Lending maturity of microcredit and dependence on moneylenders *

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Abstract

Despite the expanding access to the low-interest credit including microcredit in developing countries, the presense of informal moneylenders still remains substantial and some studies even show that the introduction of microcredit programs increased the borrowing from high-interest moneylenders instead of decreasing it. We show that the short maturity combined with the borrower's consumption smoothing motive can explain the increased borrowing from the moneylender as well as the high sensitivity of the credit demand to loan maturity. Our theoretical model suggests that whether the microcredit programs increases the average borrowing from the moneylender depends on the distribution of the investment returns and the interest rates of microcredit and moneylender, as well as the loan maturity. The simple numerical excercises show that with plausible value of the parameters, the introduction of microcredit actually can increase the average borrowing from the moneylender especially when the distribution of the investment return is not so preferable. We also show that the expansion of the lending maturity will reduce the dependence on the moneylender and increase the uptake rate of microcredit and investment, and the sufficient expansion of the lending maturity will eliminate the case where the introduction of microcredit will increase the average borrowing amount from the moneylender. Our results imply the average treatment effect of microcredit on the informal borrowing will crucially depend on the underlying parameter values, and without clear understanding of the mechanisms, applying the estimated results obtained in one setting to some other settings will be misleading.

Keywords microcredit, flexible repayment schedule, maturity expansion, informal lenders

JEL Classification G21, O16, O17,

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1 Introduction

Despite the expanding access to the low-interest credit including microcredit in developing countries, the presense of informal moneylenders still remains substantial (Sinha and Matin, 1998; Collins et al., 2009). Some studies even show that the introduction of microcredit programs or village banks increased the borrowing from high-interest moneylenders instead of decreasing it (Coleman, 1999; Jain and Mansuri, 2003). Given the fact that to "eliminate the exploitation of the poor by money lenders" was one of the objectives of the Grameen Bank Project, a pioneering microcredit institution started in 1976, [1] and the recent repayment crises in some microcredit institutions in several countries mainly driven by the multiple debt, the increasing borrowing from moneylender may seem an inconvenient truth.

Coleman (1999) argues that this increase is because many villagers joined the program largely for social reasons, e.g. to "be a part of the group" or because they assumed that any NGO program would be beneficial to them, resulting in many credit distributed without any profitable projects to invest in. Jain and Mansuri (2003) attribute the increase to the immediate and regular repayment schedule employed by the microcredit institutions which requires borrowers to repay the installment before the investment generates the income, making the borrowers need to borrow from the local moneylenders. Another oft-heard explanation is that because microcredit is "micro", borrowers need to borrow from moneylenders to implement the investment.

This paper focuses on the maturity of the microcredit programs which are often shorter than the gestation period of the investment project. We show that this short maturity combined with the borrower's consumption smoothing motive can explain the increased borrowing from the moneylender as well as the high sensitivity of the credit demand to loan maturity. Our theoretical model suggests that whether the microcredit programs increases the average borrowing from the moneylender depends on the distribution of the investment returns and the interest rates of microcredit and moneylender, as well as the loan maturity. The simple numerical excercises show that with plausible value of the parameters, the introduction of microcredit actually can increase the average borrowing from the moneylender.

The interaction between the maturity, consumption smoothing, and borrowing from moneylender is well illustrated by an example based on a female microcredit borrower we met in rural India. She plans to buy a buffalo at the price of \$200, which produces milk generating daily income of \$1 over three years. She can borrow up to \$200 from the MFI with annual simple interest rate of 10 percent, but she needs to repay both of the principal and interest in 50 week installments. On the other hand, a local moneylender employs more flexible repayment schedule and only requires the monthly interest to be repaid in the first year, though its annual interest rate is much higher, say, 50 percent. If she borrows \$200 from the MFI, the weekly repayment burden in the first year

[1] Grameen Bank's website: `http://www.grameen-info.org`.

is \$4.4 ($200 \times 1.1/50$). On the other hand, if she borrows \$100 from the MFI and \$100 from the moneylender, the weekly repayment amount is \$2.2 ($100 \times 1.1/50$) to the MFI and \$1 ($100 \times 0.5/50$), summing up to \$3.2. Given her average weekly income of \$7, these lead to a substantial difference in the weekly disposable income, \$2.6 vs. \$3.8. Thus the consumption smoothing motivation induces people to choose the latter strategy, making the borrower dependent on the moneylender.

We construct a two-period model which shows that the borrower will not use the maximum amount of the microcredit loan and finance part of the investment by borrowing from the moneylender, especially when the elasticity of intertemporal substitution is low. In this case, increasing the maximum loan size does not change borrowers' decision and will not affect the dependency on moneylenders. Then we execute numerical examples to show that when the distribution of the investment return is not so preferable, the introduction of microcredit program will increase the average borrowing amount from the moneylender. The expansion of the maturity of the microcredit loan will reduce the dependency on moneylenders, increase the uptake rate of microcredit, and eliminates the case where the introduction of microcredit results in the increase in the average borrowing amount from the moneylender. These results suggest that the expansion of the maturity not only increases the uptake rate of microcredit as shown in Karlan and Zinman (2008) but also influence the composition of the borrowing which is preferable to the borrowers (decreases the total interest repayment). Our model suggests that whether the introduction of the microcredit increases the dependency on the local moneylender crucially depends on the underlying parameter such as the loan maturity, the interest rates of the microcredit and local moneylenders, and the distribution of the investment returns. This will explain why some studies find the increased borrowing from the local moneylenders (Coleman, 1999; Jain and Mansuri, 2003) and others do not Karlan and Zinman (2011).

There are a growing number of randomized control trials which evaluate the average impacts of the programs. However, this paper shows that the impact of the microcredit on the borrowing from moneylenders will be positive in a range of parameter values and will be negative in the other values of the parameters. This implies that in some outcome variables, the problem of external validity is quite important. Without clear understanding of the mechanisms, applying the estimated results obtained in one setting to some other settings will be misleading.

The most related study to ours is Jain and Mansuri (2003), who focus on the immediate and regular repayment schedule and argue that the MFI intentionally employs this repayment schedule to have the borrower rely on the informal moneylender who can monitor the borrower's action and curve the moral hazard behavior. Instead, our focus is on how the loan maturity combined with the consumption smoothing motives affects the borrower's choice of the loan composition and to provide the simulation results that the introduction of microcredit can actually increase the average borrowing amount from moneylenders under realistic parameter values, and show how the maturity expansion benefits the borrowers. We believe this focus is important given that many practitioners do not recognize how the short maturity of the microcredit makes the poor borrowers increases the dependency on the moneylenders and how the maturity expansion saves their interest rate payment. Since the link between the maturity and the dependence on moneylenders is generated by the consumption smoothing motive, we need to deviate from the linear utility function, which Jain and Mansuri (2003) employs for analytical simplicity, and rely on the numerical examples because we cannot have the explicit form of the dependence or the parameter ranges which support increased borrowing from the moneylender.

Our study relates to the study on the rigidity in microcredit lending. Karlan and Mullainathan (2009) argue how the rigidity of most microcredit programs hinder the further development of financial services for the poor, focusing on the weekly repayment schedule which starts immediately after the loan disbursement and requires the constant installment regardless of the income seasonality. Field and Pande (2008) report that after the experimental introduction of monthly installment instead of weekly installment does not affect the repayment rates. Field et al. (2010) conducted a field experiment of introducing two-month grace period of no repayment after the loan disbursement and finds that this intervention increases the profitable risky investment and the average borrower's profit, though it also decreases the repayment rates. Our results suggest that the impact of the maturity expansion on the investment decision and the loan portfolio should be examined, and that it is crucially important to understand under which ranges of environmental parameters we are conducting the survey when we interpret the results. This points the importance of having explicit economic theory before implementing field experiments and in interpreting the empirical results.

The paper is organized as follows. The following section presents the basic model where the microcredit loan requires both the principal and interest to be paid in the first period. We also provide some numerical examples under plausible parameter values. Section 3 presents how the longer maturity affects the borrower's decision and its effect on the average borrowing amount of the economy. Section 4 provides the alternative model where we allow the agent to borrow from the moneylender to repay the microcredit loans and shows that the quantitative results still remain. Section 5 offers concluding remarks.

2 The Model

2.1 Basic Model

We consider a two period model with instantaneous utility function $u(\cdot)$, where $u' > 0$, $u'' < 0$ and $u''' > 0$, and discount factor δ. An agent has an investment project which requires one unit of capital and yields a return of $Y_I > 1$ in each period. The agent cannot finance this investment capital and thus need to borrow from the MFI and/or the informal money lenders to implement the investment. The interest rates imposed by the MFI and the moneylender is denoted by r and

i, respectively, where we assume $r < i$. We also assume that the agent's discount rate is not so high, $\frac{1}{\delta} < 1 + r < 1 + i$, to exclude the case where the agent prefers to borrow without making the investment. The agent has a steady income flow $Y_S \geq 0$ in every period and thus if she does not make the investment, her lifetime utility will be $U^N = u(Y_S) + \delta u(Y_S)$.

The MFI requires both of the principle and interest to be repaid in the first period while the moneylender allows the flexible repayment scheme in which the borrowers can choose the fraction of the principal to repay to the moneylender in the first period, $\beta \in [0, 1]$, as long as they repay the interest. Let $\alpha \in [0, 1]$ be the loan amount from the MFI and $1 - \alpha$ from the moneylender. Then the required repayment amount in the first period is $(1+r)\alpha + (i+\beta)(1-\alpha)$ and that in the second period is $(1 + i)(1 - \beta)(1 - \alpha)$. We restrict our analysis to the case $1 + r > i$, that is, the interest of the moneylender is lower than the sum of the principal and interest of the microcredit loan. If this does not hold, then there are no needs to borrow from the moneylenders to reduce the repayment burden in the first period.

Suppose the agent chooses to make the investment. Then she chooses the loan amount from MFI, α, and the fraction of the principal to repay to the moneylender in the first period, β, to maximize her utility over the two periods. In the optimum there should be no savings and thus we can ignore the savings decision because the agent faces credit constraint, the loan from the MFI is required to be repaid in the first period, and the investment return is the same over the two periods. The borrower maximizes her life-time utility $U^I(\alpha, \beta)$:

$$\max_{\alpha,\beta} U^I(\alpha, \beta) = u\left[Y_I + Y_S - (1 + r)\alpha - (i + \beta)(1 - \alpha)\right] + \delta u\left[Y_I + Y_S - (1 + i)(1 - \beta)(1 - \alpha)\right].$$

subject to $\alpha \in [0, 1]$ and $\beta \in [0, 1]$. The first proposition characterizes the solution of this problem.

Proposition 1 *Borrowers will mix the borrowing source if and only if*

$$\frac{u'(Y_I + Y_S - (1 + r))}{u'(Y_I + Y_S)} > \frac{\delta(1 + i)}{1 + r - i}. \tag{1}$$

Borrowers never choose $\beta > 0$. The optimal α^* is decreasing in r and increasing in δ. If there is a sufficient precautionary savings motive, α^* is increasing in Y_I and Y_S. The effect of an increase in i is indetermined. Mixing borrowing source is more likely to happen when i and δ are low and r is high. If there is a sufficient precautionary savings motive, low Y_I and Y_S makes mixing borrowing source more likely to happen.

Proof:

The derivatives of $U^I(\alpha, \beta)$ with respect to α and β are

$$\frac{\partial U^I(\alpha, \beta)}{\partial \alpha} = -[(1 + r) - (i + \beta)]u'(c_1(\alpha, \beta)) + \delta(1 + i)(1 - \beta)u'(c_2(\alpha, \beta)), \tag{2}$$

$$\frac{\partial U^I(\alpha, \beta)}{\partial \beta} = -(1 - \alpha)u'(c_1^*) + \delta(1 + i)(1 - \alpha)u'(c_2^*), \tag{3}$$

where $c_1(\alpha,\beta) = Y_I + Y_S - (1+r)\alpha^* - (i+\beta^*)(1-\alpha^*)$ and $c_2(\alpha,\beta) = Y_I + Y_S - (1+i)(1-\beta^*)(1-\alpha^*)$. If the optimal $l = \alpha, \beta$ is an internal solution, $l^* \in (0,1)$, then we should have $\frac{\partial U^I(\alpha^*,\beta^*)}{\partial l} = 0$. If $l^* = 0$, then we should have $\frac{\partial U^I(\alpha^*,\beta^*)}{\partial l}|_{l=0} < 0$, and if $l^* = 1$, then $\frac{\partial U^I(\alpha^*,\beta^*)}{\partial l}|_{l=1} > 0$.

Step 1 (Prove $\beta^* = 0$): Note that if $\alpha = 1$, the agent does not borrow from the moneylender. So any positive value of β requires α to be in $[0,1)$. This implies that we should have $\frac{\partial U^I(\alpha,\beta)}{\partial \alpha} \leq 0$. Then we have

$$\frac{\partial U^I(\alpha,\beta)}{\partial \beta} \leq -(1-\alpha)u'(c_1^*) + \frac{1-\alpha}{1-\beta}[(1+r)-(i+\beta)]u'(c_1^*) = \frac{(1-\alpha)(r-i)}{1-\beta}u'(c_1^*) < 0,$$

which implies $\beta^* = 0$, where the first inequality follows from equation (2) and the last inequality follows from the assumption $r < i$.

Step 2 (Prove $\alpha^* \neq 0$): Given $\beta^* = 0$, we can rewrite the partial derivative of the objective function as

$$\frac{\partial U^I(\alpha)}{\partial \alpha} = -(1+r-i)u'(c_1^*) + \delta(1+i)u'(c_2^*).$$

Note that $(1+r-i) < 1 < \delta(1+i)$ by assumption. Suppose $\alpha = 0$. Then $c_1^* > c_2^*$, $u'(c_1^*) < u'(c_2^*)$, implying $\frac{dU^I(\alpha)}{d\alpha}|_{\alpha=0} > 0$, a contradiction.

Step 3 (Condition for $\alpha^* < 1$): Now we know that the optimal α satisfies $\frac{\partial U^I(\alpha^*)}{\partial \alpha} \geq 0$, and if $\alpha = 1$, then $c_1^* < c_2^*$ and whether $\frac{dU^I(\alpha)}{d\alpha}$ is equal to or larger than zero depends on the functional form. If $\frac{dU^I(\alpha)}{d\alpha}|_{\alpha=1} \equiv M < 0$, we should have $\alpha^* < 1$. Because $M = -(1+r-i)u'(Y_I+Y_S-(1+r)) + \delta(1+i)u'(Y_I+Y_S)$, this condition reduces to

$$\frac{u'(Y_I+Y_S-(1+r))}{u'(Y_I+Y_S)} > \frac{\delta(1+i)}{1+r-i}.$$

The optimal α satisfies $-(1+r-i)u'(Y_I+Y_S-(1+r)\alpha^*-i(1-\alpha^*))+\delta(1+i)u'(Y_I+Y_S-(1+i)(1-\alpha^*)) = 0$ and it is straightforward to show that the second order condition is satisfied.

Step 4 (Comparative statistics): Consider the case $\alpha^* < 1$. The implicit function theorem implies

$$\begin{aligned}
\frac{\partial \alpha}{\partial Y_I} &= \frac{\partial \alpha}{\partial Y_S} = \frac{(1+r-i)u''(c_1^*) - \delta(1+i)u''(c_2^*)}{D}, \\
\frac{\partial \alpha}{\partial i} &= -\frac{(1-\alpha^*)[(1+r-i)u''(c_1^*) - \delta(1+i)u''(c_2^*)] + u'(c_1) + \delta u'(c_2)}{D}, \\
\frac{\partial \alpha}{\partial r} &= \frac{u'(c_1^*) - \alpha^*(1+r-i)u''(c_1^*)}{D} < 0, \\
\frac{\partial \alpha}{\partial \delta} &= \frac{-(1+i)u'(c_2^*)}{D} > 0,
\end{aligned}$$

where

$$D = (1+r-i)^2 u''(c_1^*) + \delta(1+i)^2 u''(c_2^*) < 0.$$

$\frac{\partial \alpha}{\partial Y_I} > 0$ as long as $(1+r-i)u''(c_1^*) < \delta(1+i)u''(c_2^*)$, which will hold when $u'(\cdot)$ is sufficiently convex, or the agent has sufficiently large precautionary saving motive. $\frac{\partial \alpha}{\partial i}$ will be positive if α^* is close to 1, but if α^* is not close to 1 and there is a sufficiently large precautionary saving motive, it can be negative.

On the other hand, the comparative statics on M show

$$\begin{aligned}
\frac{\partial M}{\partial Y_I} &= \frac{\partial M}{\partial Y_S} = -(1+r-i)u''(Y_I + Y_S - (1+r)) + \delta(1+i)u''(Y_I + Y_S), \\
\frac{\partial M}{\partial i} &= u'(Y_I + Y_S - (1+r)) + \delta u'(Y_I + Y_S) > 0, \\
\frac{\partial M}{\partial r} &= -u'(Y_I + Y_S - (1+r)) + (1+r-i)u'(Y_I + Y_S - (1+r)) < 0, \\
\frac{\partial M}{\partial \delta} &= (1+i)u'(Y_I + Y_S) > 0.
\end{aligned}$$

♠

Given this decision rule, the agent will choose whether to make the investment. The agent will choose to make the investment if the utility when making the investment,

$$U^I(\alpha^*) = u\left[Y_I + Y_S - (1+r)\alpha^* - i(1-\alpha^*)\right] + \delta u\left[Y_I + Y_S - (1+i)(1-\alpha^*)\right],$$

is greater than the utility of not making the investment, $U^N = u(Y_S) + \delta u(Y_S)$. Because $U^I(\alpha^*)$ is a strictly increasing function of Y_I but U^N is independent of Y_I, there is a unique cutoff value of Y_I such that with any Y_I greater than $\hat{Y}_I$ the agent always makes the investment. $\hat{Y}_I$ should satisfies the following equation:

$$u\left[\hat{Y}_I + Y_S - (1+r)\hat{\alpha}^* - i(1-\hat{\alpha}^*)\right] + \delta u\left[\hat{Y}_I + Y_S - (1+i)(1-\hat{\alpha}^*)\right] = u(Y_S) + \delta u(Y_S) \tag{4}$$

where $\hat{\alpha}^*$ is the optimal level of α when $Y_I = \hat{Y}_I$. Let $\hat{c}_1^* = \hat{Y}_I + Y_S - (1+r)\hat{\alpha}^* - i(1-\hat{\alpha}^*)$ and $\hat{c}_2^* = \hat{Y}_I + Y_S - (1+i)(1-\hat{\alpha}^*)$. Note that the strict concavity of $u(\cdot)$ implies $\hat{c}_1^* < Y_S < \hat{c}_2^*$. Consider the case where $\alpha^* < 1$. Then the implicit function theorem and the envelope theorem implies

$$\frac{\partial \hat{Y}_I}{\partial Y_S} = \frac{u'(Y_S) + \delta u'(Y_S) - [u'(\hat{c}_1^*) + \delta u'(\hat{c}_2^*)]}{u'(\hat{c}_1^*) + \delta u'(\hat{c}_2^*)} < 0, \tag{5}$$

$$\begin{aligned}
\frac{\partial \hat{Y}_I}{\partial i} &= 1 - \alpha^* > 0, \\
\frac{\partial \hat{Y}_I}{\partial r} &= \frac{\hat{\alpha}^* u'(\hat{c}_1^*)}{u'(\hat{c}_1^*) + \delta u'(\hat{c}_2^*)} > 0,
\end{aligned}$$

$$\frac{\partial \hat{Y}_I}{\partial \delta} = \frac{u(Y_s) - U(c_2^*)}{u'(\hat{c}_1^*) + \delta u'(\hat{c}_2^*)} < 0. \tag{6}$$

The inequality in (5) follows from $\hat{c}_1^* < Y_S < \hat{c}_2^*$ and the convexity of $u'(\cdot)$. This implies that less steady income discourage people from making the investment even without investment risks. Thus given the investment return, poorer people who have less steady income are less likely to make the investment. The results on $\frac{\partial \hat{Y}_I}{\partial i}$ and $\frac{\partial \hat{Y}_I}{\partial r}$ are natural: higher interest rates discourage people from making the investment. The inequality in (6) follows from $Y_S < \hat{c}_2^*$. As δ gets higher and thus the agents evaluate the future more, the cutoff value for making the investment becomes smaller.

We summarize the results as a proposition.

Proposition 2 *Borrowers will make the investment if and only if the investment return Y_I exceeds $\hat{Y}_I$ which implicitly defined by (4). The threshold value $\hat{Y}_I$ is increasing in i and r and decreasing in Y_S and δ.*

2.1.1 Numerical Examples

Because the cutoff value $\hat{Y}_I$ is defined implicitly, we rely on numerical examples to see whether and when the agent makes the investment by mixing the borrowing source. We assume the CRRA utility function $u(c) = \frac{c^{1-\theta}-1}{1-\theta}$ and set $\delta = 0.95$. The CRRA utility function includes the log utility function $u(c) = \ln(c)$ as a special case of $\theta = 1$. Note that our propositions imply that the borrower is more likely to mix the borrowing source and rely more on the informal moneylender when δ is low. So if we use a lower discount rate, then we will observe mixing the borrowing source with larger parameter values and lower level of α^*. Also note that the empirical estimate of the elasticity of intertemporal substitution, which equals to $1/\theta$ in the CRRA utility function, varies across studies depending on the estimation methodology, in most cases it is close to 1 or 0.2-0.5, sometimes not significantly different from zero.[2] Thus in the numerical examples, we report the results when we set $\theta = 1$ and $\theta = 2$.

From (1), the condition for $\alpha^* < 1$ is

$$\left(\frac{Y_I + Y_S}{Y_I + Y_S - (1+r)}\right)^\theta > \frac{\delta(1+i)}{1+r-i}.$$

Because the term in the parentheses in the left-hand side is greater than 1, this expression clearly shows that the larger θ (lower elasticity of intertemporal substitution) makes $\alpha^* < 1$ more likely to happen.

The threshold value $\tilde{Y}_I$ below which we will have $\alpha^* < 1$ can be calculated as

$$\tilde{Y}_I = \frac{\delta^{\frac{1}{\theta}}(1+i)^{\frac{1}{\theta}}}{\delta^{\frac{1}{\theta}}(1+i)^{\frac{1}{\theta}} - (1+r-i)^{\frac{1}{\theta}}}(1+r) - Y_S$$

and the optimal level of the borrowing amount from the MFI is

$$\alpha^* = \min\left[1, 1 - \frac{\delta^{\frac{1}{\theta}}(1+i)^{\frac{1}{\theta}}(1+r) - [\delta^{\frac{1}{\theta}}(1+i)^{\frac{1}{\theta}} - (1+r-i)^{\frac{1}{\theta}}](Y_I + Y_S)}{(1+i)(1+r-i)^{\frac{1}{\theta}} + \delta^{\frac{1}{\theta}}(1+i)^{\frac{1}{\theta}}(1+r-i)}\right]. \qquad (7)$$

[2] See Yogo (2004) for the estimates for eleven developed countries and the econometric problem in estimating the elasticity of intertemporal substitution. In his estimation, the upper end of the 95% confidence interval is never greater than 0.5 across these eleven countries. Ogaki, Ostry, and Reinhart (1996) provides the estimates of the elasticity of intertemporal substitution for twelve developing countries, whose estimates range from 0.35 of India to 0.65 of Mexico.

The threshold value of Y_I, $\hat{Y}_I$, such that for all $Y_I > \hat{Y}_I$ the agent will make the investment can be obtained by (4)

How frequent we observe MFI borrowers also borrowing from moneylenders due to the short maturity of MFI depends on the width of the interval $(\hat{Y}_I, \tilde{Y}_I)$. In order to get the sense of the width of this interval, we report the width of this interval given a range of i and r when $Y_S = 0.2$ in Table 1. Because we assume $r < i$, we do not report the numbers in these cases.

Table 1: Examples of interval $(\hat{Y}_I, \tilde{Y}_I)$

When $\theta = 1$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	(0.68, 2.92)	(0.72, 2.12)	(0.77, 1.70)	(0.81, 1.44)	(0.85, 1.26)	(0.89, 1.13)	(0.94, 0.96)
$r = 0.2$	(0.71, 4.22)	(0.76, 2.81)	(0.81, 2.16)	(0.85, 1.78)	(0.90, 1.54)	(0.94, 1.37)	(1.01, 1.14)
$r = 0.3$	N.A.	(0.79, 3.82)	(0.84, 2.76)	(0.89, 2.21)	(0.94, 1.87)	(0.99, 1.64)	(1.07, 1.34)
$r = 0.4$	N.A.	N.A.	(0.87, 3.60)	(0.92, 2.76)	(0.98, 2.27)	(1.03, 1.96)	(1.12, 1.57)
When $\theta = 2$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	(0.68, 5.44)	(0.73, 3.81)	(0.78, 2.93)	(0.82, 2.38)	(0.87, 1.99)	(0.91, 1.69)	(0.99, 1.23)
$r = 0.2$	(0.71, 8.00)	(0.76, 5.15)	(0.81, 3.81)	(0.86, 3.03)	(0.91, 2.51)	(0.96, 2.12)	(1.05, 1.58)
$r = 0.3$	N.A.	(0.79, 7.13)	(0.84, 4.98)	(0.90, 3.85)	(0.95, 3.13)	(1.00, 2.63)	(1.10, 1.96)
$r = 0.4$	N.A.	N.A.	(0.87, 6.62)	(0.93, 4.90)	(0.98, 3.90)	(1.04, 3.23)	(1.14, 2.39)

The results show that while θ little affects $\hat{Y}_I$, the threshold for making the investment, it does affect $\tilde{Y}_I$, the threshold for $\alpha^* < 1$. When θ is large (the elasticity of intertemporal substitution is low), then the range $(\hat{Y}_I, \tilde{Y}_I)$ expands substantially.

Small i and large r also makes the interval quite wide. But even when i is quite large relative to r, we observe the mix of borrowing source. If $r = 0.1$ and $i = 0.5$, individuals with $Y_I \in (0.77, 1.70)$ if $\theta = 1$, or individuals with $Y_I \in (0.78, 2.93)$ if $\theta = 2$, will borrow both from MFIs and moneylenders to make investment. When $r = 0.1$ and $i = 0.8$, that is, the interest rate of moneylenders is eight times as high as that of MFIs, individuals with $Y_I \in (0.89, 1.13)$ if $\theta = 1$, or individuals with $Y_I \in (0.96, 1.69)$ if $\theta = 2$, will borrow both from MFIs and moneylenders to make investment. Remember that investment requires 1 unit of capital and generate Y in each of two periods. So $Y_I = 1.13$ or $Y = 1.69$ is not a small return. Further, with $r = 0.1$, the agent with $Y > 1.1$ is able to repay the loan by the earned investment return if they borrow 1 unit of the capital from the MFI only. But they will not choose to rely only on the MFI but opt to mix the borrowing sources. This suggests the importance of the short maturity of the microcredit to explain the coexistence of microcredit borrowing and moneylender borrowing.

Next we calculate the optimal amount of the borrowing from the moneylender, $1 - \alpha^*$, when $Y_S = 0.2$. Because α^* depends on Y_I, we report the level of $1 - \alpha^*$ when $Y_I = 1$ and $Y_I = 1.5$. Note that because the required capital for the investment is 1 and it produces the returns for two periods with discount factor $\delta = 0.95$, the case $Y_I = 1$ corresponds to the case where the return to the investment is nearly 100% and the case $Y_I = 1.5$ to the case of nearly 200% investment return. Also note that Table 1 shows that the investment will not be done with $Y_I = 1$ for some parameter values, thus we will not observe α^* in those cases. Now the optimal level of the borrowing amount from the moneylender, $1 - \alpha^*$ is reported in Table 2.

Table 2: Examples of the dependence on the moneylender, $1 - \alpha^*$: CRRA with $\theta = \{1, 2\}$ and $Y_I = \{1, 1.5\}$

$\theta = 1$ and $Y_I = 1$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.412	0.370	0.329	0.287	0.240	0.179	0.000
$r = 0.2$	0.473	0.440	0.410	0.385	0.362	0.342	N.A.
$r = 0.3$	N.A.	0.494	0.471	0.454	0.443	0.439	N.A.
$r = 0.4$	N.A.	N.A.	0.519	0.506	0.501	N.A.	N.A.
$\theta = 2$ and $Y_I = 1$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.469	0.449	0.431	0.415	0.399	0.382	0.314
$r = 0.2$	0.510	0.494	0.480	0.470	0.462	0.457	N.A.
$r = 0.3$	N.A.	0.530	0.519	0.512	0.508	N.A.	N.A.
$r = 0.4$	N.A.	N.A.	0.551	0.546	0.544	N.A.	N.A.
$\theta = 1$ and $Y_I = 1.5$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.305	0.205	0.094	0.000	0.000	0.000	0.000
$r = 0.2$	0.400	0.318	0.233	0.139	0.026	0.000	0.000
$r = 0.3$	N.A.	0.406	0.338	0.266	0.188	0.095	0.000
$r = 0.4$	N.A.	N.A.	0.419	0.362	0.304	0.241	0.071
$\theta = 2$ and $Y_I = 1.5$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.416	0.369	0.320	0.265	0.197	0.106	0.000
$r = 0.2$	0.473	0.434	0.395	0.354	0.308	0.254	0.061
$r = 0.3$	N.A.	0.487	0.454	0.422	0.389	0.352	0.252
$r = 0.4$	N.A.	N.A.	0.502	0.476	0.450	0.424	0.364

The optimal level of borrowing from the moneylender is quite large. If $Y_I = 1$ and $\theta = 2$, then for most values of the parameters, the dependence on the moneylender ranges from 0.4 to 0.6, implying that MFI borrowers will borrow a half of the investment amount from the moneylender. Even in the case where the investment is quite profitable, $Y_I = 1.5$, the ratio of the borrowing from the moneylender will be 26.5 percent. Only when $\theta = 1$ and $Y_I = 1.5$, we observe no or little reliance on the moneylender when r is small and i is large.

2.2 New Borrowing from Moneylenders Generated by Microcredit

Next we see the range of parameter values in which the introduction of microcredit generates the new demand for borrowing from moneylenders. This will happen when people did not make the investment without microcredit but do make the investment by borrowing both from the MFI and the moneylender if microcredit becomes available. We have already studied the condition that borrowers make the investment by borrowing both from the MFI and the moneylender. Thus what remains to be analyzed is the condition for borrowers not to make the investment without microcredit.

The life time utility from making the investment by borrowing from the moneylender only is

$$U^{I,NMC}(\beta) = u\left[Y_I + Y_S - (i + \beta)\right] + \delta u\left[Y_I + Y_S - (1+i)(1-\beta)\right].$$

where $\beta \in [0,1]$ is the fraction of the principal to repay to the money lender in the first period. The first order condition defines the optimal β implicitly as

$$u'\left[Y_I + Y_S - (i + \beta^*)\right] = \delta(1+i)u'\left[Y_I + Y_S - (1+i)(1-\beta^*)\right]. \tag{8}$$

The investment will not be made if $U^{I,NMC}(\beta^*) \leq U_N$. Since U^N is independent of Y_I, there is a unique cutoff value of Y_I such that with any Y_I less than or equal to $\bar{Y}_I$ the agent will not make the investment in the absence of microcredit. $\bar{Y}_I$ should satisfies the following equation:

$$u\left[Y_I + Y_S - (i + \bar{\beta}^*)\right] + \delta u\left[Y_I + Y_S - (1+i)(1-\bar{\beta}^*)\right] \leq u(Y_S) + \delta u(Y_s). \tag{9}$$

where $\bar{\beta}^*$ is the optimal level of β when $Y_I = \bar{Y}_I$. New borrowing from moneylender induced by the introduction of microcredit will occur only for the agents whose Y_I lies in $(\hat{Y}_I, \bar{Y}_I]$.

Because we cannot obtain the threshold value $\bar{Y}_I$ explicitly, we rely on the numerical examples. As above, we set $\delta = 0.95$ and $Y_S = 0.2$. Note that unlike $\hat{Y}_I$ and $\tilde{Y}_I$, $\bar{Y}_I$ does not depend on r. Table 3 reports the value of $\bar{Y}_I$ across various values of i when $\theta = 1$ and $\theta = 2$.

It turns out that $\bar{Y}_I$ is little affected by θ. The comparison between Table 1 and Table 3 tells us that the interval $(\hat{Y}_I, \bar{Y}_I]$ is wide when i is large. This is because small i enables individuals with relatively low Y_I to make investment.

Table 3: Examples of the value of $\bar{Y}_I$

	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$\theta = 1$	0.73	0.82	0.90	0.98	1.06	1.15	1.32
$\theta = 2$	0.73	0.82	0.90	0.98	1.07	1.15	1.33

Whether the introduction of microcredit increases the average borrowing from the moneylender depends on the distribution of Y_I and Y_S. If there are relatively large proportion of people lies in the interval $(\hat{Y}_I, \bar{Y}_I]$, where $\hat{Y}_I$ and $\bar{Y}_I$ depends on Y_S, then the introduction of microcredit can increase the average loan amount from the moneylender. In order to see this possibility, we assume the investment return follows the log-normal distribution $LN(\mu, \sigma)$, where we set $\sigma = 0.5$. We take

10,000 draws from the distribution $LN(\mu, \sigma)$, calculate the theoretical prediction of the borrowing amount for each draw, and take the average. We present the results when we set μ to be -0.3, -0.2, -0.1, 0, and -2, and $\theta = 2$. The average investment return is 0.84 when $\mu = -0.3$, 1.13 when $\mu = 0$, and 1.38 when $\mu = 0.2$. The results when $\theta = 1$ are presented in the Appendix.

The upper panel of Table 4 reports the simulated average borrowing amounts from the moneylender when microcredit is not available. As the distribution of the investment returns move to the right, which is captured by an increase in μ, the borrowing amount from the moneylender increases as the investment project becomes more profitable and more people make the investment. On the other hand, an increase in the interest rate i leads to a decline in the borrowing amount, as expected.

Now we calculate the simulated average borrowing amounts from the moneylender when microcredit is available, which provides credit with a lower interest rate but shorter maturity. The lower panel of Table reports the simulation results. The average borrowing amount from the moneylender is larger when r gets larger. Compared with the upper panel of Table 4, the average borrowing amounts from the moneylender is increased due to the introduction of microcredit for almost all parameter values when μ is -0.3 and -0.2. This provides the possible explanation why some studies find that the introduction of microcredit programs increased the borrowing amount from the moneylender. On the other hand, when $\mu = 0$ or $\mu = 0.2$, the average borrowing amount from the moneylender is smaller when microcredit is available, implying that the introduction of microcredit will reduce the average borrowing amount from the moneylender. It also shows that the effect is dependent on the underlying parameter values, which also may explain why some studies find increased borrowing amounts and other studies do not.

Usually the target of the microcredit is relatively poor people. Thus it would be misleading if we include some agents whose Y_I is very high. Appendix Table 1 reports the simulation results when we drop the observations whose Y_I exceeds 2. While the average borrowing amounts are reduced both in the case with microcredit and without microcredit, the qualitative results are the same: when the distribution of the investment returns is not so profitable, the introduction of microcredit increases the average borrowing from the moneylender, but when the distribution is profitable, the introduction of microcredit reduces the average borrowing from the moneylender.

In Appendix Table 2 and 3 reports the simulation results when $\theta = 1$. Appendix Table 2 reports the borrowing amount from the moneylender averaged over the whole agents and 3 reports the borrowing amount averaged over the agents whose Y_I does not exceed 2. When $\theta = 1$ and thus the elasticity of intertemporal substitution is higher, the borrowing amount averaged over the whole agents will be reduced by the introduction of the microcredit for any parameter values we are considering. However, if we restrict the sample to the agents whose Y_I does not exceed 2, then we find the similar results to the case of $\theta = 2$. When $\lambda = -0.3$ or $\lambda = -0.2$, the introduction of microcredit will increase the average borrowing amount from the moneylender. This difference is

Table 4: Average borrowing amounts of the borrowers when $\theta = 2$

Average borrowing amount from the moneylender when microcredit is not available

$\theta = 2$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$\mu = -0.3$	0.239	0.196	0.159	0.127	0.101	0.080	0.050
$\mu = -0.2$	0.275	0.233	0.195	0.161	0.130	0.106	0.070
$\mu = 0$	0.347	0.307	0.268	0.233	0.201	0.172	0.121
$\mu = 0.2$	0.405	0.376	0.344	0.310	0.277	0.246	0.191

Average borrowing amount from the moneylender when microcredit is available

$\theta = 2$, $\mu = -0.3$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.262	0.221	0.182	0.147	0.114	0.083	0.022
$r = 0.2$	0.271	0.229	0.193	0.159	0.128	0.097	0.046
$r = 0.3$	N.A.	0.234	0.198	0.165	0.133	0.107	0.061
$r = 0.4$	N.A.	N.A.	0.200	0.166	0.137	0.112	0.070
$\theta = 2$, $\mu = -0.2$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.293	0.247	0.206	0.166	0.129	0.094	0.026
$r = 0.2$	0.306	0.262	0.222	0.184	0.150	0.117	0.053
$r = 0.3$	N.A.	0.272	0.231	0.195	0.163	0.131	0.074
$r = 0.4$	N.A.	N.A.	0.238	0.203	0.170	0.139	0.087
$\theta = 2$, $\mu = 0$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.341	0.292	0.243	0.196	0.150	0.106	0.028
$r = 0.2$	0.368	0.320	0.272	0.228	0.184	0.144	0.067
$r = 0.3$	N.A.	0.340	0.295	0.251	0.211	0.172	0.099
$r = 0.4$	N.A.	N.A.	0.309	0.268	0.230	0.192	0.125
$\theta = 2$, $\mu = 0.2$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.364	0.308	0.255	0.203	0.154	0.109	0.026
$r = 0.2$	0.405	0.352	0.302	0.252	0.203	0.157	0.069
$r = 0.3$	N.A.	0.389	0.339	0.292	0.244	0.197	0.111
$r = 0.4$	N.A.	N.A.	0.368	0.322	0.276	0.233	0.149

due to the fact that when $\theta = 1$, the optimal $1-\alpha^*$ is zero or close to zero for the agents with high Y_I, while these agents will make the borrowing from the moneylender when microcredit is not available since they have investments projects profitable enough to implement by borrowing money with interest rate i. Thus if we exclude the rich agents who have high investment return, the average borrowing amount from the moneylender is much more reduced for the case without microcredit, leading to the results that the introduction of microcredit increases the average borrowing amount from the moneylender when $\mu = -0.3$ or $\mu = -0.2$.

3 Longer Maturity

3.1 The Model

Now suppose that the MFI employs more flexible repayment scheme in which the borrower can repay a part of the principal in period 2. The MFI only requires λ of the principal to be repaid in period 1 and thus the borrower will repay $(\lambda + r)\alpha$ in period 1 and $(1+r)(1-\lambda)\alpha$ in period 2 to the MFI. The borrower's maximization problem becomes

$$\max_{\alpha} U^I(\alpha) = u\left[Y_I + Y_S - (\lambda + r)\alpha - i(1-\alpha)\right] + \delta u\left[Y_I + Y_S - (1+r)(1-\lambda)\alpha - (1+i)(1-\alpha)\right].$$

The first derivative is

$$\frac{\partial U^I(\alpha)}{\partial \alpha} = -(\lambda + r - i)u'(c_1) + \delta L u'(c_2),$$
$$\text{where} \qquad L = 1 + i - (1+r)(1-\lambda).$$

When $\lambda = 1$, then $L = 1 + i$ and this equation is identical to the one in the previous section. Note that if $\lambda + r - i < 0$, then $\frac{\partial U^I(\alpha)}{\partial \alpha} > 0$ and we always have $\alpha^* = 1$. We restrict our analysis to the case $\lambda + r - i > 0$. The condition for $\alpha^* < 1$ is $\frac{dU^I(\alpha)}{d\alpha}|_{\alpha=1} \equiv M_\lambda < 0$, where

$$M_\lambda = -(\lambda + r - i)u'[Y_I + Y_S - (\lambda + r)] + \delta L u'[Y_I + Y_S - (1+r)(1-\lambda)], \tag{10}$$

or

$$\frac{u'[Y_I + Y_S - (\lambda + r)]}{[Y_I + Y_S - (1+r)(1-\lambda)]} > \frac{\delta L}{\lambda + r - i}. \tag{11}$$

First consider the case $\alpha^* < 1$ and thus $\frac{\partial U^I(\alpha)}{\partial \alpha} = 0$. From the implicit function theorem, we can derive

$$\frac{\partial \alpha^*}{\partial \lambda} = \frac{u'(c_1^*) - \delta(1+r)u'(c_2^*) - (\lambda + r - i)\alpha^* u''(c_1^*) - \delta(1+r)L\alpha^* u'(c_2^*)}{(\lambda + r - i)^2 u''(c_1^*) - \delta L^2 u'(c_2^*)}.$$

Since $u'' < 0$, if $u'(c_1^*) - \delta(1+r)u'(c_2^*) > 0$, then we have $\frac{\partial \alpha^*}{\partial \lambda} < 0$. But because $(\lambda + r - i)u'(c_1^*) = \delta[(1+i) - (1+r)1 - \lambda)]u'(c_2^*)$, these terms become

$$u'(c_1^*) - \delta(1+r)u'(c_2^*) = \frac{\delta u'(c_2^*)}{\lambda + r - i}\left[1 + i - (1+r)(1 + r - i)\right] > 0.$$

Thus we have proved $\frac{\partial \alpha^*}{\partial \lambda} < 0$ as long as $\alpha^* < 1$

Next consider the condition for $\alpha^* < 1$, $M_\lambda < 0$. By differentiating M_λ by λ, we obtain

$$\begin{aligned}\frac{\partial M_\lambda}{\partial \lambda} &= -u'[Y_I + Y_S - (\lambda + r)] + \delta(1+r)u'[Y_I + Y_S - (1+r)(1-\lambda)] \\ &+ (\lambda + r - i)u''[Y_I + Y_S - (\lambda + r)] + \delta(1+r)Lu''[Y_I + Y_S - (1+r)(1-\lambda)].\end{aligned}$$

Remember that $u'(c_1^*) - \delta(1+r)u'(c_2^*) > 0$. Because $Y_I + Y_S - (\lambda + r) \leq c_1^* < c_2^* \leq Y_I + Y_S - (1+r)(1-\lambda)$, we should have $u'[Y_I + Y_S - (\lambda + r)] > \delta(1+r)u'[Y_I + Y_S - (1+r)(1-\lambda)]$. Thus $\frac{\partial M_\lambda}{\partial \lambda} < 0$, implying that the dependence of the moneylender can be reduced by having the MFI employ a longer maturity.

Now we examine the effect of the maturity on the investment decision. The utility from making the investment is

$$U^I(\alpha^*) = u\left[Y_I + Y_S - (\lambda + r)\alpha^* - i(1-\alpha^*)\right] + \delta u\left[Y_I + Y_S - (1+r)(1-\lambda)\alpha^* - (1+i)(1-\alpha^*)\right].$$

The cutoff value $\hat{Y}_I$ such that for all $Y_I > \hat{Y}_I$ the agent make the investment satisfies the following equation:

$$u\left[\hat{Y}_I + Y_S - (\lambda + r)\hat{\alpha}^* - i(1-\hat{\alpha}^*)\right] + \delta u\left[\hat{Y}_I + Y_S - (1+r)(1-\lambda)\alpha^* - (1+i)(1-\hat{\alpha}^*)\right] = u(Y_S) + \delta u(Y_S) \quad (12)$$

where $\hat{\alpha}^*$ is the optimal level of α when $Y_I = \hat{Y}_I$. Let $\hat{c}_1^* = \hat{Y}_I + Y_S - (\lambda + r)\hat{\alpha}^* - i(1-\hat{\alpha}^*)$ and $\hat{c}_2^* = \hat{Y}_I + Y_S - (1+r)(1-\lambda)\alpha^* - (1+i)(1-\hat{\alpha}^*)$. Then from the implicit function theorem and envelope theorem,

$$\frac{\partial \hat{Y}_I}{\partial \lambda} = \frac{\hat{\alpha}^*[u'(\hat{c}_1^*) - \delta(1+r)u'(\hat{c}_2^*)]}{u'(\hat{c}_1^*) + \delta u'(\hat{c}_2^*)} > 0.$$

The inequality follows from $u'(c_1^*) - \delta(1+r)u'(c_2^*) > 0$, which we have shown above. The result implies that shorter maturity, which captured by larger λ, discourages people from making the investment.

We summarize the results as a proposition.

Proposition 3 *The optimal α^* increases as λ decreases if $\alpha^* < 1$. The condition for $\alpha^* < 1$ get stricter as λ decrease. Lower λ results in lower $\hat{Y}_I$.*

3.2 Numerical Examples

We again examine the numerical examples where we specify the utility function as $u(c) = \frac{(c-\gamma)^{1-\theta}-1}{1-\theta}$ and set $\delta = 0.95$ and $\theta = \{1, 2\}$. From (10), the condition for $\alpha^* < 1$ is

$$\left(\frac{Y_I + Y_S - (1-\lambda)(1+r)}{Y_I + Y_S - (\lambda + r)}\right)^\theta > \frac{\delta L}{\lambda + r - i}.$$

As in the previous section, we define the cutoff value $\tilde{Y}_I$ such that any $Y_I < \tilde{Y}_I$ satisfies the condition for $\alpha^* < 1$. The optimal level of the borrowing amount from the MFI becomes

$$\alpha^* = \min\left[1, 1 - \frac{\delta^{\frac{1}{\theta}} L^{\frac{1}{\theta}}(\lambda + r) - (1-\lambda)(1+r)(\lambda + r - i)^{\frac{1}{\theta}} - [\delta^{\frac{1}{\theta}} L^{\frac{1}{\theta}} - (\lambda + r - i)^{\frac{1}{\theta}}](Y_I + Y_S)}{(1+r-i)^{\frac{1}{\theta}} L + \delta^{\frac{1}{\theta}} L^{\frac{1}{\theta}}(\lambda + r - i)}\right].$$

The threshold value of Y_I, $\hat{Y}_I$, such that for all $Y_I > \hat{Y}_I$ the agent will make the investment can be obtained by (12).

The interval $(\hat{Y}_I, \tilde{Y}_I)$ and the optimal borrowing amount from the moneylender, $1 - \alpha^*$, when $\lambda = \{0.9, 0.8, 0.7\}$, are reported in Table 5 and Table 6, respectively. Since we restrict our analysis to the case $\lambda + r - i > 0$, the cells which does not satisfy this condition is expressed as N.A.

As before, while θ little affects $\hat{Y}_I$, the threshold for making the investment, it does affect $\tilde{Y}_I$, the threshold for $\alpha^* < 1$. When θ is large (the elasticity of intertemporal substitution is low), then the range $(\hat{Y}_I, \tilde{Y}_I)$ expands substantially. The reduction in λ decreases both of $\hat{Y}_I$ and $\tilde{Y}_I$, but it affect much more for the latter.

Table 6 reports the borrowing amount from the moneylender when $Y_I = 1$. The results when $Y_I = 1.5$ are presented in Appendix Table 4. Again, since we restrict our analysis to the case $\lambda + r - i > 0$, the cells which does not satisfy this condition is expressed as N.A. In addition, the cells which have $\hat{Y}_I > 1$ are also expressed as N.A. because if $\hat{Y}_I > 1$, then the investment project with $Y_I = 1$ will not be implemented.

The effect of longer maturity, which is captured by a decline in λ, is substantial. For example, in case of $r = 0.1$ and $i = 0.6$, the change in λ from 1 to 0.8 reduces the borrowing amount from the moneylender, $1 - \alpha^*$, by more than 50 percent. The reduction in the borrowing from the moneylender is larger when r is relatively much smaller than i. The maturity expansion of the microcredit allows the borrowers to utilize the microcredit more which provides the lower interest loans.

Next we calculate the change in the utility induced by the expansion of the microcredit loan. Table 7 reports the surplus of the utility from making the investment over the utility from not making the investment when $\theta = 2$ and $Y = 1$. Since the utility from not making the investment does not depend on either i, r, or λ, the surplus utility gives us the comparable numbers across tables. We do not use the utility from making the investment itself because when $\theta = 2$, the CRRA utility function $\frac{c^{1-\theta}-1}{1-\theta}$ will give negative numbers for positive c, which may confuse readers.

Utility from making the investment increases as r decreases. This property enable us to compare the welfare improvement from the loan maturity expansion to the welfare improvement from the reduction of the interest rate of the microcredit, r. For example, the utility from the investment when $i = 0.5$, $r = 0.2$, and $\lambda = 0.8$ is 4.906, which is slightly higher than the utility when $i = 0.5$, $r = 0.1$, and $\lambda = 1$. The effect of lowering λ increases as the interest rate of the moneylender, i, increases. Thus when i is large, the expansion of the loan maturity from $\lambda = 1$ to $\lambda = 0.8$ leads

Table 5: Examples of interval $(\hat{Y}_I, \tilde{Y}_I)$

$\theta = 1$, $\lambda = 0.9$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	(0.66, 2.25)	(0.71, 1.65)	(0.74, 1.34)	(0.78, 1.15)	(0.81, 1.02)	(0.83, 0.93)	N.A.
$r = 0.2$	(0.70, 3.34)	(0.75, 2.23)	(0.79, 1.73)	(0.83, 1.44)	(0.87, 1.26)	(0.90, 1.13)	(0.94, 0.96)
$r = 0.3$	N.A.	(0.78, 3.11)	(0.83, 2.25)	(0.87, 1.81)	(0.92, 1.54)	(0.95, 1.36)	(1.02, 1.14)
$r = 0.4$	N.A.	N.A.	(0.86, 2.99)	(0.91, 2.28)	(0.96, 1.89)	(1.00, 1.64)	(1.08, 1.34)
$\theta = 1$, $\lambda = 0.8$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	(0.65, 1.66)	(0.68, 1.25)	(0.71, 1.03)	(0.73, 0.90)	(0.75, 0.81)	(0.76, 0.75)	N.A.
$r = 0.2$	(0.69, 2.53)	(0.73, 1.71)	(0.77, 1.35)	(0.80, 1.14)	(0.82, 1.01)	(0.84, 0.92)	N.A.
$r = 0.3$	N.A.	(0.78, 2.44)	(0.82, 1.77)	(0.85, 1.44)	(0.89, 1.25)	(0.91, 1.12)	(0.95, 0.95)
$r = 0.4$	N.A.	N.A.	(0.86, 2.40)	(0.90, 1.84)	(0.94, 1.54)	(0.97, 1.35)	(1.03, 1.13)
$\theta = 1$, $\lambda = 0.7$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	(0.63, 1.16)	(0.65, 0.90)	(0.67, 0.77)	(0.68, 0.69)	(0.68, 0.64)	N.A.	N.A.
$r = 0.2$	(0.69, 1.81)	(0.71, 1.25)	(0.74, 1.02)	(0.76, 0.88)	(0.77, 0.80)	(0.77, 0.74)	N.A.
$r = 0.3$	N.A.	(0.77, 1.82)	(0.80, 1.35)	(0.82, 1.13)	(0.85, 0.99)	(0.86, 0.91)	N.A.
$r = 0.4$	N.A.	N.A.	(0.85, 1.86)	(0.88, 1.45)	(0.91, 1.23)	(0.93, 1.10)	(0.96, 0.95)

$\theta = 2$, $\lambda = 0.9$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	(0.67, 4.09)	(0.71, 2.87)	(0.75, 2.22)	(0.79, 1.81)	(0.83, 1.52)	(0.87, 1.29)	N.A.
$r = 0.2$	(0.70, 6.23)	(0.75, 3.98)	(0.80, 2.95)	(0.84, 2.35)	(0.88, 1.95)	(0.92, 1.65)	(1.00, 1.20)
$r = 0.3$	N.A.	(0.78, 5.69)	(0.83, 3.94)	(0.88, 3.04)	(0.93, 2.47)	(0.97, 2.08)	(1.06, 1.54)
$r = 0.4$	N.A.	N.A.	(0.87, 5.38)	(0.92, 3.95)	(0.97, 3.13)	(1.02, 2.59)	(1.11, 1.91)
$\theta = 2$, $\lambda = 0.8$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	(0.65, 2.91)	(0.69, 2.07)	(0.72, 1.61)	(0.76, 1.32)	(0.79, 1.11)	(0.81, 0.94)	N.A.
$r = 0.2$	(0.70, 4.61)	(0.74, 2.94)	(0.78, 2.19)	(0.81, 1.75)	(0.85, 1.46)	(0.88, 1.24)	N.A.
$r = 0.3$	N.A.	(0.78, 4.34)	(0.82, 2.99)	(0.86, 2.31)	(0.90, 1.89)	(0.94, 1.60)	(1.00, 1.17)
$r = 0.4$	N.A.	N.A.	(0.86, 4.21)	(0.91, 3.06)	(0.95, 2.43)	(0.99, 2.02)	(1.07, 1.50)
$\theta = 2$, $\lambda = 0.7$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	(0.64, 1.91)	(0.66, 1.39)	(0.69, 1.11)	(0.71, 0.92)	(0.72, 0.78)	N.A.	N.A.
$r = 0.2$	(0.69, 3.15)	(0.72, 2.03)	(0.75, 1.54)	(0.78, 1.25)	(0.80, 1.05)	(0.82, 0.90)	N.A.
$r = 0.3$	N.A.	(0.77, 3.11)	(0.80, 2.15)	(0.84, 1.68)	(0.87, 1.39)	(0.89, 1.18)	N.A.
$r = 0.4$	N.A.	N.A.	(0.85, 3.11)	(0.89, 2.27)	(0.92, 1.81)	(0.96, 1.52)	(1.01, 1.14)

Table 6: Examples of the dependence on the moneylender, $1-\alpha^*$: $\lambda = 0.8$

$\theta=1$, $Y_I=1$, $\lambda=0.9$	$i=0.3$	$i=0.4$	$i=0.5$	$i=0.6$	$i=0.7$	$i=0.8$	$i=1.0$
$r=0.1$	0.331	0.271	0.207	0.132	0.027	0.000	N.A.
$r=0.2$	0.408	0.363	0.320	0.277	0.229	0.167	0.000
$r=0.3$	N.A.	0.432	0.401	0.373	0.350	0.329	N.A.
$r=0.4$	N.A.	N.A.	0.461	0.442	0.430	N.A.	N.A.
$\theta=1$, $Y_I=1$, $\lambda=0.8$	$i=0.3$	$i=0.4$	$i=0.5$	$i=0.6$	$i=0.7$	$i=0.8$	$i=1.0$
$r=0.1$	0.222	0.134	0.027	0.000	0.000	0.000	N.A.
$r=0.2$	0.325	0.262	0.196	0.118	0.012	0.000	N.A.
$r=0.3$	N.A.	0.353	0.308	0.262	0.213	0.151	0.000
$r=0.4$	N.A.	N.A.	0.387	0.357	0.332	0.310	N.A.
$\theta=1$, $Y_I=1$, $\lambda=0.7$	$i=0.3$	$i=0.4$	$i=0.5$	$i=0.6$	$i=0.7$	$i=0.8$	$i=1.0$
$r=0.1$	0.070	0.000	0.000	0.000	0.000	N.A.	N.A.
$r=0.2$	0.215	0.122	0.012	0.000	0.000	0.000	N.A.
$r=0.3$	N.A.	0.249	0.179	0.100	0.000	0.000	N.A.
$r=0.4$	N.A.	N.A.	0.289	0.242	0.191	0.127	0.000
$\theta=2$, $Y_I=1$, $\lambda=0.9$	$i=0.3$	$i=0.4$	$i=0.5$	$i=0.6$	$i=0.7$	$i=0.8$	$i=1.0$
$r=0.1$	0.402	0.374	0.347	0.318	0.283	0.232	N.A.
$r=0.2$	0.452	0.430	0.411	0.393	0.376	0.358	0.285
$r=0.3$	N.A.	0.475	0.460	0.449	0.440	0.434	N.A.
$r=0.4$	N.A.	N.A.	0.499	0.491	0.486	N.A.	N.A.
$\theta=2$, $Y_I=1$, $\lambda=0.8$	$i=0.3$	$i=0.4$	$i=0.5$	$i=0.6$	$i=0.7$	$i=0.8$	$i=1.0$
$r=0.1$	0.315	0.275	0.231	0.176	0.092	0.000	N.A.
$r=0.2$	0.379	0.349	0.320	0.289	0.252	0.197	N.A.
$r=0.3$	N.A.	0.406	0.384	0.365	0.346	0.327	N.A.
$r=0.4$	N.A.	N.A.	0.434	0.421	0.410	0.404	N.A.
$\theta=2$, $Y_I=1$, $\lambda=0.7$	$i=0.3$	$i=0.4$	$i=0.5$	$i=0.6$	$i=0.7$	$i=0.8$	$i=1.0$
$r=0.1$	0.198	0.136	0.057	0.000	0.000	N.A.	N.A.
$r=0.2$	0.284	0.240	0.193	0.134	0.045	0.000	N.A.
$r=0.3$	N.A.	0.315	0.283	0.249	0.210	0.152	N.A.
$r=0.4$	N.A.	N.A.	0.348	0.327	0.306	0.284	N.A.

to more welfare improvement of the agent than the reduction of the microcredit interest rate from $r = 0.2$ to $r = 0.1$.

Table 7: Utility from making the investment: $\theta = 2$ and $Y = 1$

$\theta = 2$ and $Y_I = 1$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	6.036	5.674	5.245	4.726	4.077	3.236	0.479
$r = 0.2$	5.802	5.351	4.795	4.083	3.130	1.762	N.A.
$r = 0.3$	N.A.	5.023	4.324	3.385	2.043	N.A.	N.A.
$r = 0.4$	N.A.	N.A.	3.827	2.616	0.767	N.A.	N.A.
$\theta = 2$, $Y_I = 1$, $\lambda = 0.9$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	6.119	5.830	5.509	5.152	4.756	4.330	N.A.
$r = 0.2$	5.846	5.462	5.012	4.471	3.801	2.943	0.222
$r = 0.3$	N.A.	5.083	4.484	3.721	2.699	1.238	N.A.
$r = 0.4$	N.A.	N.A.	3.917	2.878	1.383	N.A.	N.A.
$\theta = 2$, $Y_I = 1$, $\lambda = 0.8$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	6.220	6.015	5.813	5.627	5.483	5.447	N.A.
$r = 0.2$	5.899	5.596	5.266	4.906	4.517	4.117	N.A.
$r = 0.3$	N.A.	5.156	4.675	4.103	3.405	2.525	N.A.
$r = 0.4$	N.A.	N.A.	4.026	3.183	2.060	0.457	N.A.
$\theta = 2$, $Y_I = 1$, $\lambda = 0.7$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	6.345	6.238	6.170	6.158	6.158	N.A.	N.A.
$r = 0.2$	5.966	5.760	5.567	5.401	5.295	5.286	N.A.
$r = 0.3$	N.A.	5.248	4.906	4.545	4.172	3.815	N.A.
$r = 0.4$	N.A.	N.A.	4.161	3.545	2.807	1.902	N.A.

Now we calculate the simulated average borrowing amounts from the moneylender when the maturity of microcredit is expanded. Table reports the simulation results when $\theta = 2$ and $\lambda = 0.8$. The results when $\lambda = \{0.9, 0.7\}$ are reported in the Appendix. Expansion of the maturity has considerable impacts on the average borrowing amounts. When $\lambda = 0.8$, $i = 0.6$, $r = 0.1$, the average borrowing amount from the moneylender becomes less than a half. For all the values of i and r, the introduction of microcredit always reduce the average borrowing amount from the moneylender. Even when the degree of maturity expansion is smaller, $\lambda = 0.9$, the introduction of microcredit always reduce the average borrowing amount from the moneylender for all the values of i and r. When $\lambda = 0.7$, the average borrowing amount from the moneylender is much smaller. When $i = 0.6$, $r = 0.1$ and $\mu = 0.3$, the average borrowing amount is less than 0.2, while it is 0.147 when $\lambda = 1$.

Further, we can simulate to what extent the expansion of the loan maturity contributes to the increase in the investment and thus the uptake of microcredit. As we have shown in Proposition

Table 8: Average borrowing amounts of the borrowers when $\theta = 2$ and $\lambda = 0.8$

Average borrowing amount from the moneylender when microcredit is available

$\theta = 2$, $\mu = -0.3$, $\lambda = 0.8$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.181	0.139	0.102	0.066	0.036	0.011	N.A.
$r = 0.2$	0.203	0.165	0.128	0.095	0.065	0.037	N.A.
$r = 0.3$	N.A.	0.179	0.145	0.115	0.086	0.059	0.012
$r = 0.4$	N.A.	N.A.	0.156	0.126	0.098	0.074	0.032
$\theta = 2$, $\mu = -0.2$, $\lambda = 0.8$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.198	0.151	0.107	0.070	0.038	0.011	N.A.
$r = 0.2$	0.228	0.183	0.142	0.105	0.070	0.040	N.A.
$r = 0.3$	N.A.	0.205	0.167	0.131	0.098	0.068	0.015
$r = 0.4$	N.A.	N.A.	0.182	0.149	0.119	0.089	0.037
$\theta = 2$, $\mu = 0$, $\lambda = 0.8$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.215	0.159	0.111	0.070	0.037	0.010	N.A.
$r = 0.2$	0.265	0.211	0.160	0.115	0.076	0.041	N.A.
$r = 0.3$	N.A.	0.250	0.201	0.156	0.114	0.078	0.015
$r = 0.4$	N.A.	N.A.	0.231	0.188	0.148	0.111	0.046
$\theta = 2$, $\mu = 0.2$, $\lambda = 0.8$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.212	0.149	0.099	0.060	0.031	0.008	N.A.
$r = 0.2$	0.281	0.216	0.159	0.111	0.071	0.038	N.A.
$r = 0.3$	N.A.	0.275	0.217	0.164	0.118	0.078	0.015
$r = 0.4$	N.A.	N.A.	0.266	0.213	0.165	0.120	0.047

3, the expansion of the loan maturity will decrease the cutoff value of Y_I above which the agent chooses to make the investment. The simulation results show that when $i = 0.6$ and $r = 0.2$ or $r = 0.3$, the maturity expansion from $\lambda = 1$ to $\lambda = 0.8$ increases the investment rate or uptake rate of microcredit equivalent to 10 percentage reduction in the interest rate r. This effect becomes larger when i is larger and r is smaller, because low r relative to i increase the benefit of microcredit maturity expansion.

4 Borrowing for Repayment

We have assumed that the agent simultaneously make the investment and borrow from the moneylender, if $\alpha^* < 1$. However, it might be the case that the agent makes the investment only financed by the microcredit and rely on the moneylender when the repayment due comes. Compared to the case where the agents finance the investment project both by the microcredit and moneylender loan, this can save the interest paid to the moneylender. In this section, we examine the case where the agent can borrow from the moneylender to repay the microcredit loan at the end of the period 1 and see the quantitative results remain the same. In the actual microcredit where the weekly repayment is popular, the borrower may borrow from the moneylender every time they need to repay. In this section, we maintain our two-period framework, where the repayment is done only at the end of period 1. Compared to the weekly repayment scheme, this will provide more saving in the interest payment to the moneylender, which makes the borrowing from moneylender less costly, and thus the case here can be considered to provide the upper bound of the borrowing amount from the moneylender. Because our baseline case where the microcredit loan requires both of the principal and the interest to be repaid in the first period is the special case where $\lambda = 1$, in this section we describe the model where we include λ.

The only difference from the model in the previous sections is in the repayment schedule. If the agent decides to make the investment, then she will borrow 1 unit of the capital from the MFI. At the end of the period one when she need to repay to the MFI, she can borrow b from the moneylender. If she borrows b from the moneylender, she needs to repay $(1+i)b$ to the moneylender in period two. Thus the agent needs to repay to the MFI $\lambda + r$ in period 1 and $(1 + r)(1 - \lambda)$ in period 2, and repay $(1 + i)b$ to the moneylender in period 2. Then the borrower's lifetime utility from making the investment becomes

$$U_B^I(b)u\left[Y_I + Y_S - (\lambda + r) + b\right] + \delta u\left[Y_I + Y_S - (1 + r)(1 - \lambda) - (1 + i)b\right].$$

The first derivative is

$$\frac{dU_B^I(b)}{db} = u'(c_1) - \delta(1 + i)u'(c_2),$$

where $c_1(b) = Y_I + Y_S - (\lambda + r) + b$ and $c_2(b) = Y_I + Y_S - (1 + r)(1 - \lambda) - (1 + i)b$. The condition

Table 9: Uptake rate when $\theta = 2$ and $\lambda = \{1, 0.8\}$

Investment rate (or uptake rate of microcredit) when $\lambda = 1$

$\theta = 2$, $\mu = -0.3$, $\lambda = 1$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.572	0.521	0.470	0.425	0.383	0.347	0.284
$r = 0.2$	0.542	0.485	0.436	0.391	0.349	0.306	0.249
$r = 0.3$	N.A.	0.458	0.407	0.360	0.315	0.278	0.220
$r = 0.4$	N.A.	N.A.	0.381	0.334	0.291	0.256	0.197
$r = 0.5$	N.A.	N.A.	N.A.	0.310	0.270	0.236	0.182
$\theta = 2$, $\mu = -0.2$, $\lambda = 1$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.649	0.595	0.547	0.500	0.459	0.421	0.359
$r = 0.2$	0.617	0.563	0.514	0.466	0.424	0.385	0.314
$r = 0.3$	N.A.	0.536	0.481	0.436	0.394	0.352	0.283
$r = 0.4$	N.A.	N.A.	0.458	0.412	0.366	0.324	0.257
$r = 0.5$	N.A.	N.A.	N.A.	0.388	0.344	0.300	0.237
$\theta = 2$, $\mu = 0$, $\lambda = 1$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.781	0.740	0.696	0.654	0.613	0.573	0.514
$r = 0.2$	0.757	0.712	0.664	0.619	0.575	0.539	0.469
$r = 0.3$	N.A.	0.686	0.637	0.589	0.546	0.506	0.433
$r = 0.4$	N.A.	N.A.	0.611	0.564	0.521	0.477	0.405
$r = 0.5$	N.A.	N.A.	N.A.	0.541	0.494	0.453	0.379

Investment rate (or uptake rate of microcredit) when $\lambda = 0.8$

$\theta = 2$, $\mu = -0.3$, $\lambda = 0.8$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.601	0.561	0.525	0.489	0.460	0.440	N.A.
$r = 0.2$	0.556	0.512	0.471	0.436	0.404	0.375	N.A.
$r = 0.3$	N.A.	0.469	0.427	0.392	0.356	0.324	0.278
$r = 0.4$	N.A.	N.A.	0.392	0.352	0.315	0.286	0.238
$r = 0.5$	N.A.	N.A.	N.A.	0.318	0.284	0.256	0.208
$\theta = 2$, $\mu = -0.2$, $\lambda = 0.8$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.677	0.638	0.599	0.567	0.539	0.518	N.A.
$r = 0.2$	0.632	0.587	0.548	0.514	0.479	0.451	N.A.
$r = 0.3$	N.A.	0.546	0.505	0.467	0.433	0.403	0.352
$r = 0.4$	N.A.	N.A.	0.467	0.428	0.395	0.361	0.303
$r = 0.5$	N.A.	N.A.	N.A.	0.397	0.359	0.324	0.268
$\theta = 2$, $\mu = 0$, $\lambda = 0.8$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.802	0.772	0.743	0.714	0.689	0.667	N.A.
$r = 0.2$	0.767	0.733	0.698	0.663	0.634	0.604	N.A.
$r = 0.3$	N.A.	0.696	0.656	0.620	0.586	0.556	0.505
$r = 0.4$	N.A.	N.A.	0.620	0.582	0.547	0.515	0.457
$r = 0.5$	N.A.	N.A.	N.A.	0.549	0.513	0.477	0.417

for $\beta^* > 0$ is

$$\frac{u'[Y_I + Y_S - (\lambda + r)]}{u'[Y_I + Y_S - (1 + r)(1 - \lambda)]} + \delta(1 + i). \tag{13}$$

By comparing (13) with (11), we can show that the condition for $\beta^* > 0$ is looser than the condition for $\alpha^* < 1$, because $\frac{\delta L}{\lambda + r - i} > \delta(1 + i)$ if $\lambda + r - i > 0$, which is the restriction we have imposed on. Thus whenever the borrowing from the moneylender is observed in the case where the agents simultaneously make the investment and borrow from the moneylender, we will also observe the borrowing from the moneylender in the case where the agents are allowed to borrow from the moneylender to repay to the MFI.

Next consider the case $b^* > 0$, where we have $\frac{dU_B^I(b)}{db} = 0$, to examine the comparative statics. From the implicit function theorem, we can derive

$$\begin{aligned}
\frac{\partial b^*}{\partial Y_I} &= \frac{\partial b^*}{\partial Y_S} = \frac{\delta(1+i)u''(c_2^*) - u''(c_1^*)}{u''(c_1^*) - \delta(1+i)u'(c_2^*)}, && (14)\\
\frac{\partial b^*}{\partial i} &= \frac{\delta u'(c_2^*) - \delta(1+i)b^* u''(c_2^*)}{u''(c_1^*) - \delta(1+i)u'(c_2^*)} < 0, && (15)\\
\frac{\partial b^*}{\partial r} &= \frac{u''(c_1^*) - \delta(1-\lambda)(1+i)u''(c_2^*)}{u''(c_1^*) - \delta(1+i)u'(c_2^*)}, && (16)\\
\frac{\partial b^*}{\partial \lambda} &= \frac{u''(c_1^*) - \delta(1+i)(1+r)u''(c_2^*)}{u''(c_1^*) - \delta(1+i)u'(c_2^*)} > 0, && (17)
\end{aligned}$$

$\frac{\partial b^*}{\partial r} > 0$ if λ is not small.

Given this decision rule of b, the agent will make the investment if $U_B^I(\beta^*) > U^N$. The cutoff value $\hat{Y}_I$ such that for all $Y_I > \hat{Y}_I$ the agent make the investment satisfies the following equation:

$$u\left[\hat{Y}_I + Y_S - (\lambda + r) + b^*\right] + \delta u\left[\hat{Y}_I + Y_S - (1+r)(1-\lambda) - (1+i)b^*\right] = u(Y_S) + \delta u(Y_S) \tag{18}$$

where $\hat{b}^*$ is the optimal level of b when $Y_I = \hat{Y}_I$. Let $\hat{c}_1^* = \hat{Y}_I + Y_S - (\lambda + r) + \hat{b}^*$ and $\hat{c}_2^* = \hat{Y}_I + Y_S - (1+r)(1-\lambda) - (1+i)\hat{b}^*$. Then from the implicit function theorem and envelope theorem,

$$\begin{aligned}
\frac{\partial \hat{Y}_I}{\partial i} &= \frac{\hat{b}^* \delta u'(\hat{c}_2^*)}{u'(\hat{c}_1^*) + \delta u'(\hat{c}_2^*)} > 0,\\
\frac{\partial \hat{Y}_I}{\partial r} &= \frac{u'(\hat{c}_1^*) + (1-\lambda)\delta u'(\hat{c}_2^*)}{u'(\hat{c}_1^*) + \delta u'(\hat{c}_2^*)} > 0,\\
\frac{\partial \hat{Y}_I}{\partial \lambda} &= \frac{u'(\hat{c}_1^*) - \delta(1+r)u'(\hat{c}_2^*)}{u'(\hat{c}_1^*) + \delta u'(\hat{c}_2^*)} > 0.
\end{aligned}$$

The inequality of the last equation follows from the first order condition on b, $u'(c_1^*) - \delta(1+i)u'(c_2^*) > 0$. The direction of the comparative statics is the same as the case where the agents simultaneously make the investment and borrow from the moneylender. In addition, $\frac{\partial \hat{Y}_I}{\partial Y_S}$ takes the similar form to equation (5).

Proposition 4 *The optimal b^* decreases as i increases and λ decreases if $\alpha^* < 1$. The investment is more likely to be made when i, r, and λ decreases.*

The proposition shows that the qualitative characteristics of the borrowing amount from the moneylender are the same as the case we have analyzed above. Now we examine how the numbers in the numerical example changes and see if our main results still hold that the introduction of microcredit can increase the borrowing amount of the moneylender and the longer maturity can make the introduction of microcredit always reduce the borrowing amount.

First we report the interval $(\hat{Y}_I, \tilde{Y}_I)$ when $\theta = 2$ and $\lambda = \{1, 0.8\}$, and the borrowing amount b^* when $\theta = 2$, $Y_I = 1$, and $\lambda = \{1, 0.8\}$ for brevity.[3] Reflecting that $\beta^* > 0$ is looser than the condition for $\alpha^* < 1$, $\tilde{Y}_I$ is rather larger than $\tilde{Y}_I$ in the case where the agent simultaneously make the investment and borrow from the moneylender. This is because the amount of interest payment becomes lower and thus borrowing from the moneylender becomes less costly. Because borrowing from the moneylender becomes less costly, the threshold of making the investment, $\hat{Y}_I$, also gets lower.

Table 10: Examples of interval $(\hat{Y}_I, \tilde{Y}_I)$: $\theta = 2$ and $\lambda = \{1, 0.8\}$

$\theta = 2$, $\lambda = 1$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	(0.62, 10.78)	(0.64, 8.08)	(0.66, 6.58)	(0.67, 5.62)	(0.69, 4.96)	(0.70, 4.48)	(0.73, 3.81)
$r = 0.2$	(0.68, 11.78)	(0.70, 8.83)	(0.72, 7.19)	(0.74, 6.15)	(0.75, 5.43)	(0.77, 4.90)	(0.80, 4.17)
$r = 0.3$	N.A.	(0.76, 9.58)	(0.78, 7.81)	(0.80, 6.68)	(0.82, 5.90)	(0.83, 5.33)	(0.86, 4.54)
$r = 0.4$	N.A.	N.A.	(0.84, 8.43)	(0.86, 7.21)	(0.88, 6.37)	(0.90, 5.75)	(0.93, 4.90)
$\theta = 2$, $\lambda = 0.8$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	(0.60, 6.81)	(0.62, 5.14)	(0.63, 4.21)	(0.64, 3.62)	(0.65, 3.21)	(0.65, 2.91)	N.A.
$r = 0.2$	(0.67, 7.63)	(0.68, 5.76)	(0.69, 4.72)	(0.71, 4.06)	(0.72, 3.61)	(0.73, 3.27)	N.A.
$r = 0.3$	N.A.	(0.75, 6.38)	(0.76, 5.24)	(0.77, 4.51)	(0.79, 4.00)	(0.80, 3.63)	(0.82, 3.12)
$r = 0.4$	N.A.	N.A.	(0.83, 5.75)	(0.84, 4.95)	(0.86, 4.40)	(0.87, 3.99)	(0.89, 3.43)

Table 11 reports the borrowing amount from the moneylender when $\theta = 2$, $Y_I = 1$, and $\lambda = \{1, 0.8\}$. While the threshold for borrowing from the moneylender gets larger when we allow the agents to borrow from the moneylender to repay the MFI loan, the effect on the borrowing amount from the moneylender is ambiguous. The comparison with the previous tables implies that the borrowing amount increases when $Y_I = 1.5$ but decreases when $Y_I = 1$.

Now we calculate the theoretical prediction of the average borrowing amount from the moneylender when $\theta = 2$ and $\lambda = \{1, 0.8\}$. Compared to Table 4, the average borrowing amount from the moneylender is larger than the case where the agent simultaneously makes the investment and borrows from the moneylender. Even when $\mu = 0$, the introduction of microcredit will increase the average borrowing amount from the moneylender. In addition, the average borrowing amount remains still high when $i = 1.0$, while in Table 4, it becomes close to zero when $i = 1.0$. Thus when we allow the agent to borrows from the moneylender for repayment to the MFI, we will widely

[3]The results for other parameter values are available upon request.

Table 11: Examples of the dependence on the moneylender, b^*: $\theta = 2$, $Y_I = 1$, and $\lambda = \{1, 0.8\}$

$\theta = 2$ and $Y_I = 1$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.452	0.425	0.401	0.380	0.361	0.344	0.314
$r = 0.2$	0.498	0.470	0.445	0.424	0.404	0.386	0.355
$r = 0.3$	N.A.	0.515	0.490	0.467	0.447	0.428	0.396
$r = 0.4$	N.A.	N.A.	0.534	0.511	0.489	0.470	0.437
$\theta = 2$, $Y_I = 1$, $\lambda = 0.8$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.268	0.248	0.231	0.215	0.202	0.189	N.A.
$r = 0.2$	0.306	0.286	0.268	0.252	0.238	0.225	N.A.
$r = 0.3$	N.A.	0.323	0.305	0.288	0.274	0.260	0.237
$r = 0.4$	N.A.	N.A.	0.342	0.325	0.310	0.296	0.272
$\theta = 2$ and $Y_I = 1.5$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.428	0.395	0.365	0.339	0.316	0.295	0.258
$r = 0.2$	0.475	0.440	0.410	0.382	0.358	0.337	0.299
$r = 0.3$	N.A.	0.485	0.454	0.426	0.401	0.379	0.340
$r = 0.4$	N.A.	N.A.	0.498	0.470	0.444	0.421	0.381
$\theta = 2$, $Y_I = 1.5$, $\lambda = 0.8$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.245	0.218	0.195	0.174	0.156	0.140	N.A.
$r = 0.2$	0.283	0.256	0.232	0.211	0.192	0.175	N.A.
$r = 0.3$	N.A.	0.293	0.269	0.247	0.228	0.211	0.181
$r = 0.4$	N.A.	N.A.	0.306	0.284	0.264	0.247	0.216

observe that the introduction of the microcredit increases the average borrowing amount from the moneylender.

So far we have assumed that the agent borrows from the moneylender to repay to the MFI. However, if other microcredit schemes are available, she may be able to borrow from the other MFIs to repay to the first MFI. The results above suggest that if the maturity is relatively short compared to the length of the periods when the investment generates returns, the agent has an incentive to borrow from the multiple MFIs to smooth the consumption.

5 Concluding Remarks

We have shown that the short maturity of the microcredit induce borrowers to depend on the moneylender who impose much high interest rates to smooth the intertemporal consumption, even if they have enough income to repay the microcredit loans. If the distribution of the investment return is not so preferable to the borrowers, the introduction of microcredit will increase the average borrowing amount from the moneylender. We also show that the expansion of the lending maturity will reduce the dependence on the moneylender and increase the uptake rate of microcredit and investment. The sufficient expansion of the lending maturity will eliminate the case where the introduction of microcredit will increase the average borrowing amount from the moneylender.

What drives our results is the motivation for consumption smoothing. When the agent wants to smooth her consumption across time, then she will prefer to borrow from the moneylender to secure the level of current consumption. This logic will be applicable to the investment choice where the agent chooses to make a risky but profitable investment or a safe but less profitable investment. It is documented that many microcredit borrowers make the safe and less profitable investment and some argue that the contract design of the microcredit which requires the joint liability can explain this tendency toward safe but less profitable investment. Our argument implies another explanation for the tendency toward safe but less profitable investment: short maturity and consumption smoothing. Because of short maturity, the repayment amount in the first period is relatively large. If the agent chooses the risky investment, then the consumption level in the first period in case of the bad events will become too small, which makes the risky investment less desirable.

Relationship between risky investment decision and loan maturity may explain why MFIs do not employ longer maturity loans. If they allow longer maturity, then borrower will make riskier investment and the repayment rate will be reduced. However, to make the microcredit a more effective tool for poverty reduction, inducing a bit riskier investment will be socially desirable.

Maturity extension which reduces the weakly repayment burden will also enable people to participate in microcredit with lower level of savings and steady income flow. This will improve the outreach of microcredit to the poorer people, which is one of the challenges the MFIs are facing.

Table 12: Average borrowing amounts of the borrowers when $\theta = 2$ and $\lambda = 0.8$

Average borrowing amount from the moneylender when microcredit is available

$\theta = 2$, $\mu = -0.3$, $\lambda = 1$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.288	0.259	0.235	0.214	0.196	0.181	0.155
$r = 0.2$	0.282	0.255	0.232	0.210	0.191	0.176	0.150
$r = 0.3$	N.A.	0.246	0.223	0.202	0.184	0.168	0.143
$r = 0.4$	N.A.	N.A.	0.213	0.193	0.174	0.159	0.133
$\theta = 2$, $\mu = -0.2$, $\lambda = 1$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.318	0.288	0.262	0.240	0.220	0.203	0.173
$r = 0.2$	0.319	0.289	0.261	0.239	0.218	0.202	0.173
$r = 0.3$	N.A.	0.284	0.257	0.235	0.215	0.196	0.168
$r = 0.4$	N.A.	N.A.	0.249	0.227	0.207	0.190	0.162
$\theta = 2$, $\mu = 0$, $\lambda = 1$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.362	0.332	0.303	0.278	0.256	0.237	0.204
$r = 0.2$	0.378	0.345	0.315	0.289	0.266	0.246	0.212
$r = 0.3$	N.A.	0.352	0.321	0.295	0.270	0.250	0.214
$r = 0.4$	N.A.	N.A.	0.323	0.295	0.270	0.249	0.214
$\theta = 2$, $\mu = -0.3$, $\lambda = 0.8$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.176	0.159	0.144	0.131	0.119	0.109	0.000
$r = 0.2$	0.176	0.159	0.144	0.131	0.120	0.110	0.000
$r = 0.3$	N.A.	0.155	0.141	0.129	0.117	0.108	0.092
$r = 0.4$	N.A.	N.A.	0.135	0.124	0.113	0.104	0.088
$\theta = 2$, $\mu = -0.2$, $\lambda = 0.8$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.193	0.173	0.157	0.142	0.130	0.119	0.000
$r = 0.2$	0.197	0.178	0.161	0.147	0.134	0.123	0.000
$r = 0.3$	N.A.	0.177	0.161	0.147	0.135	0.124	0.106
$r = 0.4$	N.A.	N.A.	0.158	0.144	0.132	0.121	0.104
$\theta = 2$, $\mu = 0$, $\lambda = 0.8$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.215	0.192	0.173	0.157	0.142	0.129	0.000
$r = 0.2$	0.230	0.208	0.188	0.171	0.156	0.142	0.000
$r = 0.3$	N.A.	0.217	0.197	0.179	0.164	0.151	0.127
$r = 0.4$	N.A.	N.A.	0.202	0.184	0.168	0.155	0.131

Eventually, what makes the microcredit borrowers dependent on the moneylender is the short maturity of the microcredit loan relative to the income generating periods. In order to microcredit more flexible, the MFIs should prepare several lending schemes so that the timing of the repayment matches the timing of investment return inflows.

Our theoretical model and numerical examples also suggest that the impact of the introduction of microcredit crucially depends on the environmental parameters such as the elasticity of intertemporal substitution, the interest rates of the microcredit and the local moneylenders, the distribution of the investment return, other income and wealth levels, and the relative length of the maturity against the income generating period. This implies that when applying the empirical result of a certain program to other programs in other regions, one should be sufficiently cautious in the difference in these underlying parameters.

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A Appendix Tables

Appendix Table 1: Average borrowing amounts of the borrowers whose $Y_I \leq 2$

Average borrowing amount from the moneylender when microcredit is not available

$Y_I \leq 2$, $\theta = 2$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$\mu = -0.3$	0.176	0.124	0.078	0.038	0.009	0.000	0.000
$\mu = -0.2$	0.224	0.172	0.124	0.082	0.044	0.016	0.000
$\mu = 0$	0.319	0.269	0.220	0.175	0.134	0.098	0.036
$\mu = 0.2$	0.397	0.361	0.320	0.277	0.234	0.193	0.122

Average borrowing amount from the moneylender when microcredit is available

$Y_I \leq 2$, $\theta = 2$, $\mu = -0.3$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.200	0.159	0.121	0.090	0.064	0.039	0.002
$r = 0.2$	0.203	0.158	0.122	0.092	0.066	0.043	0.013
$r = 0.3$	N.A.	0.154	0.118	0.085	0.058	0.036	0.007
$r = 0.4$	N.A.	N.A.	0.109	0.075	0.046	0.024	0.000
$Y_I \leq 2$, $\theta = 2$, $\mu = -0.2$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.239	0.190	0.149	0.111	0.075	0.042	0.001
$r = 0.2$	0.247	0.199	0.159	0.122	0.092	0.066	0.018
$r = 0.3$	N.A.	0.202	0.159	0.125	0.095	0.069	0.029
$r = 0.4$	N.A.	N.A.	0.157	0.121	0.091	0.064	0.025
$Y_I \leq 2$, $\theta = 2$, $\mu = 0$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.293	0.236	0.182	0.125	0.079	0.042	0.002
$r = 0.2$	0.322	0.267	0.216	0.169	0.122	0.079	0.017
$r = 0.3$	N.A.	0.286	0.236	0.190	0.151	0.114	0.044
$r = 0.4$	N.A.	N.A.	0.247	0.203	0.166	0.130	0.071
$Y_I \leq 2$, $\theta = 2$, $\mu = 0.2$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.315	0.244	0.172	0.115	0.071	0.039	0.001
$r = 0.2$	0.364	0.300	0.239	0.177	0.120	0.077	0.018
$r = 0.3$	N.A.	0.342	0.284	0.230	0.175	0.121	0.044
$r = 0.4$	N.A.	N.A.	0.317	0.265	0.215	0.167	0.077

Appendix Table 2: Average borrowing amounts of the borrowers when $\theta = 1$: All the agents

Average borrowing amount from the moneylender when microcredit is not available

All the agents, $\theta = 1$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$\mu = -0.3$	0.254	0.212	0.176	0.142	0.115	0.093	0.059
$\mu = -0.2$	0.294	0.254	0.216	0.181	0.149	0.123	0.084
$\mu = 0$	0.375	0.339	0.303	0.268	0.234	0.203	0.147
$\mu = 0.2$	0.445	0.423	0.395	0.363	0.330	0.298	0.238

Average borrowing amount from the moneylender when microcredit is available

$\theta = 1$, $\mu = -0.3$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.224	0.172	0.125	0.086	0.056	0.030	0.001
$r = 0.2$	0.247	0.194	0.150	0.111	0.077	0.049	0.011
$r = 0.3$	N.A.	0.210	0.167	0.128	0.094	0.066	0.024
$r = 0.4$	N.A.	N.A.	0.178	0.140	0.106	0.078	0.037
$\theta = 1$, $\mu = -0.2$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.247	0.186	0.136	0.093	0.059	0.032	0.001
$r = 0.2$	0.275	0.218	0.167	0.122	0.086	0.056	0.014
$r = 0.3$	N.A.	0.241	0.190	0.148	0.110	0.077	0.028
$r = 0.4$	N.A.	N.A.	0.208	0.166	0.128	0.095	0.044
$\theta = 1$, $\mu = 0$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.273	0.203	0.145	0.097	0.061	0.032	0.001
$r = 0.2$	0.323	0.253	0.191	0.139	0.095	0.061	0.014
$r = 0.3$	N.A.	0.293	0.231	0.176	0.130	0.092	0.034
$r = 0.4$	N.A.	N.A.	0.263	0.208	0.162	0.119	0.057
$\theta = 1$, $\mu = 0.2$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.272	0.194	0.134	0.089	0.055	0.030	0.001
$r = 0.2$	0.341	0.259	0.192	0.137	0.094	0.060	0.014
$r = 0.3$	N.A.	0.320	0.248	0.187	0.136	0.094	0.034
$r = 0.4$	N.A.	N.A.	0.299	0.234	0.179	0.132	0.060

Appendix Table 3: Average borrowing amounts of the borrowers when $\theta = 1$: $Y_I \leq 2$

Average borrowing amount from the moneylender when microcredit is not available

$Y_I \leq 2$, $\theta = 1$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$\mu = -0.3$	0.176	0.124	0.078	0.038	0.009	0.000	0.000
$\mu = -0.2$	0.224	0.172	0.124	0.082	0.044	0.016	0.000
$\mu = 0$	0.319	0.269	0.220	0.175	0.134	0.098	0.036
$\mu = 0.2$	0.397	0.361	0.320	0.277	0.234	0.193	0.122

Average borrowing amount from the moneylender when microcredit is available

$Y_I \leq 2$, $\theta = 1$, $\mu = -0.3$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.200	0.159	0.121	0.090	0.064	0.039	0.002
$r = 0.2$	0.203	0.158	0.122	0.092	0.066	0.043	0.013
$r = 0.3$	N.A.	0.154	0.118	0.085	0.058	0.036	0.007
$r = 0.4$	N.A.	N.A.	0.109	0.075	0.046	0.024	0.000
$Y_I \leq 2$, $\theta = 1$, $\mu = -0.2$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.239	0.190	0.149	0.111	0.075	0.042	0.001
$r = 0.2$	0.247	0.199	0.159	0.122	0.092	0.066	0.018
$r = 0.3$	N.A.	0.202	0.159	0.125	0.095	0.069	0.029
$r = 0.4$	N.A.	N.A.	0.157	0.121	0.091	0.064	0.025
$Y_I \leq 2$, $\theta = 1$, $\mu = 0$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.293	0.236	0.182	0.125	0.079	0.042	0.002
$r = 0.2$	0.322	0.267	0.216	0.169	0.122	0.079	0.017
$r = 0.3$	N.A.	0.286	0.236	0.190	0.151	0.114	0.044
$r = 0.4$	N.A.	N.A.	0.247	0.203	0.166	0.130	0.071
$Y_I \leq 2$, $\theta = 1$, $\mu = 0.2$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.315	0.244	0.172	0.115	0.071	0.039	0.001
$r = 0.2$	0.364	0.300	0.239	0.177	0.120	0.077	0.018
$r = 0.3$	N.A.	0.342	0.284	0.230	0.175	0.121	0.044
$r = 0.4$	N.A.	N.A.	0.317	0.265	0.215	0.167	0.077

Appendix Table 4: Examples of the dependence on the moneylender, $1-\alpha^*$: $Y_I = 1.5$

$\theta=1$, $Y_I=1.5$, $\lambda=0.9$	$i=0.3$	$i=0.4$	$i=0.5$	$i=0.6$	$i=0.7$	$i=0.8$	$i=1.0$
$r=0.1$	0.198	0.064	0.000	0.000	0.000	0.000	0.000
$r=0.2$	0.321	0.215	0.100	0.000	0.000	0.000	0.000
$r=0.3$	N.A.	0.329	0.240	0.142	0.026	0.000	0.000
$r=0.4$	N.A.	N.A.	0.345	0.270	0.188	0.092	0.000
$\theta=1$, $Y_I=1.5$, $\lambda=0.8$	$i=0.3$	$i=0.4$	$i=0.5$	$i=0.6$	$i=0.7$	$i=0.8$	$i=1.0$
$r=0.1$	0.053	0.000	0.000	0.000	0.000	0.000	N.A.
$r=0.2$	0.219	0.077	0.000	0.000	0.000	0.000	N.A.
$r=0.3$	N.A.	0.230	0.108	0.000	0.000	0.000	0.000
$r=0.4$	N.A.	N.A.	0.249	0.146	0.026	0.000	0.000
$\theta=1$, $Y_I=1.5$, $\lambda=0.7$	$i=0.3$	$i=0.4$	$i=0.5$	$i=0.6$	$i=0.7$	$i=0.8$	$i=1.0$
$r=0.1$	0.000	0.000	0.000	0.000	0.000	N.A.	N.A.
$r=0.2$	0.081	0.000	0.000	0.000	0.000	0.000	N.A.
$r=0.3$	N.A.	0.097	0.000	0.000	0.000	0.000	N.A.
$r=0.4$	N.A.	N.A.	0.121	0.000	0.000	0.000	0.000
$\theta=2$, $Y_I=1.5$, $\lambda=0.9$	$i=0.3$	$i=0.4$	$i=0.5$	$i=0.6$	$i=0.7$	$i=0.8$	$i=1.0$
$r=0.1$	0.337	0.275	0.205	0.122	0.009	0.000	0.000
$r=0.2$	0.409	0.358	0.306	0.248	0.177	0.083	0.000
$r=0.3$	N.A.	0.424	0.382	0.338	0.290	0.233	0.032
$r=0.4$	N.A.	N.A.	0.442	0.408	0.372	0.333	0.228
$\theta=2$, $Y_I=1.5$, $\lambda=0.8$	$i=0.3$	$i=0.4$	$i=0.5$	$i=0.6$	$i=0.7$	$i=0.8$	$i=1.0$
$r=0.1$	0.233	0.146	0.043	0.000	0.000	0.000	N.A.
$r=0.2$	0.327	0.259	0.185	0.097	0.000	0.000	N.A.
$r=0.3$	N.A.	0.345	0.288	0.226	0.152	0.052	0.000
$r=0.4$	N.A.	N.A.	0.366	0.319	0.267	0.206	0.000
$\theta=2$, $Y_I=1.5$, $\lambda=0.7$	$i=0.3$	$i=0.4$	$i=0.5$	$i=0.6$	$i=0.7$	$i=0.8$	$i=1.0$
$r=0.1$	0.090	0.000	0.000	0.000	0.000	N.A.	N.A.
$r=0.2$	0.218	0.124	0.013	0.000	0.000	0.000	N.A.
$r=0.3$	N.A.	0.240	0.160	0.065	0.000	0.000	N.A.
$r=0.4$	N.A.	N.A.	0.266	0.198	0.118	0.013	0.000

Appendix Table 5: Average borrowing amounts of the borrowers when $\lambda = 0.9$

Average borrowing amount from the moneylender when microcredit is available

$\theta = 2$, $\mu = -0.3$, $\lambda = 0.9$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.228	0.188	0.148	0.113	0.079	0.048	N.A.
$r = 0.2$	0.241	0.201	0.165	0.133	0.102	0.072	0.017
$r = 0.3$	N.A.	0.210	0.175	0.144	0.114	0.087	0.040
$r = 0.4$	N.A.	N.A.	0.181	0.150	0.120	0.096	0.054
$\theta = 2$, $\mu = -0.2$, $\lambda = 0.9$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.252	0.207	0.164	0.124	0.086	0.052	N.A.
$r = 0.2$	0.272	0.228	0.189	0.150	0.115	0.082	0.020
$r = 0.3$	N.A.	0.243	0.203	0.168	0.136	0.104	0.046
$r = 0.4$	N.A.	N.A.	0.213	0.179	0.148	0.119	0.065
$\theta = 2$, $\mu = 0$, $\lambda = 0.9$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.287	0.234	0.184	0.137	0.093	0.054	N.A.
$r = 0.2$	0.323	0.273	0.225	0.178	0.134	0.094	0.022
$r = 0.3$	N.A.	0.301	0.254	0.210	0.168	0.129	0.057
$r = 0.4$	N.A.	N.A.	0.275	0.233	0.195	0.156	0.088
$\theta = 2$, $\mu = 0.2$, $\lambda = 0.9$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.298	0.236	0.179	0.131	0.087	0.050	N.A.
$r = 0.2$	0.351	0.292	0.238	0.185	0.138	0.095	0.021
$r = 0.3$	N.A.	0.339	0.286	0.235	0.186	0.141	0.059
$r = 0.4$	N.A.	N.A.	0.324	0.274	0.227	0.181	0.098

Appendix Table 6: Average borrowing amounts of the borrowers when $\lambda = 0.7$

Average borrowing amount from the moneylender when microcredit is available

$\theta = 2$, $\mu = -0.3$, $\lambda = 0.7$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.117	0.076	0.044	0.019	0.003	N.A.	N.A.
$r = 0.2$	0.151	0.112	0.076	0.047	0.023	0.005	N.A.
$r = 0.3$	N.A.	0.137	0.104	0.074	0.048	0.025	N.A.
$r = 0.4$	N.A.	N.A.	0.122	0.093	0.067	0.044	0.007
$\theta = 2$, $\mu = -0.2$, $\lambda = 0.7$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.123	0.078	0.044	0.019	0.003	N.A.	N.A.
$r = 0.2$	0.167	0.121	0.081	0.049	0.024	0.005	N.A.
$r = 0.3$	N.A.	0.155	0.116	0.080	0.051	0.027	N.A.
$r = 0.4$	N.A.	N.A.	0.141	0.108	0.077	0.051	0.009
$\theta = 2$, $\mu = 0$, $\lambda = 0.7$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.124	0.075	0.040	0.017	0.002	N.A.	N.A.
$r = 0.2$	0.188	0.130	0.085	0.049	0.023	0.004	N.A.
$r = 0.3$	N.A.	0.183	0.132	0.090	0.055	0.027	N.A.
$r = 0.4$	N.A.	N.A.	0.174	0.129	0.091	0.058	0.009
$\theta = 2$, $\mu = 0.2$, $\lambda = 0.7$	$i = 0.3$	$i = 0.4$	$i = 0.5$	$i = 0.6$	$i = 0.7$	$i = 0.8$	$i = 1.0$
$r = 0.1$	0.111	0.062	0.031	0.012	0.002	N.A.	N.A.
$r = 0.2$	0.190	0.123	0.075	0.042	0.019	0.004	N.A.
$r = 0.3$	N.A.	0.192	0.133	0.086	0.052	0.025	N.A.
$r = 0.4$	N.A.	N.A.	0.192	0.138	0.094	0.058	0.009