area Madhulal Hussain and Daroghawala branches. The sample consists of 314,291[14] monthly observations on voluntary contributions and instalment payments. Borrowers make voluntary contributions in 65% to 70% of the months. Thus, for a 10-month loan, the average borrower would contribute in roughly seven out of the 10 months (Table 3). The sample period overlaps with a period of high inflation in Pakistan (monthly inflation rate close to 1%). Therefore, to allow comparisons over time, the data have been adjusted using the monthly Consumer Price Index (CPI).[15]

In the sample, voluntary contributions by borrowers are equivalent to an implicit interest rate[16] of between 4% and 4.5%, with a standard deviation of about 4.2%. The

[13]The default rate is under 0.2%. Borrowers who defaulted are not part of the analysis.
[14]The top 0.05% of the sample has been trimmed for outliers.
[15]Data series obtained from Reuters EcoWin.
[16]This is a nominal rate and is calculated as the annualised average monthly voluntary contribution

implicit interest rate is lower in later loan cycles.[17] Although the level of voluntary contributions is higher in later loan cycles, the contributions are lower as a proportion of the loan amount.

In figure 1, we plot the contribution behaviour of 10,007 first-time borrowers on a 10-month loan, and 2,231 second-time borrowers on a 12-month loan. The figure shows that borrowers are, on average, less likely to give contributions later in the loan cycle. The amount given initially declines with loan age before picking up towards the end of the loan cycle (although contributions do not return to their initial levels). These variations in giving suggest that the borrowers are not coerced into giving a fixed amount that serves as an implicit interest payment. The increase in giving towards the end of the loan cycle - when borrowers may be considering applying for a repeat loan - suggests a different motive for giving. We look at these relationships in more detail in the next section.

5 Voluntary Contribution Behaviour over the Loan Cycle

5.1 Empirical Specification

We begin our analysis by investigating how voluntary contributions by the borrowers evolve through the loan cycle. For this purpose, we specify the following equation:

$$Y_{it} = \alpha + \mathbf{K}_{it}\tau + \gamma_i + \varepsilon_{it} \tag{2}$$

where Y_{it} is the total voluntary contribution made by individual i in month t of the loan cycle. The vector $\mathbf{K}_{it}$ contains a set of variables we introduce to investigate changes in voluntary contributions by the borrower through the loan cycle, including dummies for the first quarter (= **1** during the first three months of the loan cycle) and the last quarter (= **1** during the last three months of the loan cycle). We also

taken as a ratio of the instalment amount.

[17] The difference is 0.25% and is statistically significant.

include a dummy variable which equals one if all loan instalments up to and including month $t-1$ were paid on time and zero otherwise. This serves as a proxy for any financial hardship faced by the borrower (or group in the case of a joint liability loan). Individual fixed effects γ_i absorb the borrowers' time-invariant characteristics.

The total voluntary contribution Y_{it} made by individual i in month t is a truncated variable. It always takes a value greater than or equal to zero. In addition, it has a value of zero for a non-trivial proportion of the population (see Figure 2). The zeros indicate the months in the loan cycle in which the borrower made no voluntary contribution. An obvious choice for modelling such a distribution is a Tobit model. However, a Tobit model is restrictive because it assumes that the same mechanism determines the choice between $Y_{it} = 0$ and $Y_{it} > 0$, and the value of Y_{it} conditional on $Y_{it} > 0$, such that it constrains the partial effects $\partial P(y > 0|x)/\partial x$ and $\partial E(y|x, y > 0)/\partial x$ to have the same sign. However, it is possible that the same characteristics have a different impact on $Y_{it} = 0$ versus $Y_{it} > 0$ because a choice of zero represents a distinct decision making process from that of choosing the amount to be given. In our theoretical model, whether a borrower makes voluntary contributions depends on whether her project was successful. Conditional on giving, the amount given is determined by the extent of 'warm glow' in the borrower's preferences and the scope and incentives for signalling. Therefore, the two processes are distinct and need to be estimated separately.

A corner solution may also raise concerns about selectivity. However, it is important to note that the outcome is always observed. There is no counter-factual for the observed zero (i.e. what the voluntary contribution amount would have been if no voluntary contribution had been made). We want to model observed voluntary contributions, not what contributions could potentially have been. Therefore, we are interested in $E[Y|X]$ and not $E[Y^*|X]$ and the need for a Heckman selection model does not arise.[18]

We use a two-part Hurdle Model, which has been used in the literature on health and education (see, for example, Aslam and Kingdon (2008) and Madden (2008)). The first

[18]This argument is based on the discussion in Wooldridge (2010).

hurdle in our case is the decision to make a voluntary contribution. Then, conditional on this decision, borrowers will proceed to the next stage of deciding how much to give. This will take following form:

Stage:1

$$Pr\left[Y_{it} > 0\right] = \alpha + \mathbf{K}_{it}\tau + \gamma_i + \varepsilon_{it} \tag{3}$$

where Y_{it} = 1 if a borrower makes a voluntary contribution in month i and 0 otherwise. The other variables are as defined in equation 2. As the outcome is binary, the equation is estimated using a standard Logit Model.

Stage:2

Conditional on $Y_{it} = 1$, we estimate the following equation using Ordinary Least Square (OLS):

$$log\left(Y_{it}\right) | \left(Y_{it} > 0\right) = \alpha + \mathbf{K}_{it}\tau + \gamma_i + \varepsilon_{it} \tag{4}$$

5.2 Findings

Table 5 contains the estimates for equations 3 and 4 with borrower fixed effects. The first stage is estimated only for borrowers for whom there is variation in giving through the loan cycle (i.e. it excludes borrowers who give every month and those who never give). We find that borrowers are more likely to give if they are behind in making the previous month's payments (Table 5, column 1). Consistent with Figure 1, borrowers are most likely to make a voluntary contribution during the first three months of the loan cycle and the least likely to give during the last three months. This is also consistent with the theoretical prediction obtained in Section 3 about contributions through the loan cycle (Result 3 and the subsequent discussion). Borrowers are less likely to give in the last three months of their loan cycle; but, when they do give, contributions are larger (column 4). This is consistent with our theoretical premise that the contributions towards the end of the loan cycle come from borrowers who have achieved high output in their projects, and have a signalling motive (Result 3).

5.3 Joint Liability Loans

In the case of joint liability loans, borrowers may have stronger incentives for making voluntary contributions because the organisation observes loan repayment at the group level only; this is in contrast to contributions, which can be observed at the individual level. To test if this is the case, we estimate equation 3 separately for individual and joint liability loans. Akin to the results for the full sample, borrowers are more likely to make voluntary contributions when they are lagging behind in their instalment payments (column 3 in Table 5). Among those who give, voluntary contributions are larger when borrowers are lagging behind in their payments, but only if they have a joint liability loan (column 6), and not if they have an individual liability loan (column 5). Hence, borrowers in joint liability groups appear to be compensating for the poor performance of their group by contributing larger amounts individually. Because individuals are not required to maintain the same group when renewing a loan, borrowers have an incentive to give a signal to separate themselves from their group, as discussed in Section 3 (Result 3). We also find, in line with this evidence, that within-group variance in contributions is significantly higher when groups exhibit poor repayment discipline, compared to when they are more disciplined.[19]

6 Signalling Behaviour

To investigate whether borrowers' behaviour is consistent with a signalling motive, we look at how these contributions correlate with repeat borrowing. The organisation classifies a loan as 'defaulted' only if it remains unpaid three months after the end of the loan period. As such, default rates are very low. For the majority of borrowers, even those with poor discipline (and investment projects that may have failed), the organisation eventually manages to recover the entire amount of the loan. However, loan recovery in these cases carries high administrative costs for the organisation,

[19]When we regress the standard deviation of monthly contributions in a group on a dummy for whether they are on time, the coefficient on this dummy is positive and significant (with a value of 5.36; standard error 0.66). This regression includes group fixed effects and controls for calendar month.

which is why screening low-ability borrowers is useful. That is, clients who are likely to succeed in their projects and to repay the loan on schedule are preferable to those who fail in their projects and exhibit poor repayment discipline, even if the loan is, ultimately, fully recovered. We also evaluate the quality of this signal by checking the correlation between contributions made in one loan cycle and borrower discipline in a subsequent cycle.

6.1 Repeat Borrowing

To look at whether the pattern of voluntary contributions is related to the likelihood of borrowing again, we estimate the following equation:

$$Repeat_{it} = \alpha + \mathbf{X}_i\beta + \gamma AvgDon_i + \tau + \sum_{m=2}^{14} \theta_m + \varepsilon_{it} \tag{5}$$

where $Repeat_{it}$ is a binary variable equal to one if the borrower takes out another loan within a specific time period after the expiry of the last loan and zero otherwise. The coefficient of interest is γ which measures the impact of average monthly voluntary contributions ($AvgDon_i$) made in a particular loan cycle on borrowing again; $\mathbf{X}_i$ is a vector of borrower characteristics (gender, whether part of a group, reason for borrowing) and performance during the loan cycle (as measured by the proportion of months that the borrower was not on time in paying instalments). The summary statistics for these characteristics are shown in Table 4.

Equation 5 is estimated for first- and second-time borrowers only, as the number of borrowers in our sample with additional loans is not large enough for this analysis. We also exclude all first-time loans that expire within two months of the end of our sample period; and all second-time loans that expire in the last month of the sample period. The reason for excluding these loans from the analysis is that a shorter timeframe following the completion of the loan cycle may not be sufficient to observe repeat-borrowing behaviour. In our sample, 75% of first-time borrowers borrow again within two months and 60% of second-time borrowers borrow again within one month. We use these as cut-off points, and define $Repeat_{it} = 1$ for first time (second-time) borrowers

if they borrow again within two months (one month) of the expiry of the previous loan, and zero otherwise. The results are robust to the use of the median time, rather than average time, for taking out another loan.

6.1.1 First time borrowers

First, we compare, descriptively, the voluntary contributions behaviour of first-time borrowers who borrow again and those who do not. We observe a stark difference in behaviour between the two groups through the loan cycle (Figure 3). For those who do not borrow again, the likelihood of giving steadily declines as the loan ages. However, for those who do borrow again, the likelihood of making voluntary contributions remains roughly constant till the late stages of the loan cycle when such contributions begin to rise. Conditional on giving, the average amount given is similar across the two groups of borrowers until the late stages of the loan cycle. During the last four months, the amounts given by both groups trend upward, but the trend is much steeper for those who borrow again. This pattern is evidence that voluntary contributions are not motivated purely by altruism; if altruism were the motive, we would expect to see consistent behaviour across the two groups and over the loan cycle. However, we see clear differences in the behaviour of the two groups over the loan cycle in both the decision to make a voluntary contribution and in the amount given[20]

Results from Probit estimates of equation 5 in Table 6 for first-time borrowers confirm the pattern displayed by the raw data. Average monthly voluntary contributions made in the previous loan cycle have a consistently positive effect on the likelihood of borrowing again. Borrowers with poor repayment discipline - as measured by the proportion of months they are behind in making payments - are less likely to borrow again. We also find that, among first-time borrowers, the likelihood of repeat borrowing

[20]We compared the behaviour of borrowers who take out another loan within two months of the expiry of their last loan with those who take out a loan three to six months after the expiry of their last loan. We find that, although both groups behave similarly (donate more towards the end), those who borrow again three to six months after loan expiry are: 1) less likely to donate, and 2) likely to donate smaller amounts than those who borrow again within two months. The second finding provide evidence of planning on the part of borrowers such that those who are more certain about taking out another loan donate even more towards the end of the loan cycle.

is significantly more responsive to average donations for those with joint liability loans compared to those with individual liability loans (column 2). The positive effects of voluntary contributions on repeat borrowing, and their larger impact on borrowers with joint liability loans, are consistent with the theoretical predictions (Result 2).
Next, we investigate whether the timing of voluntary contributions made over the loan cycle matters for repeat borrowing. For this purpose, we introduce a dummy variable that takes a value of one if a borrower makes larger voluntary contributions in the last quarter rather than in the first quarter of the loan cycle. We find that those who make larger contributions in the last quarter are more likely to borrow again.
For those with joint liability loans, we also explore whether contributions by other group members affect their own likelihood of borrowing again. Keeping the same set of controls as in column 2, we replace individual monthly voluntary contributions made in the loan cycle with the average contributions by the rest of the group. We find that, similar to the results regarding own voluntary contributions, contributions by other group members also increases the likelihood of borrowing again (column 3).

6.1.2 Second time borrowers

Among second-time borrowers, those who borrow again within one month of loan expiry are consistently more likely to have made a voluntary contribution during their second loan cycle as compared to those who do not borrow again within this time period (Figure 4). A sharp decline takes place in the likelihood of giving toward the end of the loan cycle among those who do not renew their loans, but not among repeat borrowers. We also see a divergence in the amounts given between the two sets of borrowers much earlier in the loan cycle than in the case of first-time borrowers (Figure 3).
Estimates of equation 5 in Table 7 7 for second-time borrowers show results similar to those for first-time borrowers. There is no statistically significant difference in the magnitude of the impact of average monthly contributions on borrowing again for

first- and second-time borrowers[21] This suggests that borrowers continue to behave in a strategic manner even after the first loan cycle. As in the case of first-time borrowers, voluntary contributions by other group members are a positive predictor of the likelihood of borrowing again. However, unlike the case of first-time borrowers, contributions are equally important in predicting repeat borrowing both for those with individual liability loans and for those with joint liability loans.[22]

6.2 Voluntary contributions and borrower discipline

We find that voluntary contributions predict the likelihood of borrowing again, even when we control for borrower discipline in the previous loan cycle. But do these voluntary contributions also correlate with superior borrower performance in the next loan cycle? Identifying good-quality borrowers is considered to be a difficult and costly exercise for MFIs. In the conventional microfinance model, it is common to rely on observed borrower discipline in the previous loan cycle to make inferences about borrower quality. To investigate whether voluntary contributions during one loan cycle predict borrower performance in a subsequent loan cycle, we estimate the following specification:

$$Borrowerdiscipline_{il} = \alpha + \mathbf{X}_i\beta + \gamma AvgDon_{l-1} + \sum_{m=2}^{14} \theta_m + \varepsilon_{it} \qquad (6)$$

where $Borrowerdiscipline_{il}$ is measured as the proportion of months in loan cycle l during which borrower i was ***not*** on time in making instalment payments. The coefficient of interest here is γ which indicates whether voluntary contributions in the previous loan cycle ($AvgDon_{l-1}$) correlate with better borrower discipline in the next loan cycle; $\mathbf{X}_{il}$ is a vector of controls for individual and loan characteristics of borrower

[21]The coefficient on the interaction of the second time borrower dummy and average donations made is 0.000 with a p-value of 0.818, when Equation 5 is estimated for the combined sample of first and second time borrowers.

[22]In terms of our theoretical model, this may be because a signal of project success is sufficient to obtain a second loan while a signal of high output is required to obtain a third loan. For first-time borrowers, a voluntary contribution may be required to signal project success if the borrower is on a joint liability loan, but repayment is sufficient to signal project success if the borrower is on an individual liability loan. However, for second-time borrowers, contributions are required to signal high output whether the loan contract entails individual liability or joint liability.

i for loan l.

Since the dependent variable $Borrowerdiscipline_i$ is a proportion, it is restricted to the unit interval $[0, 1]$. Predicted values from the OLS regression, as in the case of binary data, may not always lie between these values. A traditional solution to this problem is to use a log-odds transformation, but that causes boundary values (zero and one) to be dropped because no transformation is possible for them. Instead, as proposed by Papke and Wooldridge (1996), we use a generalized linear model (GLM) to estimate equation 6 with a logistic function in which the dependent variable can take any value in the interval $[0, 1]$.

There are 3,939 borrowers for whom we have data for more than one complete loan cycle. The majority of these borrowers (70%) are recipients of first-time loans. For this selected group of borrowers (those we are able to observe for more than one loan cycle), we find that better borrower discipline in one loan cycle is correlated with larger average voluntary contributions in the previous cycle (see Table 8). This relationship is robust to the inclusion of borrower discipline in the previous loan cycle. This suggests that voluntary contributions do, in fact, provide additional information about the 'quality' of the borrower. Interestingly, a significant correlation between voluntary contributions and borrower discipline (column 4) no longer exists when we restrict the sample to individual liability loans. This is consistent with our theoretical result that voluntary contributions are more informative for the lender in the case of joint liability loans compared to individual liability loans (see Result 2 and the preceding discussion).

7 Robustness Checks

7.1 Telephone survey

Our finding that the likelihood of repeat borrowing is increasing in the average level of voluntary contributions in the preceding loan cycle may be confounded by individual characteristics (such as income levels, social capital and religiosity) that are not included in the organisational dataset. For example, higher income levels may translate

into larger voluntary contributions. Individuals with larger incomes may also have better chances of getting another loan. If so, the effects of this omitted variable will be confounded with those of voluntary contributions. Similarly, borrowers with stronger ties to the neighbourhood may be inclined to make voluntary contributions more often; and, for the same reason, these well-connected borrowers may be able to form groups more easily, and, therefore, they may be more likely to borrow again.

In order to address these alternative hypotheses, we conducted a survey with a subsample of the organisation's clients. Faced with budgetary and time constraints, we opted for a telephone survey. We collected basic information on individual characteristics and household financial condition from 1,350 borrowers in August 2014. A random sample stratified by the branch, gender and loan cycle of the borrower was drawn to have the same proportional representation as that of the main sample. Although the refusal rate was low (3.5%), a significant fraction of calls to borrowers (about 30%) received no response, or reached deactivated telephone numbers. There was a potential risk that borrowers who had taken out loans further back in time (and who, as a result, were more likely to have changed their telephone numbers) would be under-represented in the final sample. To mitigate this problem, we ensured that for every unsuccessful call, the replacement borrower for the telephone survey was picked from the same time period. The final sample, after accounting for missing values, was 1,280 (summary statistics are shown in Table 9).

Although we used a stratified sample of the administrative data, the telephone survey sample exhibits significantly better borrower discipline (on schedule with payments 93% of the time) and a higher rate of repeat borrowing (47% of first-time borrowers renewed their loans) compared to the full sample (80% and 35.5%, respectively). This may be due to the survey's 30% non-response rate, which is discussed above. Nevertheless, we argue that our analysis with the telephone survey sample still provides an appropriate test for the alternative hypotheses. This is because, for borrowers who exhibited poor discipline in repayment, the lender can screen on the basis of this information. The lender may use other, more nuanced information to engage in

screening of more disciplined borrowers. The telephone survey sample is representative of the more disciplined borrowers in the MFI's clientele. Yet, even for this sample, as we discuss in the next section, we find that a large set of borrower characteristics does not predict repeat borrowing, while average voluntary contributions still do.

7.2 Findings

We estimate equation 5 for the combined sample of first- and second-time borrowers[23] controlling for age, education and marital status. In the first column in Table 10, we include borrower characteristics without introducing average monthly contributions in the previous loan cycle. To capture the financial condition of the household, we include a measure of the dependency ratio,[24] and a binary variable to indicate whether the borrower owns the house he/she lives in. We collected information on the borrower's involvement in community organisations; a small number (15%) report being part of one. We also construct a variable indicating the number of years the borrower has lived in the current area of residence as a fraction of his/her age. Assuming that social connections grow over time, this measure can serve as a proxy for social capital. Finally, we collected information on the borrowers' income levels. As some respondents refused to disclose this information, the sample is slightly smaller when we introduce monthly per capita income in the regression (in column 2 of Table 10).

The estimated coefficients for nearly all borrower characteristics are statistically insignificant in explaining the likelihood of repeat borrowing. It is possible that the relevant characteristics are used in the screening process when the organisation evaluates the first loan application, and, as a result, they do not predict subsequent borrowing. The important determinants are whether the borrower experienced an improvement in his or her financial condition during the previous loan cycle, and whether the borrower was disciplined in making instalment payments. Most importantly for our analysis, the size of voluntary contributions continues to be a

[23] As discussed above, we found no significant difference in the average contributions made and likelihood of borrowing again between first- and second-time borrowers.

[24] We calculate the dependency ratio by subtracting the number of working people from the total number of people, and then dividing that by the number of people working.

strong, statistically significant predictor of repeat borrowing. This gives support to the hypothesis that these contributions are not merely serving as a proxy for borrower characteristics that we are unable to control for in our main analysis.

The size and frequency of voluntary contributions may be impacted by the degree of a borrowerâ€s religiosity given that the organisation is seen to conform to Islamic principles of the prohibition of interest charges. Any direct questioning on obligatory religious practices may be deemed offensive, and is unlikely to elicit an honest response. Therefore, we asked the respondents whether they perform any non-obligatory prayers (e.g. *tahajud*) or engage in fasting outside of the month of Ramadan. This question was included only during the second half of the survey period, and, therefore, the information is available for a subset of the sample. In column 3 of Table 10, we introduce a dummy variable which equals one if the borrower responded with a yes to this question. While it has a marginally significant effect, the average contribution variable continues to be an important predictor of repeat borrowing.

8 Explaining Voluntary Contribution Patterns

In this section, we discuss potential explanations for the patterns in voluntary contributions identified in the empirical analysis. We begin by summarising how the empirical findings compare with the key predictions of the signalling model presented in Section 3.

Signalling Ability: We have three main findings that support the signalling model. First, we find that, controlling for discipline in repayment, both first- and second-time borrowers with larger voluntary contributions have higher probabilities of receiving another loan (Tables 6 and 7). We argue, in terms of the signalling model, that this is because larger voluntary contributions signal that the investment has yielded a higher return, which in turn signals to the lender that the borrower has higher ability, and is likely to repay a larger loan. Second, we find that voluntary contributions in one loan cycle are correlated with repayment discipline in the next loan cycle. This

finding is robust to controlling for borrower discipline in the initial loan cycle, but only if the initial loan was a joint liability loan, as opposed to an individual liability loan (Table 8). This is consistent with our hypothesis that voluntary contributions contain information about the borrower's ability. Voluntary contributions offer more valuable information in a joint liability contract because repayment discipline provides group-level information only. Third, we find that repeat borrowers maintain voluntary contributions through their initial loan cycle, while one-time borrowers give only towards the beginning of the loan cycle (Figure 3). We argue that this is because motivations change throughout the cycle of the loan. Early in the loan cycle, giving is motivated by 'warm glow' alone, while late in the loan cycle giving has a signalling element intended to increase the chances that the loan will be renewed. In the remainder of this section, we consider alternative explanations for our empirical findings.

'Warm Glow': Can the concept of 'warm glow', on its own, account for our empirical findings? Borrowers who are more successful in their investments have more money, and so, 'warm glow' could motivate them to make higher voluntary contributions. The lender may infer borrower ability, not on the basis of voluntary contributions, but from directly observing the project outcome. This would account for the correlation between voluntary contributions and project renewal, as well as for repayment discipline in the next loan cycle (Tables 6, 7 and 8). This would also explain why borrowers of high ability, who have a better income stream and therefore give more, are more likely to have their loans renewed (Figure 3). But this does not account for the fact that borrowers in joint liability groups *give more* when their group is behind in making payments (Table 5), and for the fact that the variance in voluntary contributions is greater when the group is behind in making payments.

Solidarity Contracts: The lending organisation, Akhuwat, may have an implicit solidarity contract with its borrowers, whereby it renews loans for borrowers who have supported the organisation through voluntary contributions in the past. In this story, voluntary contributions do not signal ability, but instead signal a willingness to enter

into such a solidarity contract. We would expect the willingness to enter into such a solidarity contract to be higher among borrowers who are poorer or who have a weaker social network and for the probability of loan renewal to be higher for these types of households. We would also expect voluntary contribution patterns to be either steady during the loan cycle, for those opting for a solidarity contract, or entirely absent, for those not interested in such a contract. We would not expect any correlation between measures of ability, such as repayment discipline during a loan cycle, and voluntary contributions. However, the evidence contradicts these predictions. Table 10 shows that per capita household income and membership in community organisations are unrelated to repeat borrowing. Figures 3 and 4 show that even borrowers who do not take out another loan give voluntary contributions; particularly among second-time borrowers who do not borrow again, we observe a high propensity to give up to nine months into the 12-month loan cycle. Finally, Table 8 shows that average voluntary contributions do predict repayment discipline in the next loan cycle, which is a plausible measure of ability.

Reciprocity: Borrowers may be motivated to give to the lending organisation by a 'feeling of reciprocity' â€“ more precisely, utility derived from giving that is contingent on having previously received something from the gift recipient. Similarly, the lender reciprocates by renewing loans for borrowers who have made voluntary contributions. In this framework, borrowers differ in terms of a reciprocity parameter that determines whether, and for how long, they reciprocate through voluntary transfers. While such a model would explain the empirical relationship between voluntary contributions and repeat borrowing, it does not account for the fact that voluntary contributions are a predictor of repayment discipline in the next loan cycle (Table 8). The model would also predict that borrowers who do not experience a 'feeling of reciprocity' give strategically, starting late in the loan cycle in the hope that the lender will reciprocate by renewing their loans. If this is the case, we should observe an upward trend in the average propensity to give towards the end of the loan cycle. However, we find no evidence of this (Figure 1); even among repeat borrowers, the average propensity to

give remains steady, but does not increase, towards the end of the loan cycle (figures 3 and 4).

Social Pressure: Suppose the lending organisation can exert social pressure on borrowers; more precisely, suppose that it can exert a disutility (by incurring some cost) on borrowers who do not make voluntary contributions. Borrowers may differ in terms of their responsiveness to social pressure. The lender renews loans for those who make higher voluntary contributions because these borrowers have revealed themselves to be more responsive to social pressure. In this setting, it would be optimal for the lender to exert social pressure through the loan cycle as a means of extracting more from the borrower whenever he or she pays an instalment for loan repayment. By contrast, we find the propensity to give declines through the loan cycle (Figure 1). Borrowers who are responsive to social pressure exerted by the lender should also be susceptible to social pressure from friends and family. This means that they would struggle to hold cash and, therefore, would likely be worse performers in terms of repayment discipline. Instead, we find that voluntary contributions are positively correlated with loan discipline in the next loan cycle (Table 8).

Learning: An alternative to the model presented in Section 3 is one in which potential borrowers do not know their own ability levels, but, similar to the lender, have beliefs about their ability. In this case, borrowers would update beliefs about their ability after observing the output from each project they invest in. However, the incentives to signal their output to the lender are identical to those presented in our formal model; voluntary contributions would raise the lender's posterior belief of high output and, thus, high ability. In fact, we obtain the same theoretical predictions as those presented in Section 3. Therefore, we cannot distinguish between the signalling story and one involving both learning and signalling. Nevertheless, both stories support our core argument that voluntary contributions to the lender provide scope both for signalling and for reducing informational asymmetries in credit markets.

9 Conclusion and Discussion

In this paper, we investigated charitable giving by atypical donors in an unusual setting: the donors are microfinance recipients who provide charitable contributions to the microfinance institution that provides them with loans. The organisation offers interest-free microcredit loans, and invites borrowers to make a voluntary contribution of any amount when making instalment payments for repaying the principal each month. We find that, towards the end of the loan cycle, those who go on to borrow again from the same organisation contribute more compared to those who do not. This differential pattern of giving is difficult to explain in terms of an altruistic motive alone. Karlan (2007) highlights how the promise of repeat lending as a repayment incentive is a key element of the mechanism design inherent in microcredit practices today. Our empirical findings suggest that borrowers are responding to this incentive, and that they are signalling their quality for a repeat loan when the outcome of their current project becomes evident. To explain these patterns, we develop a theory in which voluntary contributions by borrowers can provide them with ('warm glow') utility, but also can signal to the lending organisation their level of success with existing loans. The organisation updates its beliefs about the borrower's ability based on voluntary contributions, which, in turn, affect repeat lending decisions.

In the standard model of delivering microcredit, the discipline displayed by the borrower in repaying the last loan is considered important when evaluating repeat loan applications. This discipline is measured by the timeliness in making payments in the previous loan cycle. We find that even after controlling for the timeliness in making payments, the amount of individual voluntary contributions made in the previous loan cycle is a strong predictor of borrowing again. Furthermore, in the case of joint liability loans, the larger the voluntary contributions made by a borrower during one loan cycle, the more likely he or she is repay on time in a subsequent loan cycle. Thus, these voluntary contributions can serve as an additional source of information when repeat loan applications are being evaluated, particularly for borrowers who were previously in

a poorly performing group.

While there may be some external validity concerns,[25] our findings can be useful for the ongoing debate on alternative models of microfinance. Our analysis suggests that, compared to the conventional interest-only contracts in microcredit, a mechanism of voluntary contributions (coupled with lower interest rate charges) can provide the lender with a more precise signal of borrower ability. The mechanism that we highlight also applies to a wider set of contracting situations with informational asymmetries. We also contribute to the literature on charitable giving by identifying a motive for giving that hitherto has received little attention in the literature: signalling productive ability to an organisation in order to sustain the relationship into the future.

[25]Our sample is drawn from a single large metropolitan city in which MFI branches offered interest-free loans; this context raises questions about whether these results would be valid in other settings.

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Tables

Table 1: Distribution of loans by loan cycle

Loan Cycle	No. of loans	Average Loan Period (months)	Average Loan Size (Rs.)
First	18,192	11.73	13,088
Second	5,454	13.12	16,345
Third or more	3,781	14.39	19,262

Note: The table above reports the summary statistics by loan cycle for the sample of 27,427 loans that we observe over a complete loan cycle.

Table 2: Branch wise distribution of borrowers

Name of Branch	No. of Loans	% of total	Male	Male (%)	Female	Female (%)
Green Town	2,611	10%	1,559	60%	1,052	40%
Samanabad	2,241	8%	1,254	56%	987	44%
Township	2,058	8%	1,325	64%	733	36%
Hall Road	1,435	5%	751	52%	684	48%
Mian Meer	2,056	8%	925	45%	1,131	55%
Badar Colony	1,961	7%	594	30%	1,367	70%
Walton	1,903	7%	491	26%	1,412	74%
Firdaus Market	1,663	6%	866	52%	797	48%
Shah Jamal	1,796	7%	1,064	59%	732	41%
Wassan pura	1,694	6%	1,045	62%	649	38%
Data Sahab	2,002	7%	1,247	62%	755	38%
Madhulal Hussain	2,751	10%	2,023	74%	728	26%
Daroghawala	2,164	8%	1,490	69%	674	31%
Nain Sukh	1,092	4%	444	41%	648	59%
Total	27,427		15,078	55%	12,349	45%

Note: The table above reports the gender wise distribution of 27,427 loans issued in the 14 branches that form the sample for study.

Table 3: Summary Statistics - Voluntary contributions

Loan Cycle	Proportion of months (%)	Average Contribution (Rs.)	Standard Deviation	Implicit Interest Rate (%)
First	66.79	39.60	68.28	4.51
Second	72.33	47.47	67.18	4.29
Three or more	71.43	52.84	85.81	4.11

Note: The table above reports the summary statistics for voluntary contributions made by borrowers over the loan cycle. It is based on 27,427 complete loans that form the sample for this study. 'Proportion of months' is the number of months the borrower makes a voluntary contribution out of the total number of months the loan is active.

Table 4: Summary Statistics - Loan and borrower characteristics

Variable	Obs	Mean	Std. Dev.	Min	Max
Loan Characteristics					
Loan Amount (Rs.)	27,427	14586.63	5067.01	4000	1000000
Loan Duration (months)	27427	12.37	2.39	8	35
Loan Cycle	27,427	1.58	1.05	1	9
Group Loan (=1)	27,427	0.70	0.46	0	1
Borrower Characteristics					
Gender (Male=1)	27,427	0.55	0.50	0	1
Age at borrowing	24,504	39.55	10.13	18.15	78.63
Non-productive reason (=1)	27,427	0.09	0.28	0	1

Note: The table above reports the summary statistics for the loan and borrower characteristics of the sample for this study.

Table 5: Voluntary Contribution Behaviour

	First stage: Decision to Give			Second stage: Amount Given		
	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample	Individual Liability	Joint Liability	Full Sample	Individual Liability	Joint Liability
First Quarter	0.705***	0.588***	0.769***	0.178***	0.168***	0.175***
	(0.013)	(0.023)	(0.016)	(0.003)	(0.005)	(0.003)
Last Quarter	-0.352***	-0.305***	-0.406***	0.034***	0.041***	0.027***
	(0.012)	(0.020)	(0.015)	(0.003)	(0.005)	(0.003)
Not on time at t-1	0.666***	0.936***	0.423***	0.024***	-0.008	0.048***
	(0.017)	(0.027)	(0.022)	(0.005)	(0.008)	(0.006)
Observations	248,850	84,347	164,503	215,686	60,187	155,499

Note: The dependent variable in columns (1), (2) and (3) is equal to one if the borrower makes a voluntary contribution in that month, and zero otherwise. In columns (4), (5) and (6) the dependent variable is the log of the amount of voluntary contribution made. 'First quarter', 'last quarter' and 'not on time at t-1' are all dummy variables. All specifications include individual fixed effects, and control for calendar month. Standard errors are shown in parentheses. $***p < 0.01, **p < 0.05, *p < 0.1$.

Table 6: Voluntary Contributions and Repeat Borrowing (1st Time Borrowers)

	(1)	(2)	(3)	(4)
Avg. Monthly Contribution	0.003***	0.002***	0.003***	
	(0.000)	(0.000)	(0.000)	
Avg. Monthly Contribution*Group		0.001***		
		(0.00)		
Avg. Monthly Contribution by Group				0.001***
				(0.000)
Proportion of months not on time	-0.235***	-0.236***	-0.229***	-0.431***
	(0.015)	(0.015)	(0.015)	(0.023)
Greater contribution in last quarter			0.113***	
			(0.008)	
Observations	16,540	16,540	16,540	11,529

Note: The dependent variable is equal if a first-time borrower takes out another loan; zero otherwise. Marginal effects are reported. 'Avg. Monthly Contribution' is the monthly average of the contributions made by the borrower over the loan cycle. 'Proportion of months not on time' is the number of months the borrower was not on time divided by the total number of months of the loan cycle. All regressions include controls for gender, reason for borrowing, dummy for borrowers on joint liability loan, and branch fixed effects. In column 4 the sample is restricted to joint liability loans. Robust standard errors are shown in parentheses. $***p < 0.01, **p < 0.05, *p < 0.1$.

Table 7: Voluntary Contributions and Repeat Borrowing (2nd Time Borrowers)

	(1)	(2)	(3)	(4)
Avg. Monthly Contribution	0.003***	0.003***	0.003***	
	(0.000)	(0.000)	(0.000)	
Avg. Monthly Contribution*Group		0.000		
		(0.00)		
Avg.Monthly Contribution by Group				0.001***
				(0.000)
Proportion of months not on time	-0.246***	-0.249***	-0.246***	-0.458***
	(0.031)	(0.031)	(0.031)	(0.057)
Greater contribution in last quarter			0.123***	
			(0.015)	
Observations	5,035	5,035	5,035	3,416

Note: The dependent variable is equal if a first-time borrower takes out another loan; zero otherwise. Marginal effects are reported. 'Avg. Monthly Contribution' is the monthly average of the contributions made by the borrower over the loan cycle. 'Proportion of months not on time' is the number of months the borrower was not on time divided by the total number of months of the loan cycle. All regressions include controls for gender, reason for borrowing, dummy for borrowers on joint liability loan, and branch fixed effects. In column 4 the sample is restricted to joint liability loans. Robust standard errors are shown in parentheses. $***p < 0.01, **p < 0.05, *p < 0.1$.

Table 8: Impact of Voluntary Contributions and Borrower Discipline in the Next Loan Cycle

	(1) Full Sample	(2) Full Sample	(3) Joint Liability	(4) Individual Liability
Average contributions$_{t-1}$	-0.0033***	-0.0033***	-0.0041**	-0.0026
	(0.001)	(0.001)	(0.002)	(0.002)
Borrower discipline$_{t-1}$		0.619***	0.769***	0.414***
		(0.08)	(0.10)	(0.134)
Observations	3,939	3,939	2,037	1,092

Note: The dependent variable is the proportion of months that the borrower was *not* on time in making instalment payments. Columns (1) and (2) show estimates using the full sample, Column (3) shows results when the sample is restricted to borrowers for whom the last loan was on joint liability, and Column (4) shows results when the sample is restricted to borrowers for whom the last loan was individual liability. All regressions include controls for gender, loan amount and number of previous loans of the borrower. Robust standard errors are shown in parentheses. $***p < 0.01, **p < 0.05, *p < 0.1$.

Table 9: Summary Statistics - Survey Data

Variable	Obs	Mean	Std. Dev.	Min	Max
Age	1,280	38.66	9.29	18	73
Education	1,280	5.87	4.49	0	16
Married (=1)	1,280	0.90	0.29	0	1
Proportion of years lived in the area	1,280	0.55	0.33	0	1
Own house (=1)	1,280	0.75	0.43	0	1
Part of an organization (=1)	1,280	0.16	0.36	0	1
Income	1,227	22947.43	11417.82	1000	150000
Dependency Ratio	1,280	2.87	2.03	0	29
Condition improved (=1)	1,280	0.84	0.37	0	1
Extra religious rituals	976	0.33	0.47	0	1

Note: The table above reports the summary statistics for the sub-sample of borrowers who were surveyed.

Figure Legends

Figure 1: The figure is a plot of the likelihood of making a voluntary contribution and, conditional on making a voluntary contribution, the average amount given, over the loan cycle for borrowers on first and second loan cycles of durations of 10 and 12 months, respectively.

Figure 2: The figure is a plot of monthly voluntary contributions for the full sample.

Figure 3: The figure is a plot of the likelihood of making a voluntary contribution and, conditional on making a voluntary contribution, the average amount given over the loan cycle for first time borrowers on a loan of a 10-month duration. Those who do and do not go on to take a second loan are plotted separately.

Figure 4: The figure is a plot of the likelihood of making a voluntary contribution and, conditional on making a voluntary contribution, the average amount given over the loan cycle for second time borrowers on a loan of 12 months' duration. Those who do and do not go on to take a third loan are plotted separately.

Table 10: Repeat Borrowing and Voluntary Contributions with Additional Borrower Characteristics

	(1)	(2)	(3)
Age	-0.001	-0.002	-0.002
	(0.002)	(0.002)	(0.002)
Education	0.003	0.004	0.004
	(0.003)	(0.003)	(0.003)
Married	0.069	0.063	0.035
	(0.048)	(0.049)	(0.058)
Proportion of years lived	-0.029	-0.016	-0.077
	(0.045)	(0.047)	(0.052)
Own house (=1)	0.005	0.014	-0.011
	(0.034)	(0.035)	(0.038)
Part of comm org (=1)	-0.015	-0.020	-0.034
	(0.038)	(0.039)	(0.042)
Monthly per capita income		-0.001	
		(0.001)	
Extra religious rituals			0.058*
			(0.034)
Dependency Ratio	-0.005	-0.006	-0.004
	(0.008)	(0.008)	(0.009)
Financial condition improved (=1)	0.062*	0.067*	0.057
	(0.037)	(0.038)	(0.041)
Proportion not on time	-0.446***	-0.358***	-0.537***
	(0.107)	(0.108)	(0.142)
Average monthly donation		0.002***	0.002***
		(0.001)	(0.001)
Observations	1,276	1,217	968

Note: In the table above the dependent variable =1 if borrowers take out another loan and 0 otherwise. It is based on the sub-sample of first- and second-time borrowers that were surveyed. Monthly per capita income is scaled by 1000. Robust standard errors in parentheses. $***p < 0.01, **p < 0.05, *p < 0.1$

Figures

Figure 1: Voluntary Contribution Behaviour over the Loan Cycle

(a) Likelihood of giving

(b) Average Amount Given

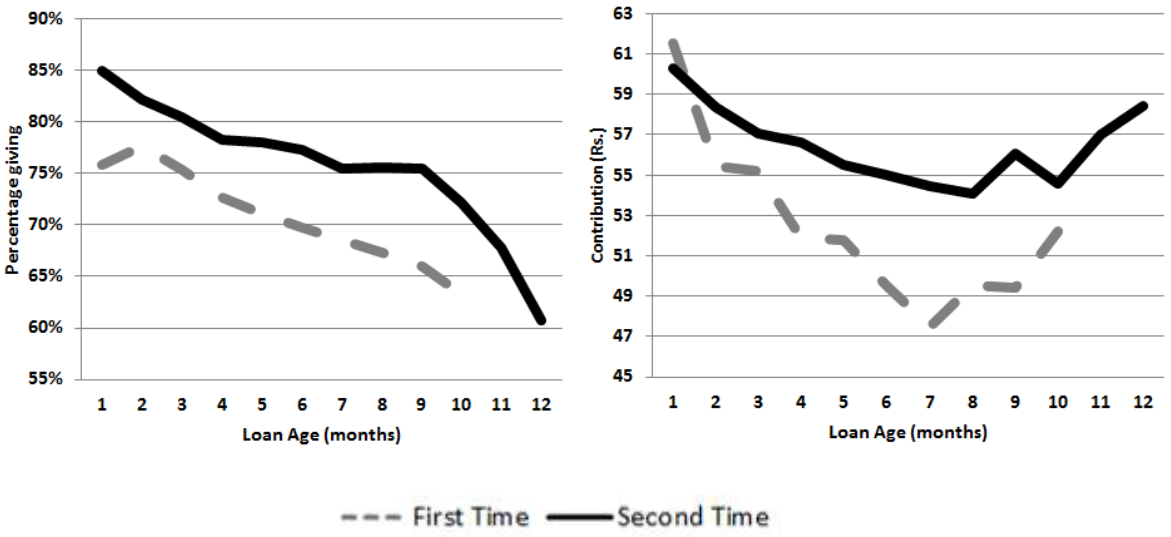


Figure 2: Histogram of Monthly Voluntary Contributions

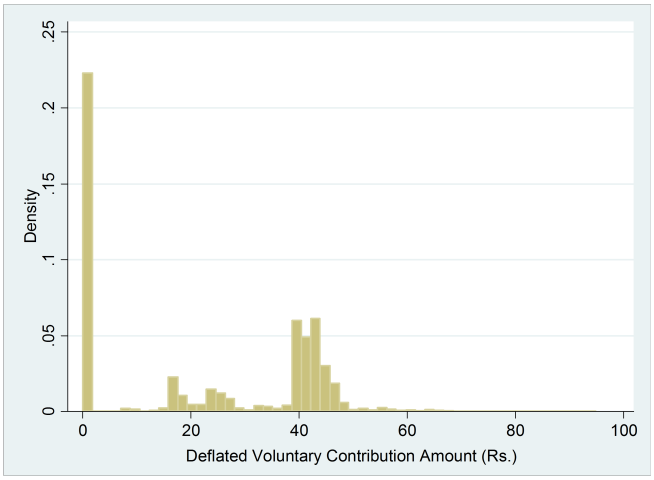


Figure 3: Voluntary Contribution Behaviour - First Time Borrowers

(a) Likelihood of giving

(b) Average Amount Given

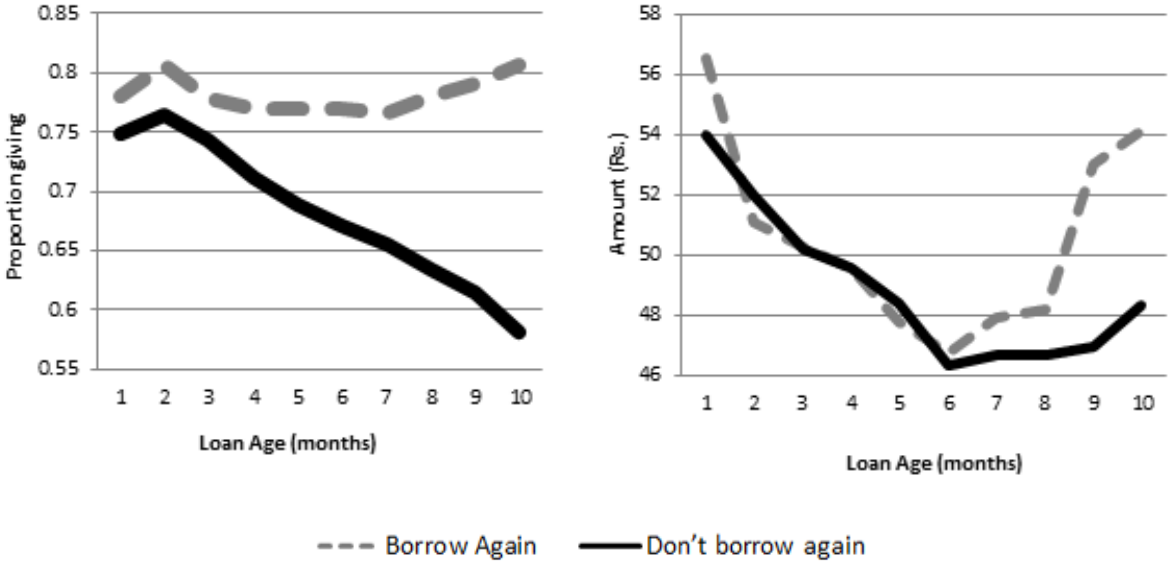
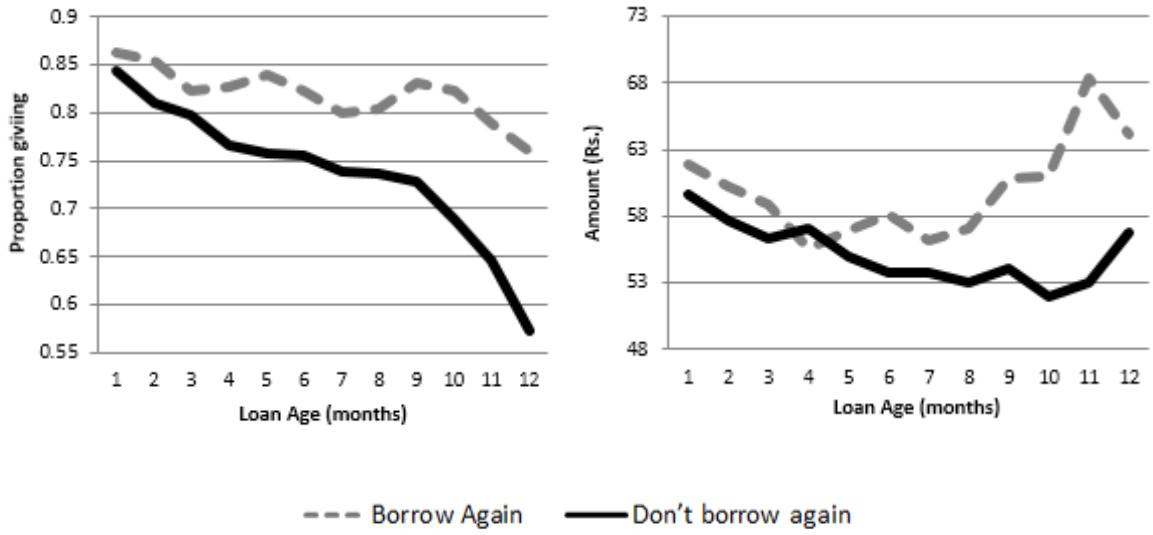


Figure 4: Voluntary Contribution Behaviour over the Loan cycle - Second Time Borrowers

(a) Likelihood of giving

(b) Average Amount Given



A Theoretical Appendix

In the following, we provide a characterisation of the credit market equilibrium with signalling. We then provide proofs of Lemma 1 and Results 1-2 introduced in Section 3. In the final subsection, we discuss potential extensions to the theoretical model.

A.1 Characterisation of Credit Market Equilibrium

We assume that, in equilibrium, the lender makes zero profits. This would hold true both for a for-profit firm operating in a competitive market with free entry, as well as for a non-profit firm that gives back any surplus to its borrowers in the form of lower interest charges. Using the zero-profit condition, we obtain

$$\mathbf{E}_\theta \left[\Pr\left(\text{success}\right)\left(X_j R_j + \tau_j\right)|\theta \geq \underline{\theta}_j\right] - X_j R_0 = 0$$

$$\implies R_j = \frac{R_0}{\mathbf{E}_\theta \left[\Pr\left(\text{success}\right)|\theta \geq \underline{\theta}_j\right]} - \mathbf{E}_\theta \left[\frac{\tau_j}{X_j}|\text{success}, \theta \geq \underline{\theta}_j\right] \tag{7}$$

We see from (7) that voluntary contributions (either because of the 'warm glow' effect or because of signalling) drive down the equilibrium interest rate. Note that (7) ignores donations that the lender may receive from non-borrowers; such donations could make interest-free loans, such as those offered by Akhuwat, viable. But the formulation is sufficient to demonstrate the signalling motive behind voluntary contributions, as we show below.

Consider a potential borrower with ability $k \in \{k_h, k_l\}$. We denote by θ the lender's probability that the borrower has high ability. We denote by $V\left(k, \theta\right)$ the expected continuation payoff to the borrower from making the optimal loan choice and voluntary contributions in each period. Then the optimal loan choice can be represented by the following Bellman equation:

$$\max_{j, \{(c^s, \tau^s)\}_{s \in \{h,l,f\}}} V\left(k, \theta\right) = \sum_{s \in \{h,l,f\}} \pi^s_{jk} \left[U\left(c^s, \tau^s\right) + \beta V\left(k, \theta'\right)\right] \tag{8}$$

$$\text{s.t. } c^f, \tau^f = 0 \text{ and } c^s + \tau^s \leq Y^s_j - X_j R_j \text{ for } s = h, l$$

where θ' is the lender's updated belief based on the borrower's loan choice, project outcome and voluntary contributions in the current period. Using $V(k,\theta)$, we can derive a condition under which a signalling equilibrium can be sustained. Recall that a contribution $\tau > Y_j^l - X_j R_j$ is beyond the reach of a borrower with low output. Therefore, such a contribution signals high output, positively affects the lender's posterior beliefs about the borrower's skill level, and, thus, improves the chances of future loan approval. Formally, we have the following result:

Proposition 1 *Let* $\Pi_j^x = Y_j^x - X_j R_j$, $\tau_j^x(\alpha) = \alpha \Pi_j^x$ *for* $x \in \{h,l\}$. *Let* $\hat{\tau}_j = \Pi_j^l + \delta$ *where* $\delta > 0$ *is the smallest unit in the available currency. There is a separating equilibrium in which a borrower with skill level* k, *signal* θ, *preference parameter* α, *who has taken a loan for a project of type* j, *makes a voluntary contribution* $\tau_j^l(\alpha)$ *for low output and a contribution* $\hat{\tau}_j$ *for high output if and only if*

$$U\left(\Pi_j^h - \tau_j^h(\alpha), \tau_j^h(\alpha)\right) - U\left(\Pi_j^h - \hat{\tau}_j, \hat{\tau}_j\right) < \beta\left[V(k,\theta_\alpha) - V\left(k,\hat{\theta}\right)\right] \tag{9}$$

where θ_α *and* $\hat{\theta}$ *refer to the lender's posterior belief following transfers of* $\tau_j^h(\alpha)$ *and* $\hat{\tau}_j$ *respectively. If the condition in (9) does not hold, her contribution is* $\tau_j^h(\alpha)$ *for high output, and* $\tau_j^l(\alpha)$ *for low output.*

Proof. (**for Proposition 1**): By construction, a borrower who achieves low output on a project of type j cannot afford a contribution of size $\hat{\tau}_j$. Therefore, a borrower who makes a contribution of this size must signal high output to the lender. In the absence of signalling, the borrowers best alternative is to make a contribution based on altruism which yields $\tau_j^h(\alpha)$ based on utility maximisation. The right-hand side of (9) represents the future expected utility gain from making this contribution in the current period over a contribution of $\tau_j^h(\alpha)$. The left-hand side represents the utility cost of making this contribution in the current period. Therefore, if the condition in (9) holds, a contribution of $\hat{\tau}_j$ is incentive compatible for a borrower who has achieved high output. A contribution of τ_j^s is infeasible for a borrower with low output. In the absence of signalling, the best action available to a borrower with low output is

to make a contribution based on altruism which is $\tau_j^l(\alpha)$. This establishes that the proposed strategy profile constitutes an equilibrium.

Next, consider a strategy profile in which the borrower contributes $\tau_j^h(\alpha)$ when output is high and $\tau_j^l(\alpha)$ when output is low. A borrower with high output can signal this by making a contribution of $\hat{\tau}_j$ but, if the condition in (9) does not hold, such a contribution is not incentive compatible. A borrower with low output cannot make a contribution which has a signalling effect and, therefore, has no profitable deviation from $\tau_j^l(\alpha)$. Therefore, the proposed strategy profile constitutes an equilibrium. ■

The proposition implies that (i) when a borrower achieves low output, her voluntary contributions are motivated by 'warm glow' alone; (ii) when she achieves high output, her contributions may exceed the 'warm glow' level of contribution if the gain in terms of future loan prospects from signalling her skill level is sufficiently high. Note that if $\alpha\Pi_j^h \geq \hat{\tau}_j$, then the borrower simply makes the 'warm glow' level of contribution when output is high, but this is enough to indicate to the lender that she has achieved high output.

Next, we discuss the equivalent conditions in the case of joint liability loans. If the group is unable to repay the loan, this means that both projects have failed, or one project has failed while the other has achieved low output. In this situation, *any* positive contribution by one of the borrowers signals that she has achieved low output and, therefore, has a positive effect on the lender's posterior belief about her skill level. If a group is able to repay the loan, this means that both borrowers have achieved at least low output, or that one project has failed while the other project has achieved high output. Once again, a positive contribution has a positive effect on the lender's posterior belief by signalling that the contributor;s project has been successful. As in the case of individual liability loans, a borrower can signal high output by choosing $\tau > Y_j^l - X_j R_j$ as a borrower with low output (who participates in repayment) would not be able to make such a contribution. The following proposition summarises these results.

Proposition 2 *Consider two borrowers who have taken a joint liability loan for a*

project of type j. Let $\hat{\Pi}_j^h = Y_j^h - 2X_jR_j$. (i) Suppose the condition in (9) holds for some borrower $i \in \{1,2\}$ and for both Π_j^h and $\hat{\Pi}_j^h$. Then the voluntary contributions behaviour described in Proposition 1 holds true for borrower i whenever there is group repayment. (ii) Whether or not there is group repayment, any positive voluntary contribution has a signalling effect in the sense that $V\left(k_i, \hat{\theta}\right) > V\left(k_i, \theta_0\right)$ where θ_0 and $\hat{\theta}$ refer to the lender's posterior belief following zero transfers and positive transfers respectively.

Proof. (for Proposition 2): (i) If borrower i has achieved high output, group repayment will occur because of the assumption $Y_j^h > 2X_jR_j$. Then if the condition in (9) holds for both Π_j^h and $\hat{\Pi}_j^h$, borrower i has sufficient incentive to make the transfer $\hat{\tau}_j$ to signal high output. (ii) Suppose the group has defaulted. Since a group does not default when at least one borrower has achieved high output, it must be that, for both borrowers, the project has failed or resulted in low output. Therefore, a borrower who makes a positive contribution unambiguously signals low output. A borrower who makes no contribution must have a positive probability of failure because those with failed projects necessarily make zero contributions. Therefore, positive contributions raise the lender's posterior probability of high ability, and, as per the reasoning behind Result 1, positive contributions raise the probability that a repeat loan application is approved. Therefore, $V\left(k_i, \hat{\theta}\right) > V\left(k_i, \theta_0\right)$. ■

A.2 Proofs of Lemma and Results

Proof. (for Lemma 1): (i) Consider a borrower with an individual liability loan to whom the lender assigns a probability θ of being of high ability. If the borrower makes full repayment on the loan, then the lender's posterior belief that the borrower has high

ability can be obtained using Bayes' Rule as follows:

$$\begin{aligned}\Pr\left(k=k_h|\text{repayment}\right) &= \frac{\Pr\left(\text{repayment}|k=k_h\right)\Pr\left(k=k_h\right)}{\Pr\left(\text{repayment}\right)} \\ &= \frac{\left(1-\pi_{jh}^{f}\right)\theta}{\left(1-\pi_{jh}^{f}\right)\theta+\left(1-\pi_{jl}^{f}\right)\left(1-\theta\right)} \\ &= \frac{\theta}{\theta+\left(\frac{1-\pi_{jl}^{f}}{1-\pi_{jh}^{f}}\right)\left(1-\theta\right)} \end{aligned} \tag{10}$$

By assumption, $\pi_{jh}^{f} < \pi_{jl}^{f} \iff \left(\frac{1-\pi_{jl}^{f}}{1-\pi_{jh}^{f}}\right) < 1$. Therefpre, if $\theta < 1$, the last expression in (10) is greater than θ. Thus, loan repayment raises the posterior probability that the borrower has high ability.

Consider two borrowers with a joint liability loan, labelled 1 and 2, to whom the lender assigns probability θ_1 and θ_2 of being of high ability. If the borrowing group makes full repayment on the loan, then the lender's posterior belief that borrower 1 has high ability is given by

$$\Pr\left(k_1=k_h|\text{repayment}\right) = \frac{\Pr\left(\text{repayment}|k_1=k_h\right)\Pr\left(k_1=k_h\right)}{\Pr\left(\text{repayment}\right)}$$

$$\begin{aligned} &= \frac{\left\{\pi_{j2}^{h}+\pi_{j2}^{l}\left(1-\pi_{jh}^{f}\right)+\pi_{j2}^{f}\pi_{jh}^{h}\right\}\theta_1}{\left\{\pi_{j2}^{h}+\pi_{j2}^{l}\left(1-\pi_{jh}^{f}\right)+\pi_{j2}^{f}\pi_{jh}^{h}\right\}\theta_1+\left\{\pi_{j2}^{h}+\pi_{j2}^{l}\left(1-\pi_{jl}^{f}\right)+\pi_{j2}^{f}\pi_{jl}^{h}\right\}\left(1-\theta_1\right)} \\ &= \frac{\theta_1}{\theta_1+\left\{\frac{\pi_{j2}^{h}+\pi_{j2}^{l}\left(1-\pi_{jl}^{f}\right)+\pi_{j2}^{f}\pi_{jl}^{h}}{\pi_{j2}^{h}+\pi_{j2}^{l}\left(1-\pi_{jh}^{f}\right)+\pi_{j2}^{f}\pi_{jh}^{h}}\right\}\left(1-\theta_1\right)} \end{aligned} \tag{11}$$

where π_{j2}^{h} and π_{j2}^{l} are the probabilities with which borrower 2 achieves high and low output respectively (specifically, $\pi_{j2}^{h}=\theta_2\pi_{jh}^{h}+\left(1+\theta_2\right)\pi_{jl}^{h}$ and $\pi_{j2}^{l}=\theta_2\pi_{jh}^{l}+\left(1+\theta_2\right)\pi_{jl}^{l}$). By assumption, $\pi_{jh}^{f} < \pi_{jl}^{f}$ and $\pi_{jh}^{h} > \pi_{jl}^{h}$. It follows that $\pi_{j2}^{h}+\pi_{j2}^{l}\left(1-\pi_{jh}^{f}\right)+\pi_{j2}^{f}\pi_{jh}^{h} > \pi_{j2}^{h}+\pi_{j2}^{l}\left(1-\pi_{jl}^{f}\right)+\pi_{j2}^{f}\pi_{jl}^{h} \iff \left\{\frac{\pi_{j2}^{h}+\pi_{j2}^{l}\left(1-\pi_{jl}^{f}\right)+\pi_{j2}^{f}\pi_{jl}^{h}}{\pi_{j2}^{h}+\pi_{j2}^{l}\left(1-\pi_{jh}^{f}\right)+\pi_{j2}^{f}\pi_{jh}^{h}}\right\} < 1$. Therefore, if $\theta_1 < 1$, the expression in (11) is greater than θ_1. The equivalent result for borrower 2 can be derived based on the same reasoning.

(ii) In the case of an individual liability loan, 'repayment discipline' means that the

borrower obtained some income at stage zero. Therefore

$$\Pr\left(k=k_h|\text{repayment disclipine}\right)=\frac{\Pr\left(\text{repayment disclipine}|k=k_h\right)\Pr\left(k=k_h\right)}{\Pr\left(\text{repayment disclipine}\right)}$$

$$\begin{aligned}&=\frac{\left(\pi_{jh}^{h}+\pi_{jh}^{l}\right)\theta}{\left(\pi_{jh}^{h}+\pi_{jh}^{l}\right)\theta+\left(\pi_{jl}^{h}+\pi_{jl}^{l}\right)\left(1-\theta\right)}\\&=\frac{\theta}{\theta+\left(\frac{\pi_{jl}^{h}+\pi_{jl}^{l}}{\pi_{jh}^{h}+\pi_{jh}^{l}}\right)\left(1-\theta\right)}\end{aligned}\tag{12}$$

Using the assumption $\pi_{jh}^{f}<\pi_{jl}^{f}\iff\left(\frac{1-\pi_{jl}^{f}}{1-\pi_{jh}^{f}}\right)=\left(\frac{\pi_{jl}^{h}+\pi_{jl}^{l}}{\pi_{jh}^{h}+\pi_{jh}^{l}}\right)<1$. Then, if $\theta<1$, comparing (10) and (12) we obtain $\Pr\left(k=k_h|\text{repayment disclipine}\right)>\theta$. Thus, repayment discipline at stage 0 raises posterior probability of high ability for borrowers with individual liability loans.

In the case of a joint liability loan, 'repayment discipline' means that *both* borrowers had some income at stage zero. Therefore,

$$\Pr\left(k_1=k_h|\text{repayment discipline}\right)=\frac{\Pr\left(\text{repayment discipline}|k_1=k_h\right)\Pr\left(k_1=k_h\right)}{\Pr\left(\text{repayment discipline}\right)}$$

$$\begin{aligned}&=\frac{\left(\pi_{j2}^{h}+\pi_{j2}^{l}\right)\left(\pi_{jh}^{h}+\pi_{jh}^{l}\right)\theta_1}{\left(\pi_{j2}^{h}+\pi_{j2}^{l}\right)\left(\pi_{jh}^{h}+\pi_{jh}^{l}\right)\theta_1+\left(\pi_{j2}^{h}+\pi_{j2}^{l}\right)\left(\pi_{jl}^{h}+\pi_{jl}^{l}\right)\left(1-\theta_1\right)}\\&=\frac{\theta_1}{\theta_1+\left(\frac{\pi_{jl}^{h}+\pi_{jl}^{l}}{\pi_{jh}^{h}+\pi_{jh}^{l}}\right)\left(1-\theta_1\right)}\end{aligned}\tag{13}$$

As shown above, $\frac{\pi_{jl}^{h}+\pi_{jl}^{l}}{\pi_{jh}^{h}+\pi_{jh}^{l}}<1$. Therefore, if $\theta<1$, the expression in (13) is greater than θ_1 which implies that repayment discipline at stage zero raises the posterior probability that the borrower has high ability. The equivalent result for borrower 2 can be derived based on the same reasoning. ■

Proof. (for Result 1): The expected return on an individual liability loan for a project of type j to a borrower i with $\Pr\left(k_i=k_h\right)=\theta$ covers the cost of the loan to the lender if and only if

$$\Pr\left(\text{success}|\theta\right)\left\{X_jR_j+\mathbf{E}\left(\tau|\text{success},\theta\right)\right\}-X_jR_0\geq 0\tag{14}$$

where τ represents the borrower's total voluntary contributions over the loan cycle. By assumption, $\Pr(\text{success}|\theta)$ is increasing in θ. Furthermore, we can show that $\mathbf{E}(\tau|\text{success},\theta)$ is increasing in θ (because $\mathbf{E}\left(\tau|\tilde{Y}_j = Y_j^h\right) \geq \mathbf{E}\left(\tau|\tilde{Y}_j = Y_j^l\right)$ and, by assumption, $\Pr\left(\tilde{Y}_j = Y_j^h|\text{success},\theta\right)$ is increasing in θ). Therefore, if the condition in (14) is satisfied for $\theta = 1$ for some j, there exists some threshold value $\underline{\theta}_j \in [0,1]$ such that a profit-maximising lender will approve a loan application for a project of type j if and only if $\theta \geq \underline{\theta}_j$.

Consider a borrower who initially has a loan (individual or joint liability) for a project of type j_1 and subsequently applies for a loan of type j_2. We denote by θ and θ' the lender's belief that the borrower is high-skilled at the time of application for the first and second loan respectively. Suppose θ is drawn from a population with a c.d.f. $\Theta(.)$. According to Lemma 1, loan repayment and repayment discipline for project j_1 raise the posterior probability that the borrower is high-skilled, i.e. $\theta' > \theta$. Based on the same reasoning, we can show that default and lack of repayment discpline lower the posterior probability that the borrower is high-skilled. Therefore $\Pr\left(\theta' \geq \underline{\theta}_j|\text{repayment}\right) > \Pr\left(\theta' \geq \underline{\theta}_j|\text{default}\right)$ and $\Pr\left(\theta' \geq \underline{\theta}_j|\text{repayment discipline}\right) > \Pr\left(\theta' \geq \underline{\theta}_j|\text{no repayment discipline}\right)$. ■

Proof. (for Result 2): Let us denote by θ the lender's prior probability that a borrower has high ability. If the borrower has an individual liability loan that is repaid with discipline, we obtain, using Bayes' Rule

$$\Pr(k = k_h|\text{repayment discipline}) = \frac{\theta\left(\pi_{jh}^h + \pi_{jh}^l\right)}{\theta\left(\pi_{jh}^h + \pi_{jh}^l\right) + (1-\theta)\left(\pi_{jl}^h + \pi_{jl}^l\right)} = \frac{\theta}{\theta + (1-\theta)\left(\frac{\pi_{jl}^h + \pi_{jl}^l}{\pi_{jh}^h + \pi_{jh}^l}\right)} \tag{15}$$

$$\Pr\left(k = k_h|\text{repayment discipline},\tilde{Y}_j = Y_j^h\right) = \frac{\theta\pi_{jh}^h}{\theta\pi_{jh}^h + (1-\theta)\pi_{jl}^h} = \frac{\theta}{\theta + (1-\theta)\left(\frac{\pi_{jl}^h}{\pi_{jh}^h}\right)} \tag{16}$$

By assumption, $\frac{\pi_{jh}^l}{\pi_{jh}^h + \pi_{jh}^l} < \frac{\pi_{jl}^l}{\pi_{jl}^h + \pi_{jl}^l} \iff \frac{\pi_{jl}^h}{\pi_{jl}^h + \pi_{jl}^l} < \frac{\pi_{jh}^h}{\pi_{jh}^h + \pi_{jh}^l} \iff \frac{\pi_{jl}^h}{\pi_{jh}^h} < \frac{\pi_{jl}^h + \pi_{jl}^l}{\pi_{jh}^h + \pi_{jh}^l}$. Then, comparing (15) and (16), we see that, if $\theta < 1$, we obtain $\Pr\left(k = k_h|\text{repayment discipline},\tilde{Y}_j = Y_j^h\right) > \Pr(k = k_h|\text{repayment discipline})$. In any separating equilibrium, borrowers with high output must make higher transfers.

If not, borrowers with low output can deviate to the transfers made by those with high output and, thus, raise expected utility. Proposition 1 provides the conditions under which one such separating equilibrium can be sustained. In a pooling equilibrium, voluntary contributions will be identical across borrowers with high and low output. Therefore, higher voluntary contributions will (weakly) raise the posterior probability that the borrower has high ability. Then, following the reasoning behind Result 1, higher voluntary contributions will (weakly) raise the probability that a repeat loan application is approved.

Next, suppose the borrower has a joint liability loan that is repaid with discipline. By assumption, this occurs if and only if both borrowers in the joint liability group have achieved at least low output. Therefore, using Bayes' Rule, we obtain

$$\begin{aligned}\Pr\left(k=k_h|\text{repayment discipine}\right) &= \frac{\left(\pi_{j2}^h+\pi_{j2}^l\right)\left(\pi_{jh}^h+\pi_{jh}^l\right)\theta}{\left(\pi_{j2}^h+\pi_{j2}^l\right)\left(\pi_{jh}^h+\pi_{jh}^l\right)\theta+\left(\pi_{j2}^h+\pi_{j2}^l\right)\left(\pi_{jl}^h+\pi_{jl}^l\right)(1-\theta)} \\ &= \frac{\theta}{\theta+\left(\frac{\pi_{jl}^h+\pi_{jl}^l}{\pi_{jh}^h+\pi_{jh}^l}\right)(1-\theta)} \qquad (17)\end{aligned}$$

$$\begin{aligned}\Pr\left(k=k_h|\text{repayment discipine},\tilde{Y}_j=Y_j^h\right) &= \frac{\left(\pi_{j2}^h+\pi_{j2}^l\right)\pi_{jh}^h\theta}{\left(\pi_{j2}^h+\pi_{j2}^l\right)\pi_{jh}^h\theta+\left(\pi_{j2}^h+\pi_{j2}^l\right)\pi_{jl}^h(1-\theta)} \\ &= \frac{\theta}{\theta+\left(\frac{\pi_{jl}^h}{\pi_{jh}^h}\right)(1-\theta)} \qquad (18)\end{aligned}$$

where π_{j2}^h and π_{j2}^l are the probabilities with which the other borrower in the joint liability group achieves high and low output respectively. The expressions obtained in (17) and (18) are identical to those in (15) and (16). Therefore, following the reasoning above, if $\theta < 1$, we obtain $\Pr\left(k=k_h|\text{repayment discipline},\tilde{Y}_j=Y_j^h\right) > \Pr\left(k=k_h|\text{repayment discipine}\right)$. If there is repayment discipline then, as per the reasoning above, in a separating equilibrium borrowers with high output must make higher transfers while, in a pooling equilibrium, transfers from borrowers with high and low output will be identical. Proposition 2 provides the conditions under which one such separating equilibrium can be sustained. If there is no repayment discipline then, by assumption, at least one project in the group has failed. Then a positive voluntary

contribution by a member of the group signals that her own project has succeeded and, thus, raises the lender's posterior probability that this borrower has high ability. Together, these arguments imply, once again, that higher voluntary contributions by an individual borrower will (weakly) raise the posterior probability that she has high ability. Then, following the reasoning used in the proof of Result 1, higher voluntary contributions will (weakly) raise the probability that a repeat loan application is approved. (ii) In a joint liability loan, if there is repayment discipline, then the signalling effect of voluntary contributions are identical to that in an individual liability loan. More precisely, if there exists a particular separating equilibrium in an individual liability loan (where borrowers with high output make voluntary contributions above a certain threshold, and those with low output make a contribution below the threshold), there is an equivalent separating equilibrium, with the same threshold, in the case of a joint liability loan when both projects have been successful. In addition, if there no repayment discipline in a joint liability loan (whether or not the loan is repaid) then, as argued in part (i) *any* positive contributions by a borrower raise the lender's posterior belief that that borrower has high ability. Thus, the lender's beliefs and, consequently, the decision over whether to approve a repeat loan, is more responsive to voluntary contributions from borrowers in the case of a joint liability loan than in the case of an individual liability loan. ■

Proof. (for Result 3): We consider separately the case of (i) individual liability loans and (ii) that of joint liability loans.

(i) Consider, first, a borrower with preference parameter and an individual liability loan. At stage zero, the borrower learns whether her project has been successful. If the project is unsuccessful, she has no resources available to make voluntary contributions during the loan cycle. If successful, she obtains an income of Y_j^l and knows that she will have an income of at least $\left(Y_j^l - X_j R_j\right)$ at her disposal after the loan has been repaid. Therefore, she would want to make a voluntary contribution of at least $\alpha\left(Y_j^l - X_j R_j\right)$ during the loan cycle, motivated by 'warm glow'. At stage zero, repayment discipline signals to the lender that a project has been successful, and

no information is available to successful borrowers about whether their project will generate low or high output. Therefore, contributions at stage zero have no signalling purpose, and contributions at stage zero above $\alpha\left(Y_j^l - X_j R_j\right)$ would be suboptimal if the project generates no additional return at stage one. Therefore, the borrower pledges voluntary contributions of $\alpha\left(Y_j^l - X_j R_j\right)$ at stage zero.

At stage one, a borrower with a successful project learns if output is high or low. If output is low, she has no incentive to pledge additioinal voluntary contributions (beyond the $\alpha\left(Y_j^l - X_j R_j\right)$ already pledged). If output is high, then total contributions motivated by 'warm glow' will equal $\alpha\left(Y_j^h - X_j R_j\right) = \alpha\left(Y_j^l - X_j R_j\right) + \alpha\left(Y_j^h - Y_j^l\right)$. In addition, in a separating equilibrium, the borrower with high output will make an additional contribution at stage one for signalling purposes as per the reasoning of Result 2. Therefore, at stage zero successful borrowers pledge voluntary contributions motivated by 'warm glow' only; successful borrowers with high output pledge voluntary contributions motivated by 'warm glow' and signalling.

(ii) Consider a borrower with preference parameter α and a joint liability loan. At stage zero, the borrower learns her own project outcome as well as her total debt liability. If her own project has been unsuccessful, she has no resources available to make voluntary contributions during the loan cycle. If both projects in the group have been successful, then she will know at stage zero that her disposal income, after the group loan has been repaid, will be at least $\left(Y_j^l - X_j R_j\right)$. Therefore, she will make a voluntary contribution of $\alpha\left(Y_j^l - X_j R_j\right)$ at stage zero, motivated by 'warm glow'. If her own project has been successful but the other group member's project has been unsuccessful, then no repayment will be made at stage zero. Then, as per the reasoning of Result 2, any positive voluntary contribution by her signals that her project has been successful, and raises the lender's posterior probability that she has high ability.

At stage one, a borrower with a successful project learns if output is high or low. In groups where both projects have been successful, her disposal income after loan repayment, and the lender's information about the borrowers' abilities, are identical to the case of successful borrowers with individual liability loans. Therefore, her

voluntary contributions are identical to those obtained in case (i). In groups where one project has failed, and the other has been successful, there is no signalling motive for additional voluntary contributions at stage one because the voluntary contribution pledge at stage zero coupled with the group's repayment record is sufficient to inform the lender about the borrowers' output levels. Therefore, at stage zero, successful borrowers make voluntary contributions motivated by 'warm glow' and signalling; at stage one, successful borrowers with high output make additional voluntary contributions motivated by 'warm glow' and signalling if both group members have been successful, and by 'warm glow' alone if the other group member has been unsuccessful. ■

A.3 Extensions to the Model

Savings: In the model presented in Section 3, we assume that an individual cannot save income from one period to the next, and that no liquid assets of their own can be used for investments. We discuss here how the main results of the model can be extended to a setting in which individuals do have access to an intertemporal technology. In this setting, when an individual is choosing from the menu of loan contracts on offer, they have, potentially, an additional choice: she can decide whether to use her own liquid assets for the purpose of investment. It is reasonable to assume that a loan applicant's assets have some degree of observability, such that the lender is able to restrict loans to applicants below a certain level of wealth, in line with its social objectives.

If borrowers have some liquid assets of their own, they may be able to repay loans, and to maintain repayment discipline even when their own projects fail. Thus, loan repayment and repayment discipline provide less information about the borrower's ability than in the model presented in Section 3. For the same reason, individuals with failed projects or low output may be able to make sizeable voluntary contributions, which would make it more difficult for the lender to discern output from the level of voluntary contributions. Nevertheless, if the marginal utility of consumption is

decreasing in consumption (as we have assumed), then, for any given wealth, the disutility of a particular level of voluntary contributions is lower when output is high compared to when output is low. Therefore, there is, potentially, a threshold level of contributions such that borrowers with high output would find it attractive to satisfy this threshold to obtain another loan, while those with low output or failed projects would not. If so, a signalling equilibrium can be sustained in a setting where savings are allowed.

Learning about Ability: In the model presented in Section 3, we assume that individuals have knowledge of their own ability. An alternative formulation would be that individuals learn about their ability from observing their project outcomes. In this setting, past experience with projects would affect what projects, and loans, an individual pursues in the future. But note that the lender learns about the borrower ability in the same manner as in our basic model. More precisely, the lender can update beliefs about the borrower's ability on the basis of repayment status, repayment discipline and voluntary contributions as discussed in Section 3. Therefore, the borrower's signalling motive for voluntary contributions are nearly identical to those we have presented, except that these motives are now affected by what they have learnt so far about their own ability.

Learning by Doing: Another alternative is that borrowers are differentiated not by ability but by skill, and that their skill is affected by their past experience with projects. Those who have successfully learnt from their previous project achieve high output while those who have failed to learn achieve low or zero output. The lender does not observe the skill level of individuals or their project outcomes. Then, as in our basic model, the lender will use the loan repayment status and repayment discipline to infer their borrowers' project outcomes and, thus, their current skill levels. The borrower has similar incentives to signal project success or high output via voluntary contributions.